Gems & Jewellery

Summer 2019 / Volume 28 / No. 2

DISCOVERY OF A LIFETIME

TREASURES OF THE V&A

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SORT HOUSE INNOVATIONS

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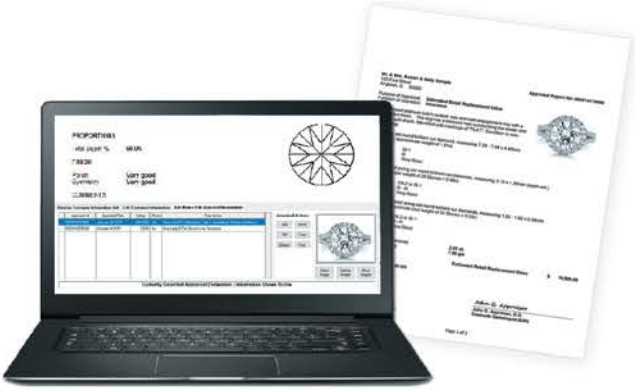

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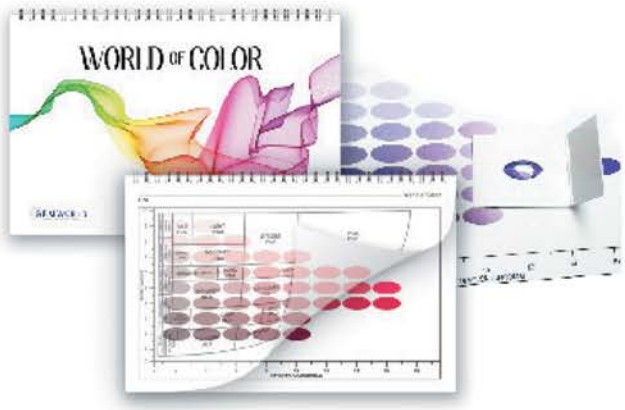

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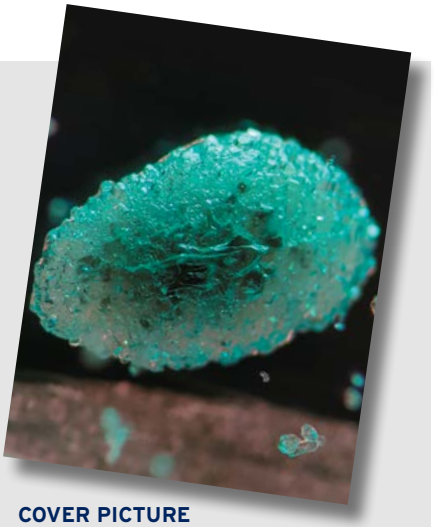

COVER PICTURE

'Virus evolution' by Yenruedee Lhongsomboon – a compact agglomeration with innumerable small, colourless-transparent to greyish white crystals in a flux-grown synthetic emerald from the production of Pierre Gilson. The subject is magnified 38× with dark field lighting conditions.

MODERN DISCOVERY OF AAPPALUTTOQ

David Turner, William Rohtert, Meghan Ritchie and Brad Wilson recall their discovery of the Aappaluttoq ruby deposit in Greenland in the summer of 2005.

TREASURES OF THE V&A

After a three-month refurbishment, The Victoria & Albert Museum (V&A) has reopened its William and Judith Bollinger Gallery, home to its jewellery collection. *Gems&Jewellery* considers some of the most unique pieces in the collection.

DEVELOPMENTS IN JADE

Jessica Han FGA, head of Chinafor Gem-A, speaks to Mr. Yan Ao, of the Beijing Institute of Economics, and Mr. Bo Wang of Bo Guan Auction, about current developments in Chinese jade carving.

Published by

Gem-A (The Gemmological Association of Great Britain)

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Registered charity no. 1109555

Gem-A is a company limited by guarantee, registered in England, number 01945780

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Zest Design +44 (0)20 7403 7596

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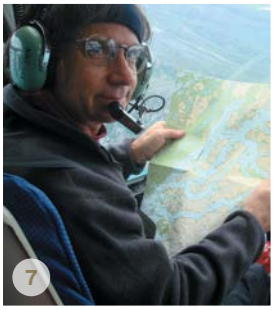


Gems&Jewellery

Summer 2019 featured contributors

Gems&Jewellery *would like to thank Gemfields, Graff, The Victoria & Albert Museum and Marcus McCallum for their support in creating this issue.*

1. MEGHAN RITCHIE

Meghan Ritchie is an exploration geologist based in Perth, Australia, with a wide range of geological experience in many commodities. She has worked on multiple continents and covered the breadth of mineral exploration, from initial prospectivity analysis and project generation through surficial geology, geophysics, geochemistry and drilling techniques to underground exploration and resource drilling.

2. JOHN BENJAMIN

John Benjamin FGA DGA FIRV began his career in 1972 at Cameo Corner, the celebrated Bloomsbury antique jewellers. In 1976 he joined Phillips Fine Art Auctioneers as a cataloguer and valuer where he remained for 23 years, ultimately becoming international director of jewellery with responsibility for the sale programmes in London and Geneva. In 1999 he established his own jewellery consultancy John C Benjamin Limited acting as an independent consultant for a private and corporate client network.

3. DEBORAH CRAIG

Deborah Craig FGA DGA is a board member of International Women in Mining, which connects and supports women working in mining across the globe. She has contributed several articles about the industrial mining of gemstones to *Gems & Jewellery*. In February, Deborah attended Mining Indaba in Cape Town, and had the opportunity to learn more about the state of South Africa's diamond mining and beneficiation industries.

4. DAVID TURNER

Dr. David Turner is a geoscientist with backgrounds in applied mineralogy, economic geology, ore sorting and remote sensing. He has worked within and consulted for academia and industry in a range of capacities on several continents, from greenfield projects to operating mines. He has been studying the geology of gemstone and rare metal deposits since 2002.

5. BRAD WILSON

Brad completed BSc and MSc degrees in geology in the 1980s. In 1991, he became a fellow of the Canadian Gemmological Association (CGA) and for five years in the early 2000s was its vice-president. A facetter of gemstones since 1979, Brad cuts many rare and soft collector stones as well as the more traditional coloured gemstones. Brad currently operates Alpine Gems, a gem cutting shop and consulting business in Kingston, Ontario and is the Canadian officer of Coast to Coast Rare Stones International, a coloured gemstone company specialising in rare, soft and collector gemstones.

6. SHIRLEY MITCHELL

Shirley Mitchell FGA DGA FIRV PJValDip PJGemDip FNAJ has been in the jewellery trade for over 20 years and adores coloured gems and valuing beautiful pieces of jewellery. Having been a retail manager and valuer for a number of years, she hung up her retail hat and started her own independent valuation consultancy in 2010.

Shirley was recognised with the first Association of Independent Jewellery Valuers (AIJV) Valuer of the Year award in May 2013 and the coveted IRV David Wilkins Valuer of the Year Award in September 2013. She is a fellow of the Institute of Registered Valuers (IRV), served six years as an elected member of the IRV committee and is now a co-opted member of the committee and chair of the Academy of Valuers. She is a senior member of the Association of Independent Valuers, a member of the National Association of Jewelry Appraisers and Accredited Gemologists Association in the USA, and with a dedication for education became a tutor for Gem-A in 2016.

7. WILLIAM ROHTERT

William Rohtert is an economic geologist and graduate gemmologist with four decades experience in the field. He was the chief of operations for True North Gems who led the company into Greenland, and he was the expedition leader in Greenland for the team that discovered the Aappaluttoq ruby deposit in August of 2005. Rohtert remains active in diamond and coloured gemstone projects from discovery through development worldwide.

Straight from the heart

Opinion and comment from CEO, Alan Hart FGA DGA

They say time flies when you are having fun, which is perhaps why this year feels like it has zoomed past in the blink of an eye. Here we are introducing the Summer 2019 edition of *Gems&Jewellery* and in just a few short months we will be introducing our first speaker at the annual Gem-A Conference! This year's event takes place from November 2-3 at etc.venues County Hall on London's South Bank, just a stone's throw from the London Eye. We are thrilled each and every year to welcome familiar faces, new connections and a growing international contingent who join us for insightful talks, workshops and plenty of networking opportunities. Last year's Conference was immensely popular and was packed to capacity with enquiring minds. We look forward to replicating this in 2019 and announcing our line-up of speakers in due course. Keep your eyes peeled for news on our social media channels and on the Gem-A website.

Of course, before November rolls around we have some very nervous students waiting in the wings to sit their exams. I am sure that the month of June feels like a big black mark in the calendars of many of our students, but I am sure you will do a fantastically well. Remember, by passing your exams and securing your Gem-A Gemmology Foundation, Gemmology Diploma or Diamond Diploma, you are taking your first steps into the world of professional gemmology, armed with well-respected qualifications that are recognised globally. As the old adage goes, if something is easy it is probably not worth doing!

With June out of the way, we will look forward to seeing our students with slightly-less concerned faces at the annual Gem-A Graduation on November 4. This evening also provides us with the time and the occasion to hand-out very special commendations, known as the Presentation of Awards. These special prizes, medals and acknowledgments cover fantastic exam results – both theory and practical – as well as the best written projects. Within the ranks of these award winners are certainly some of the next generation of top gemmologists and we encourage everyone to strive for these markers of excellence. Good luck one and all!

Photo credit Henry Mesa.

Opportunities to work and to socialise at last year's Gem-A Conference. Photo credit Alex Herbert.

> **As the old adage goes, if something is easy it is probably not worth doing!**

Any beady eyes out there looking at the Gem-A calendar may notice that the period from June to September is slightly on the quieter side at Gem-A HQ. However, the time between our last student finishing their exam and International Jewellery London (from September 1-3) is some of the most valuable for our in-house team. It is a period of reflection, of planning, improvements, discussion and collaboration. It is the time when we consider what will benefit Gem-A most in the year ahead and how we can best support our Members. If you have any feedback you would like to share, or ideas for the future, we would be thrilled to hear from you.

Enjoy this issue, which is packed with tales of rubies, Victorian treasures, South African diamonds, moonstones, amethyst, opals, photomicrography, record-breaking diamonds and much more.

Best wishes
Alan Hart FGA DGA

Gem-A News

A round-up of the latest news from Gem-A

THE LANGUAGE OF LEARNING

Gem-A is pleased to announce that the Gem-A Diploma Practical Handbook is now available in French, Japanese and Traditional and Simplified Chinese for the first time.

Designed for training gemmologists and as a useful reference guide for graduates, the Gem-A Diploma Practical Handbook is an essential resource that has now been made more accessible for our students across the globe. Sections focus on observation techniques, instructions on the proper use of gemmological testing equipment, such as the refractometer, spectroscope and polariscope, as well as explanations of specific gravity and hardness testing. Also included is an A to Z of the gem materials covered in the Gem-A Gemmology Diploma, plus illustrated examples of rough and faceted gems, natural and synthetic gem material and crystal habits.

The Gem-A Diploma Practical Handbook is priced at £50 (also available in English, £45). Gem-A Members and Students receive a 5% discount. If you require further information, advice or simply wish to make a purchase, please email instruments@gem-a.com.

DID YOU KNOW?

The Presidium Synthetic Diamond Screener II has been awarded with the ASSURE Mark by the Diamond Producers Association (DPA). The ASSURE Program was initiated to create a universal standard to test the performance of various laboratory-grown diamond testers available on the market.

A total of 11 pioneer manufacturers, including Presidium, De Beers Group, GIA and HRD Antwerp were selected to submit their instrument to a third-party laboratory and the results have now been published in the ASSURE directory. Presidium is the only company to feature in the ASSURE Directory with a portable screener priced below US$1,000.

It has also achieved a 100% synthetic diamond referral rate. The device will now be sold with the ASSURE Mark — a sign of its third-party proven quality. View the results here: *diamondproducers.com/assure/assure-directory/*

The Presidium Synthetic Diamond Screener II (SDS II) is priced at £630 and is available via Gem-A Instruments. Current Gem-A Members and Students receive a 10% discount on instruments. Email us at instruments@gem-a.com to find out more.

Gem-A putting down new roots in Beijing

Gem-A is pleased to announce a new office in Beijing, China, allowing our presence and influence in the country to continue growing. Gem-A Beijing can now be found at Room 1428, Floor 14, Landmark Tower B, 8 North Dongsanhuan Road in the Chaoyang District of Beijing. This physical presence is supported by a growing digital foothold on Chinese social media giant, WeChat. To follow Gem-A on WeChat, please scan the QR code below.

New faces and rising stars

We are pleased to welcome two new staff members at our London HQ. Chelleanne McKenzie joins the Education team as education administration assistant, while Olivia Gillespie will lend her support to the Marketing team as a communications assistant. Elsewhere at Gem-A HQ, we are pleased to announce that Claire Downes has been promoted to education coordinator following her success in a senior education administrator role. Linden Condon, formerly education administration assistant is now ODL and Moodle officer, and will be supporting the many students who choose to study with Gem-A remotely.


Chelleanne McKenzie


Olivia Gillespie


Claire Downes


Linden Condon

GEMMOLOGY EDUCATION ON TOUR!

From February 28 to March 18, Gem-A's head of education, Nysa Pradhan, and regional head of Gem-A in Asia, Anne Carroll Marshall FGA DGA, went to visit Accredited Teaching Centres (ATCs) in the Far East. Here is a report from their travels, plus some pictures of the many friends of Gem-A they met along the way.

With less than three weeks to travel between Hong Kong, Taiwan, Bangkok, Myanmar and Singapore, both Nysa Pradham and Anne Carroll Marshall had their work cut out for them on a recent tour of Gem-A ATCs. Fortunately, they managed to visit all 13 existing ATCs and some potential new partners across these regions in the time frame, in addition to meeting with Gem-A exam managers and markers. Of course, there are places in Asia where Gem-A does not yet have an ATC, and this was one of the main goals of the trip — to meet new institutions and discuss possible future collaborations.

When visiting existing Gem-A ATCs, Nysa and Anne spoke to students to find out more about their experiences, while also sitting down with ATC managers to discuss current processes and further development opportunities. As Nysa explains: "All the ATCs were extremely hospitable and this was a very memorable trip. It is amazing to see the ATCs and the work they put in to offer Gem-A courses to students. They are true ambassadors for Gem-A on the ground."

While in the region, Nysa also spoke on the growing need for education in the gems and jewellery sector at the Asian Gemmological Institute and Laboratory (AGIL) conference, resulting in an even wider audience for Gem-A and our Gemmology and Diamond Diplomas. ■

1: Capturing the end of a positive meeting with the Hong Kong Baptist University.

2: A picture to mark a successful discussion with the Hong Kong Jewelry Manufacturers' Association (HKJMA).

3: A group picture following discussions with the Taiwan Gemmological Institute.

4: Lunch with GSC Myanmar.

5: Discussions about education and collaboration opportunities with the HK Design Institute.

6: Lunch with representatives of the Taiwan Earth Gemmological Institute.

Entrance to an emerald mine, Cundinamarca Department, Colombia

Titled 'Open Sesame!', this photograph by Jonathan Muyal FGA goes behind-the-scenes of emerald mining on the eastern belt of the Cordillera Oriental. Here, he explains the story behind the picture...

This photo was taken in October 2015 at an emerald mine on the eastern belt of the Cordillera Oriental, the widest of the three branches of the Colombian Andes, in Gachalá area, Department of Cundinamarca, Colombia.

Unlike the western belt where the most active and famous mines are located, such as Muzo and Coscuez (Department of Boyacá), mining on the eastern belt is less developed. However, it still has significant production that can offer high-end and exceptional emeralds.

In recent years, protecting the environment has also become a concern for the Colombian government and emerald mining regulations have changed. Nowadays deposits are mainly worked from underground tunnels rather than open pits which disfigured the landscape.

Gachalá's weather is wet and it experiences rainfall throughout the year. This photo shows almost the whole area covered by lush vegetation and a miner facing a small door embedded in the mountain. This is the tunnel entrance to an emerald mine. This scene conjures a kind of secret door hidden in the middle of a hostile jungle. The photo reflects and illustrates an environment that is isolated and difficult to access.

Also the green colour of these mountains is evocative of the green colour of its emeralds. Nevertheless, the quest to find emeralds is a very long journey. The precious stone is rare and mining in these mountains is harsh.

The symbolism of this scene is the fantasy; the myth of a mysterious cave with secret treasure kept deep inside the bowels of the earth and protected by the ramparts of these mountains, hidden by green nature. Only the chosen one will find the magic words to open it.

Jonathan Muyal is a French citizen from Paris. He is based in the United States and works as a gemmologist at the Gemological Institute of America at its Carlsbad, California headquarters. Muyal started his career in the gem industry in 2007 and studied with GIA in 2008 in Bangkok, Thailand. In 2013, Muyal completed the Gem-A Gemmology Diploma and became an FGA Member. He won the Gem-A Photographer of the Year competition in 2017 and in the same year was awarded second prize in a competiton hosted by the Royal Microscopy Society. ■

Photo Credit: Jonathan Muyal FGA.

PAST PRESENT FUTURE

3: Cape Town's V&A Waterfront. Image courtesy of Deborah Craig.

The history of diamonds in South Africa is inextricably entwined with the history of the country itself, but today the South African diamond industry is under pressure. There have been no significant discoveries of diamonds in the past decade and disadvantageous policies and global pressures are shrinking its diamond cutting industry. International Women in Mining board member, Deborah Craig FGA DGA, reports from a recent visit.

The story of South Africa's diamonds begins on the banks of the Orange River. A boy finds a diamond in 1867 and aptly names it 'Eureka'. Thousands of fortune-seekers descend with the discovery of the 83.5ct 'Star of South Africa' in 1869. They trace diamonds from riverbeds to the 'blue ground' near Kimberley and the term kimberlite is born. These primary deposits provide a steady supply of diamonds in a range of qualities and colours, thus bringing diamonds, previously enjoyed only by the elite, to a wider market. The world's largest piece of gem diamond rough is discovered: the Cullinan, weighing 3,106 carats. By the 1880s, South Africa is producing 95% of the world's diamonds, easily displacing Brazil as the world's leading diamond producer.

Today, Russia tops the charts, having produced a whopping 42.6 million carats in 2017. South Africa's production of 9.7 million carats places the country in 6th place, albeit 4th in terms of value. Much of South Africa's production comes from older, deeper, costlier mines. Where will revitalizing new discoveries come from? Exploration has deceased, with increased delays processing licenses. Petra Diamonds, owner of the Finsch and Cullinan (previously Premier) mines, has eschewed exploration for maximising value from its existing mines. De Beers has been selling off its smaller projects and will close its uneconomic Voorspoed mine. The company will focus instead on the USD $2 billion underground expansion of its mighty Venetia mine, which produced 4.6 million carats in 2017, almost half of the country's total. De Beers, established in 1888 on the diamond fields of Kimberley, will have only one mine left in South Africa.

South Africa's supply constraints are part of a global contraction, with mined diamond production set to decrease from

1: South Africa's President, Cyril Ramaphosa, makes the case for mining investment at Mining Indaba. Image courtesy of Deborah Craig.

2: Selae Mashiloane of the State Diamond Trader, which promotes access to the country's diamond resources. Image courtesy of Deborah Craig.

about 145 million carats in 2018 to an estimated 115 million carats in 2030.

Diamond beneficiation is also decreasing. Large-scale diamond manufacturers, especially those specialising in high value goods, have endured, but many others have scaled down or closed. The number of diamond cutters in South Africa, once in the thousands, is now in the hundreds. Foreign companies have left for myriad reasons, including the decreased availability of rough diamonds, government bureaucracy, VAT on imported diamonds, and currency restrictions (**1**). The number of De Beers sightholders, who employ about 80% of the cutters and polishers in South Africa, has fallen from 20 before the 2008 crisis, to only seven today.

Again, global factors are also at play. Wages in South Africa have increased rapidly in the past decade and together with a lack of technological advances, this means that only high value diamonds can be cut profitability; sources put the cost between $120 – 150 per carat, twice as much as China, and four times more than India. New market entrants Vietnam, Thailand and Laos will add pressure to manufacture diamonds cheaply.

To grow South African diamond manufacturing and increase the participation of historically disadvantaged South Africans, who are majority black, the government established the State Diamond Trader (SDT) in 2007 (**2**). The SDT is empowered by law to purchase up to 10% of the run-of-mine production from all diamond mines in South Africa. To date, the SDT has sold over two million carats of rough diamonds to more than 100 South African diamond manufacturers, promoting equitable access to, and beneficiation of the country's diamond resources. Through partnerships, the SDT also facilitates access to equipment, training, financing and international markets.

> The SDT is empowered by law to purchase up to 10% of the run-of-mine production from all diamond mines in South Africa.

4 and 5: The Cape Town Diamond Museum, nestled in the V&A Waterfront. The museum includes kimberlite samples and historical mining artefacts.

6: The Cape Town Diamond Museum.

Shimansky creates extra value by offering branded goods such as its iconic Millennium ring, and patented diamond cuts like its 'My Girl' diamond.

One challenge the SDT faces is matching the wide range of diamonds it is required to purchase from the mines, with the demands of specialist diamond cutters. The mix will include diamonds that can't be cut profitably. The SDT is currently reviewing this situation.

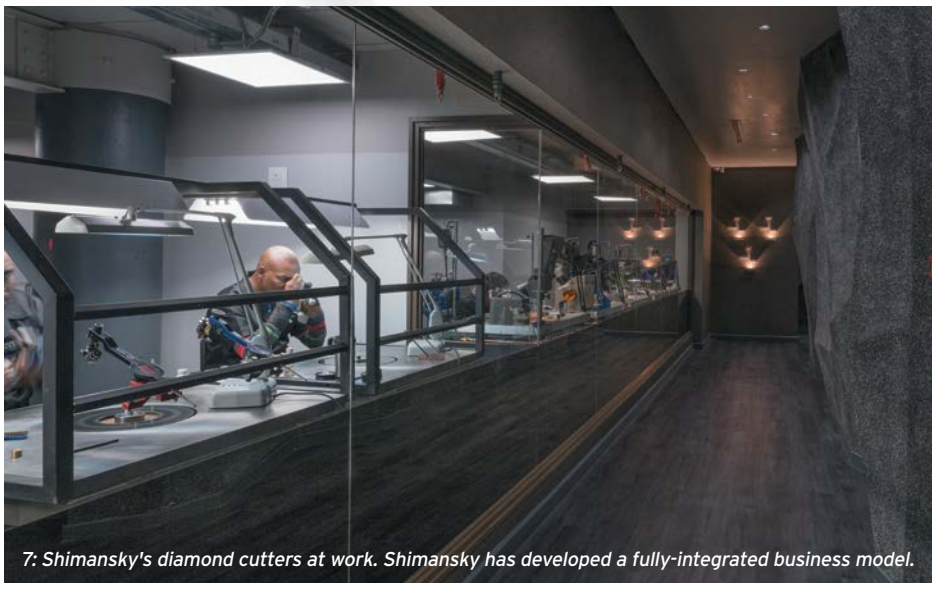
How can a company navigate these challenges and attain success? For answers, I met with Kelly Richards, a diamond expert and representative of Shimansky, the leading South African diamond manufacturer and retailer. We began with an appointment-only visit to the melee-sized Cape Town Diamond Museum at the V&A Waterfront, set against the backdrop of Table Mountain (**3**). The museum traces the history of diamonds in South Africa via historical photos, Kimberley mining artefacts, and replicas of famous diamonds, including the Cullinan and Eureka (**4**, **5** & **6**). Upon exiting the museum, we entered a passageway and were awarded a rare look at jewellery designers and diamond cutters at work, before moving onward to a retail space (**7**).

The tour mirrors Shimansky's mine to retail strategy. Because of long-standing business relationships, the company can access good quality rough directly from mines. They ensure high cutting standards by owning their own facilities, with GIA certificates providing extra assurances to consumers. Shimansky creates extra value by offering branded goods such as its iconic Millennium ring, and patented diamond cuts like its 'My Girl' diamond (**8**). By bringing all processes in-house, the company can control quality, and offer competitive prices to their clients.

8: Shimansky's iconic Millenium ring, released in 2000.

The need to revitalize South Africa's diamond manufacturing industry is clear. Access to rough diamonds is not enough. Increased training, investment in new technologies, reduced bureaucracy and streamlined taxes would be a start. South Africa must develop a strategic advantage to compete in the global marketplace. ■

Shimansky's Diamond Experience Tour operates seven days a week, 9am to 9pm. To book, contact Shimansky at tel: +27 (0)21 421 2488, email: diamondtour@shimansky.com



7: Shimansky's diamond cutters at work. Shimansky has developed a fully-integrated business model.

Images courtesy of Shimansky unless otherwise stated.

Gem-A INSTRUMENTS

Current Gem-A members and students receive a 10% discount on instruments!

NEW IN STOCK!
PROFESSIONAL CARAT SCALE KIT

Available now from Gem-A Instruments, these precision scales are professional, compact and portable for the busy gemmologist who wants reliable accuracy on-the-go.

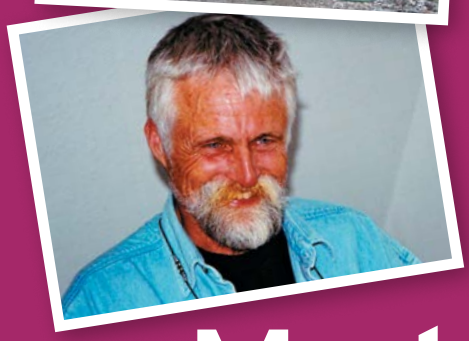
Gem-A Instruments is pleased to introduce the On Balance CTP-250 Pro Carat Scale, which is now available to purchase. This professional and portable carat scale is designed for the hands-on gemmologist and comes as part of a kit that includes slide-lock tweezers, 20g and 50g calibration weights, a gem tray, a universal USB power plug and a zip travel case, in addition to a helpful user guide.

The Pro Carat Scale is a precision instrument designed for the weighing of coloured gemstones and diamonds and benefits from exceptional accuracy (to 0.005 carat and 0.001 grams) and a 250 carat (50g) capacity, making it a trustworthy addition to any gemmologist's arsenal of desk-top devices. Its sleek design is suitable for those conducting client-facing work, while its compact (dimensions 141 × 75 × 36 mm), portable and user-friendly design makes it easy to transport and store.

To get started, simply connect to your laptop with the USB adaptor included or operate with AAA batteries. The instrument also benefits from an auto switch-off function to preserve battery life and a three-year warranty.

Retail Price £80.40
Current Gem-A members and students receive a 10% discount on instruments

If you require any further information about our products or simply wish to make a purchase then please email instruments@gem-a.com ■



The 2005 field crew; Brad Wilson (top left, with microblaster), David Turner and Meghan Ritchie (top right), Trevor Thomas (bottom left) and Yvon the waterfall-loving pilot (bottom right). Photos by Meghan Ritchie and David Turner.

The summer of 2005 is one that will remain in the memories of David Turner, William Rohtert, Meghan Ritchie and Brad Wilson, who have worked together to pen this report on the discovery of the Aappaluttoq ruby deposit in Greenland.

Modern Discovery of Aappaluttoq

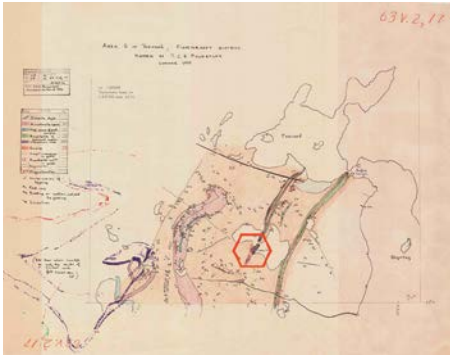
The Aappaluttoq ruby deposit is located near the small town of Qeqertarsuatsiaat (Fiskenæsset) in Greenland and hosted within a package of rocks known as the Fiskenæsset Anorthosite Complex. These distinctive rocks are ~2.8 billion years old and have a magmatic origin, but have since undergone significant metamorphism and metasomatism.

The Aappaluttoq ruby deposit was discovered using conventional mineral exploration and prospecting techniques in the summer of 2005, however, corundum at the same location was also noted on a 1970 field map stored in the Geological Survey of Denmark (GEUS) archives. Since formal discovery of the deposit in 2005, the extents and tenor of mineralisation were sufficiently defined to allow the project to advance to production. This article recounts the early days of prospecting and discovery of Aappaluttoq.

MODERN DISCOVERY OF AAPPALUTTOQ – SUMMER OF 2005

Kalaallit Nunaat (Greenland) is a vast island dominated by an ice sheet that covers more than 1.5 million square kilometers. Only a thin margin of the island around its edges reveals its rocky core. Countless spectacular fjords run from the ice sheet's edge through the rugged rocky foreland and into the North Atlantic Ocean. Waterfalls dramatically

Bjornesund, Fiskenæsset Area, Greenland. Photo by David Turner.



Unpublished geological map from 1970 of the Tasiusa and Rubin Ø area by Chris Pulvertaft, including note of ruby at what would become the Aappaluttoq ruby deposit (annotated with red hexagon). Pulvertaft's map photographed by Meghan Ritchie at GEUS' office in Copenhagen. (T.C.R. Pulvertaft 1970, GEUS).

Ruby-bearing sample from Kigutilik overlooking Kigutilik Bay. Photo by Brad Wilson.

plummet off the edges of these fjords, fed by lakes and rivers of pure glacial waters. It is truly awe-inspiring.

The island has been inhabited by the local Greenlandic Inuit, cultivating a rich culture intimately tied to the land and ocean. The Vikings also called Greenland home and their mark can still be seen today as navigational cairns covered in centuries of moss along the many channels and old building foundations.

This same rugged coastline has also been a fascination for geologists and mineralogists, and the amazing level of exposure both along the surface and in elevation has provided a natural laboratory for understanding the Earth's complex processes. In fact, Greenland is home to some of the oldest preserved sedimentary and volcanic rocks on the planet, the Isua Supercrustals, which have given insight into the very ancient and very different landscapes of 3.6 billion years ago. The infamous Illimaussaq layered intrusive complex at the southern tip of the island has been studied in great detail, revealing arguably the most diverse collection of minerals in a single locality and shedding light on complex old and deep igneous intrusions.

Mineralogy as a science underwent a particularly popular phase in the late 19th century with European expeditions to far off places, Fiskenæsset included. Among the unusual minerals they would find in and around this ice-free harbour were kornerupine, spinel, sapphirine, pargasite, zircon, and corundum. The oldest European descriptions of the area come from Giesecke in the earliest 1800s. The Fiskenæsset region is also the type locality for the minerals sapphirine and kornerupine.

> Greenland is home to some of the oldest preserved sedimentary and volcanic rocks on the planet...

Corundum is the parent mineral for the gemstones sapphire, fancy sapphire and ruby, and so the first descriptions of corundum by Henning Sorensen near Fiskenæsset undoubtedly intrigued many mineralogists and prospectors. The first mention of ruby proper was during a 1965 field season by Martin Geisler of the Geological Survey of Greenland. This first notable report of ruby was documented at Rubin Ø (Ruby Island), a small island in the middle of a brackish lake (Tasiusa) influenced by tidal fluctuations and the site of a Viking settlement. In the 1960s regional mapping of the area was being conducted by the Geological Survey of Denmark (GEUS), who also noted the presence of ruby further towards the ice sheet at Qeqertarsuasiat and Qaqat Aqulerit.

By the 1980s exploration had increased for chromium and platinum group metals in the Fiskenaesset Complex, and these ores are associated with similar rocks that host rubies in the area. As a result,

Field photographs of surface-reaching ruby mineralisation at Aappaluttoq. Top: Clusters of euhedral hexagonal dipyramidal ruby crystals measuring ~2.5 cm in length. Bottom: Ruby hosted in a sapphirine-biotite/phlogopite-rich rock with magnesite, plagioclase and electric blue kyanite. Photos by David Turner.

Hand samples from Kigutilik (left), Aappaluttoq (middle) and Qaqqatsiaq (right) on the GEUS geological map of the region (by Myers 1985) used during fieldwork. These three localities show commonalities in corundum formation but distinct differences in texture and mineralisation style. Photo by David Turner.

Aerial photograph of the peninsula hosting ruby mineralisation at Aappaluttoq. Photo by William Rohtert.

The very large composite ruby crystal cluster (left, 445 carats) that would become the carved Kitaa Ruby (right, 302 carats). Photo of rough by William Rohtert and carved courtesy of True North Gems.

additional showings of corundum and ruby were formally 'discovered' at Siggartartulik and Annertusoq. The discovery of ruby at Kigutilik would come later and work would progress to bulk sampling stages, but never any further. Interestingly, and a prompt for all geologists to inspect all old and archived maps, GEUS geologist Chris Pulvertaft mapped the Ruby Island region in 1970 and did note ruby at what would become Aappaluttoq but it was never included on the published maps.

In 2004, True North Gems acquired the exploration licenses that covered all the known ruby occurrences and the adjacent regions with similar geology. A small program in summer 2004 showed promise. True North Gems dedicated the summer of 2005 to establish the extent and grades of ruby mineralisation at Kigutilik, Siggartartulik and Qaqqatsiaq. Bulk sampling focused on key areas, but the geology was so promising that dedicated prospecting was also carried out for most of the summer. The field team was small and lean, comprising Brad Wilson, Trevor Thomas, Meghan Ritchie, William Rohtert and David Turner with support from the local community, including Thue Noahsen. A helicopter was the main mode of transportation in order to reach far inland and when weather turned for the worse, the team was supported by a 25-foot boat moored in the harbour.

Each day prospecting brought new finds. Corundum was found mostly as opaque crystals often with blue to cream colouration, and sometimes longer than 15cm in length. It had become clear that structural features (such as fold hinges), metasomatic fluids and the right geological lithologies in contact with one another were key controls to corundum mineralisation with gem potential. Key indicator minerals with association to corundum mineralisation included pargasite, kornerupine, spinel, sapphirine and gedrite, as well as areas rich in biotite and phlogopite. The summer was coming to a close, the team was tying up their last targets, and an investor tour was coming to see the results first hand. A route from the water to the Siggartartulik and Kigutilik showings was laid out in detail in case weather didn't permit helicopter access.

> Within 50m of where the helicopter landed it was clear that the rocks were different somehow... and in a good way.

Everything had been set up and on the day before the investor tour the team set out to conduct another day of prospecting. The tedious and detailed work of following geological contacts, breaking rocks, backtracking to confirm and expand observations was being carried out on the geological units north of Rubin Ø. The rocks didn't seem to have the right feel, and so the group moved to the south of Rubin Ø in hopes of more prospective rocks. Things were looking better and more indicator minerals were observed, but the day was drawing to an end and the crew was growing tired.

The call was made to head back to camp, but the crew leader at the time,

Bulk Sampling at Aappaluttoq, August 22, 2005 by diamond chainsaw. Inset top left: William Rohtert and David Turner assessing Aappaluttoq mineralization, Thue Noahsen and Trevor Thomas in the background. Inset bottom right: strongly mineralized biotitite-phlogopitite with kyanite and ruby. Photos by Meghan Ritchie and William Rohtert.

Display rock samples from Qaqat Aqulerit (left) and Aappaluttoq (right). Photo by David Turner.

Rough and faceted rubies (0.29, 0.69 and 0.23 carats) from early Aappaluttoq material. Photos and faceting by Brad Wilson.

David Turner, had a feeling about a small spit of land in a lake just a bit further to the south. He had walked by the lake's eastern flank earlier in the summer, but the peninsula hadn't been looked at yet. Instead of heading back to camp, the helicopter was landed to look at "just one more spot" before calling it a day in order to get ready for the investor tour. Within 50m of where the helicopter landed it was clear that the rocks were different somehow… and in a good way. A little over 100m up the peninsula the team came upon a small outcrop along a sandy beach and could not believe their eyes.

Pink sapphires and rubies were scattered along the shoreline like in some fictional story of splendour. These crystals were unlike anything else discovered that summer and the team immediately knew that this showing was a game-changer. The pink sapphire and ruby crystals were large and some nearly completely transparent. Those that were broken glittered as if they had been faceted by nature, laying on the beach awaiting discovery.

The small outcrop was also encrusted with rubies and pink sapphires, hosted within a matrix of gedrite, sapphirine, spinel and biotite-phlogopite. The discovery was surreal. There was no way to contact the incoming investor with what we had just uncovered, and so it was going to be a pleasant surprise. The icing on the cake of an already successful field season!

The next day the group arrived and we gave them the good news and showed off the recent finds we had brought back to camp. Everyone was eager to visit the site and the weather was good for flying. The group proceeded to what would become known as 'Aappaluttoq', or 'Big Red' in Greenlandic, landing on the small peninsula at the barely-explored or understood showing. The group eagerly and excitedly explored around the site, finding their own crystals and fragments of pink sapphire and ruby.

As the group stood on the outcrop and discussed the success of the summer and the prospect of extensions at Aappaluttoq, David Turner noticed a little bit of red poking out of the nearby soil and reached down to lift the piece up. To his continuing surprise the stone kept coming and his heart was racing! These are the moments of one's career that one remembers for life! The rock was a composite of many clean ruby crystals set in a host of biotite-phlogopite, and it was huge. He happily interrupted an ongoing conversation with this amazing discovery — everyone else was equally astounded at the sheer size and colour!

The day eventually came to a close and we returned to Fiskenæsset, everyone beaming with excitement. The return to the village was equally memorable since a celebration with the local community was well underway. Everyone enjoyed a feast of local foods, music, dancing and birthday celebrations for Meghan, who was turning 22! The large stone was eventually weighed, with a kitchen scale, and measured up at ~90 grams.

Late August was quickly upon the exploration team and a mini-bulk sampling program was quickly put into action. Geological mapping was carried out alongside dimensional measurements of the discovery outcrops, and ore bags were being filled with surface-cut ruby and pink sapphire-bearing material. The entire program wrapped up by the end of August, and most of the field crew returned home to Canada via Copenhagen. A summary was written for each prospect visited in the region, and Aappaluttoq earned this praise:

"Prospecting is strongly recommended to the south of this occurrence [Aappaluttoq] along the Ruby Island South Line. This is an incredibly productive horizon and should be given the highest priority next field season."

Although much work would be required to bring the prospect to production, it was pretty clear that we had just discovered the northern hemisphere's most important ruby deposit.

ACKNOWLEDGEMENTS

The authors would like to acknowledge True North Gems, who funded the 2005 exploration program, and the local Greenlandic communities and individuals who provided logistical support for the fieldwork. This is especially so for the community of Qeqertarsuatsiaat (Fiskenæsset) who enthusiastically housed the team and kept us energized.

A full list of references is available upon request. ■

Trevor and Katrina Thomas at community ruby-bearing rock garden in Fiskenæsset. Photo by William Rohtert.

TREASURES OF THE V&A

V&A William and Judith Bollinger Gallery. © Victoria and Albert Museum, London.

After 10 years and 4.2 million visitors, The Victoria & Albert Museum (V&A) has reopened its William and Judith Bollinger Gallery, home to its jewellery collection, after a three-month refurbishment with eighty new pieces joining the display. *Gems&Jewellery* considers some of the unique pieces in the collection...

The Victoria & Albert museum is known throughout the world for its incredible exhibitions, broad collections and wonderful architecture. Now, following a three-month refresh, the William and Judith Bollinger Gallery has been reopened to the public with a new floor, new lighting, improved computer systems, a glass staircase and new labels for the many treasures on display. In honour of the reopening, a further 80 pieces have been added, including Queen Victoria's sapphire and diamond coronet – gifted by William and Judith Bollinger and their family – as well as a selection of jewelled vanity gases loaned by Kashmira Bulsara, in memory of her late brother, singer Freddie Mercury.

The latter collection of 49 Art Deco vanity cases takes inspiration from Modernism, as well as the cultures of Persia, Ancient Egypt, China and Japan.

The striking exterior of the V&A. Image courtesy of Victoria and Albert Museum, London.

'Blue Seanemone II' brooch, paper on silver frame, designed and made by Flóra Vági, Hungary, 2016. Given by Katalin Spengler. © the artist. Image courtesy of Victoria and Albert Museum, London.

Brooch, gold and iron, designed and made by Annamaria Zanella, Italy, 1997. The Louise Klapisch Collection, given by Suzanne Selvi. © the artist. Image courtesy of Victoria and Albert Museum, London.

They are beautifully rich in colour, thanks to the use of hard stones, enamel and lacquer, and are signed by the likes of Cartier, Lacloche, Van Cleef & Arpels, Charlton and other leading jewellers in Paris and New York.

Other new acquisitions that take pride of place in the William and Judith Bollinger Gallery are around 30 pieces ranging from the late 19th century to the present day. Highlights include the American singer Beyoncé's Papillon ring by designer Glenn Spiro, works by Fabergé, as well as designs by Ute Decker, Charlotte de Syllas, Flóra Vági and Annamaria Zanella. Of course, this adds to the incredible collection already on display, with pieces that tell the story of European and Western jewellery from Ancient Greece and Rome to the present day.

Highlights include the American singer Beyoncé's Papillon ring by designer Glenn Spiro...

When it came to refresh the gallery, the V&A called upon the expertise of architects Eva Jiricna and Georgina Papathanasiou from Atelier A&D, who originally led the creation of the gallery in 2008. The infrastructure and display materials have been enhanced to offer something more interactive for visitors, such as Hidden Treasures, which includes a photograph taken by musician Jay-Z of Beyoncé wearing the Papillon ring, as well as a film showing the ring's fluttering wings in action.

The gallery is now open to the public and entry is free, allowing everyone to experience the sparkling and creative history of jewellery in one of London's most famous institutions. →

Queen Victoria, François Forster (1790-1872), Paris, 1846, after Franz Xaver Winterhalter (1805-73). Engraving on paper. © Victoria and Albert Museum, London.

Top: Enamelled gold vanity case and lipstick holder mounted with coral and set with diamonds and emeralds, Cartier, Paris, 1923. Centre: Gold and white enamel vanity case containing gold key, Cartier, New York, ca. 1930. Formerly in the collection of Gloria Vanderbilt (1903-2011). Bottom: Gold, coral and diamond-set vanity case with 'laque burgauté' panels, Cartier, Paris, 1924. All three are loans and promised gifts from Kashmira Bulsara in memory of her brother, Freddie Mercury. © Cartier International AG. Image courtesy of Victoria and Albert Museum, London.

THE STAR OF THE SHOW

It is perhaps fated that Queen Victoria's sapphire and diamond coronet found its permanent home at the V&A in 2019, not least because this year marks the 200th anniversary of the births of both Queen Victoria and Prince Albert.

The coronet was first acquired by the museum in 2017 and is considered one of Queen Victoria's most important jewels. It was lovingly designed by her husband, Prince Albert, in 1840 (the royal couple's wedding year) and was made by jeweller Joseph Kitching. The coronet is mounted with diamonds set in silver, with 11 step-cut sapphires of octagonal and calf's head shape, set in gold. The piece was designed to match a sapphire and diamond brooch that Albert gave to Victoria the day before their wedding, perhaps kick-starting the Queen's love of parures. In fact, in the same year, she purchased a pair of diamond and sapphire earrings, a brooch and a bracelet of sapphires and diamonds, which suggests she was building a rather impressive matching set!

The design of the coronet was based on the Saxon Rautenkranz – acknowledged as Prince Albert's coat of arms – although the gemstones are believed to have come from jewellery previously given to Victoria by King William IV and Queen Adelaide. Prince Albert took a keen interest in Victoria's jewellery, with one of the Queen's diary entries from February 1843 stating: "We were very busy looking over various pieces of old jewellery of mine, settling to have some reset, in order to add to my fine 'parures'. Albert has such taste and arranges everything for me about my jewels."

Housed within its own cylindrical display cabinet at the heart of the refurbished William and Judith Bollinger Gallery, Queen Victoria's sapphire and diamond coronet is sure to attract attention and admiration. Here, we delve into its past and present...

Soon, the coronet was immortalised in influential early paintings of Victoria, including the 1842 official portrait by Franz Xaver Winterhalter, making the sparkling jewel a recognisable symbol of her power and status. Prior to the untimely death of Prince Albert, Queen Victoria famously had a great love of colourful gemstones and transformable pieces that could be worn in multiple ways. In 1866, she wore the coronet in place of the heavy state crown at the first Opening of Parliament she attended after Albert's death (perhaps signalling that the piece gave her confidence).

Speaking on the introduction of the coronet to the V&A, senior curator Richard Edgcumbe says: "Queen Victoria's sapphire and diamond coronet is one of the great jewels of her reign. Designed by Prince Albert, it is an iconic symbol of their love, worn by Victoria as young queen and as widow. We are entirely indebted to William and Judith Bollinger and their sons for the gift of this masterpiece of the jeweller's art, which is so intimately associated with Victoria and Albert that it will become part of the identity of the V&A. Together with an array of eighty new acquisitions and loans made possible by the generosity of many supporters, the display of the coronet inaugurates the next phase in the life of a much-loved gallery." ■

All images credit to Jewellery, Rooms 91 – 93, The William and Judith Bollinger Gallery at the Victoria and Albert Museum (V&A).

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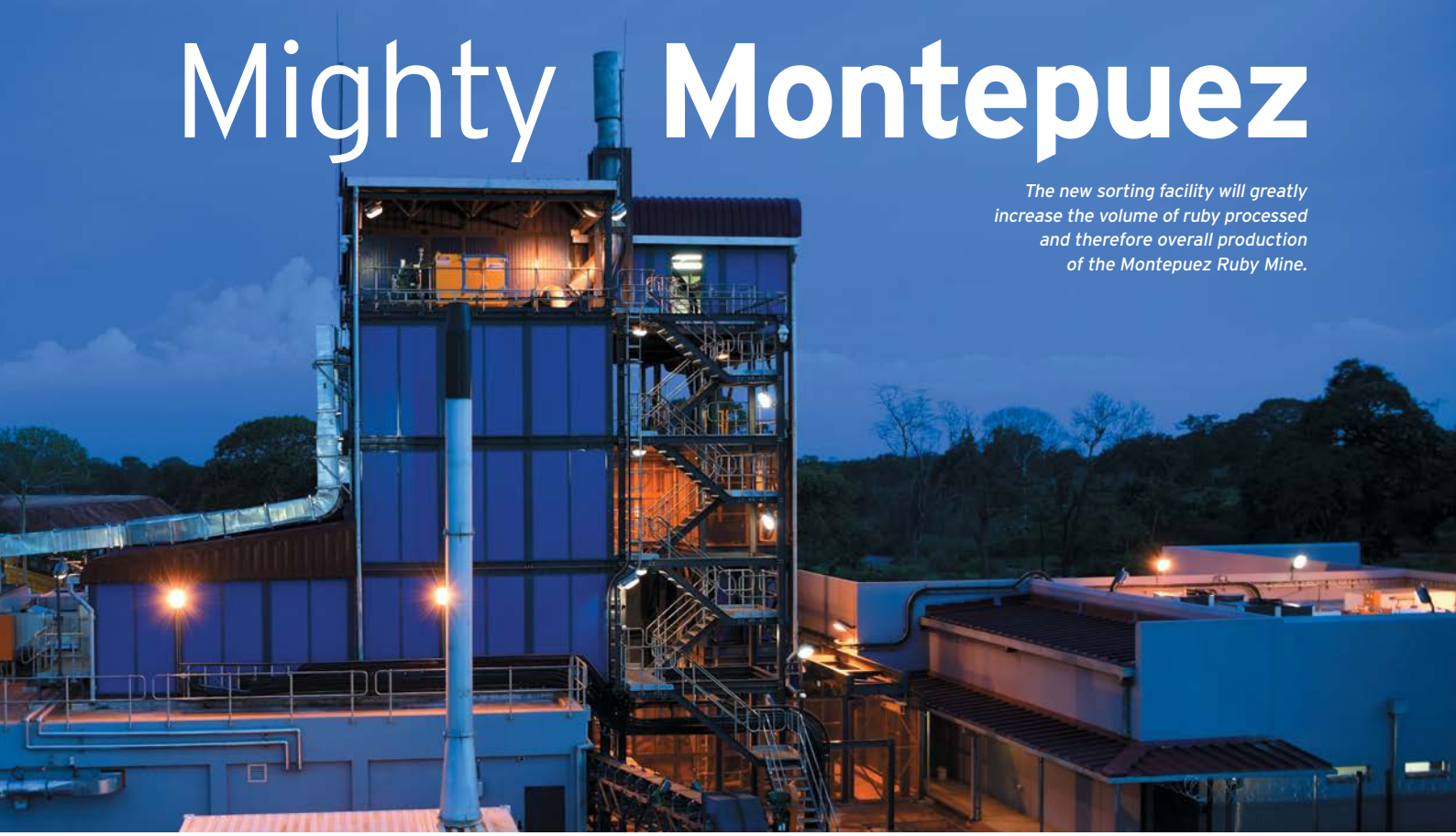
Mighty Montepuez



The new sorting facility will greatly increase the volume of ruby processed and therefore overall production of the Montepuez Ruby Mine.

In February, Gemfields unveiled its new, state-of-the-art ruby sort house at its mine in Mozambique. Here, *Gems&Jewellery* finds out more about the facility and speaks to Mervyn Dettmer to discuss the intricacies of the Montepuez Ruby Mine.

Described as the "first of its kind in the coloured gemstone industry," the new Gemfields ruby sorting facility at the Montepuez Ruby Mine (MRM) in Mozambique has cost US$15 million and features sophisticated technology to raise production levels significantly.

The site uses the natural properties of rubies as a means of automated sorting. The process starts by washing the raw material before passing it under ultra-violet light. Rubies naturally fluoresce under UV light, meaning optical sorters can detect the fluorescence and signal blasts of air to direct individual rubies to separate channels for further sorting and grading. This process is "faster, more reliable and more efficient than the human eye," according to Gemfields, and also allows the "identification of a finer material component than before".

Gemfields has stated that the introduction of automation will not result in a reduction of its workforce. According to a Gemfields media release: "The greater throughput of the sort house means an expansion of the current active mining area, which will require an increase in workforce. Secondly, the manual part of the sorting process – categorisation and grading the rubies themselves – will require a greater volume of highly skilled employees. Rather than import this expertise, MRM is creating the first group of Mozambican gemmologists specialised in the selection and classification of rubies, which marks a substantial step for the ruby industry."

Overall, 2019 looks set to be a significant year for Gemfields' ruby mine. Its new sort house will be complemented with changes to the wash plant, increasing capacity to 150 tonnes of ore per hour. To find out more, *Gems&Jewellery* spoke to Mervyn Dettmer, head of the sort house, to discuss exploratory mining, Gemfields' commitment to local people and the training required to sort ruby effectively.

Can you give us an idea of the scale of the Montepuez Ruby Mine (MRM) and can you share any specifics about its operation?

The Montepuez ruby deposit, located in the north-east of Mozambique within the Cabo Delgado Province, is believed to be the most significant recently discovered ruby deposit in the world, covering an area of 34,966 hectares. Montepuez Ruby Mining (MRM) is 75% owned by Gemfields and 25% owned by local Mozambican partner, Mwriti Limitada.

The mining operation at MRM comprises a number of shallow, open-cast pits split between three main operating areas. Mining is carried out as a conventional open-pit operation using excavators, loaders and articulated dump trucks, but the production operates on a very shallow basis, with the pits varying in depth from 5 to 28 metres. There is no blasting required.

Loaded trucks haul ore to stockpiles

Rough ruby grading in action.

adjacent to the processing plant while waste is backfilled into excavated areas. In line with our sustainability and environmental policies, the top soil is removed and sifted, prior to commencing operations, with any seeds being retained and grown in a nursery onsite. Once work on the area has been completed, it is backfilled with the seeds replanted, returning it as close to its original state as possible.

Total rock handling during the FY 2018 equated to 4,02 million tonnes, comprising 0.75 million tonnes of ore, 3.27 million tonnes of waste material at an overall stripping ratio of 4.4.

What can you tell us about the resources you use, such as electricity, water and diesel?

The entire operation is running on a power supply connected by EDM (Electricidade de Moçambique, an energy company of Mozambique) with 3 phase 33 KV line voltage. Diesel generators are also installed at mine and camp to provide power when the fixed connection is interrupted to ensure operations remain unaffected. MRM is now served by a fully operational base camp at Namanhumbir which has been in consistent development since operations began.

A borehole supports the Namanhumbir camp with water pumped to elevated tanks for domestic and sanitary consumption. Raw water is treated by a small reverse osmosis plant in the kitchen prior to use by kitchen staff for food preparation.

The cost of fuel changes every month as per the Government of Mozambique rules. There are three tanks provided by Petromoc to facilitate MRM needs with a total capacity of 96,000 litres.

What has Gemfields done to support local communities in the region?

Gemfields is committed to upholding strong standards of social responsibility and as such works closely with the local community to develop projects that will have the most positive impact. Examples of work to date include:

- Provision of two mobile health clinics to support 10 communities in the Namanhumbir Administrative Post, which had previously depended on a single health facility. From March 2017 to November 2018, more than 68,000 consultations were held: including screening of diseases, vaccination, deworming in children, vitamin A supplementation, prenatal consultation and nutrition consultation


Pits and the surrounding landscape at the mine.

The new Montepuez Ruby Mine sort house opened at a cost of US $15m in February 2019.

- Construction of an outpatient ward for the Namanhumbir Health Centre
- Building of three primary schools with 13 classrooms and six teacher houses (in Nanune, Mpene and Nseue villages). Also rehabilitated one primary school with five classrooms in Nanune village providing a combined capacity of 2,000 students
- Establishment of nine farming associations which benefit more than 400 local farmers through skills training, improved seeds, pesticides and agricultural equipment, improving yield by 200%. Two of these are chicken production projects, providing a source of regular income for the female participants, with 25,360 chickens produced since the beginning in 2016
- Launched a seven-year training programme aimed at equipping 2,100 community members with vocational skills to improve their employability and ability to create self-employment
- Opened 12 drinking water outlets and rehabilitated an additional four in different villages
- Awarded with the best Social Responsibility practices by the Government of Cabo Delgado in 2017
- Recognised as the biggest taxpayer in Cabo Delgado province in 2014, 2015, 2016 and 2017
- Creation of more than 1,000 jobs at the mine

Are there ongoing exploration operations?

A multidisciplinary approach has been adopted for ruby exploration in MRM. Both indirect (aerial geophysical survey) and direct methods (sub-surface drilling) are used first to delineate the target zone and subsequently define the ore body.

MRM is creating the first group of Mozambican gemmologists specialised in the selection and classification of rubies...

Ruby and corundum mineralisation is found in two fashions: namely, primary amphibolite, and secondary gravel beds. The auger drilling has been mainly used to target the secondary mineralisation with the aim of determining the thickness and nature of the gravel bed and the overlying material. Diamond drilling is predominantly aimed at determining the nature of the basement geology with the aim of defining the primary mineralisation and understanding the bedrock geology.

A total 21,012m of auger drilling was completed in October 2016 for the secondary deposit. The secondary rubies are dark red in colour, more transparent, with fewer inclusions, and often rounded in shape.

Rubies from the primary mineralisation are typically tabular hexagonal crystals, with a strong basal cleavage. The stones are highly fractured and included. Typically, the primary rubies are lighter, pink colour, and so are often classified as sapphires. A new hydraulic drilling rig (Sandvik DE-710) was commissioned in December 2016 by Sandvik technical team to increase the drilling efficiency and speed up the exploration program.

The exploration program mainly consisted of core-drilling and was designed to explore the primary source of the premium rubies, and to understand the role of structural discontinuities in ruby mineralisation on the basis of aerial geophysical data. Based on exploration, the Northern Shear (NS) and Southern Shear (SS) mineralised zones were identified. Core drilling data indicates that the mineralised amphibolite extends about 30 meters below the surface and lies on top of the basement gneiss.

The geological modelling of both primary and secondary deposits has been reproduced using leapfrog software integrating all exploration data and recent aerial geophysical survey.

The Exploratory Processing Unit was commissioned in April 2018 with an objective to understand the ore

The landscape of the Montepuez Ruby Mine in Mozambique.

characteristics and grade of the secondary deposit explored within 77sq km by auger drilling. The actual grade and quality of ruby in the secondary deposits is more difficult to predict owing to its sporadic distribution in pockets/traps within the gravel horizon and can only be determined after processing a considerable amount of ore.

How many people do you currently employ and how many do you hope to employ. What percentage are local?

As of 31 December 2018, a total of 1,261 people are employed by MRM, 93% of whom are from the local communities, of which 456 personnel were directly employed and 805 were contractors. During the calendar year, various internal and external training programmes were attended including human rights, managerial skills, health and safety, finance, security and specialised software. Local students also took part in internships at the operations during the period.

How is ruby sorted by your specialists and what sort of training must an individual undertake in order to master the role?

The deposit consists of two sources, one the primary and the other secondary. The secondary deposit is divided into two categories namely premium ruby which is above 0.5 grams and secondary ruby which is below 0.5 grams in size. The primary deposit production is divided into six categories based on the colour intensity or lack thereof and clarity; namely premium, ruby, low ruby, sapphire, low sapphire and corundum.

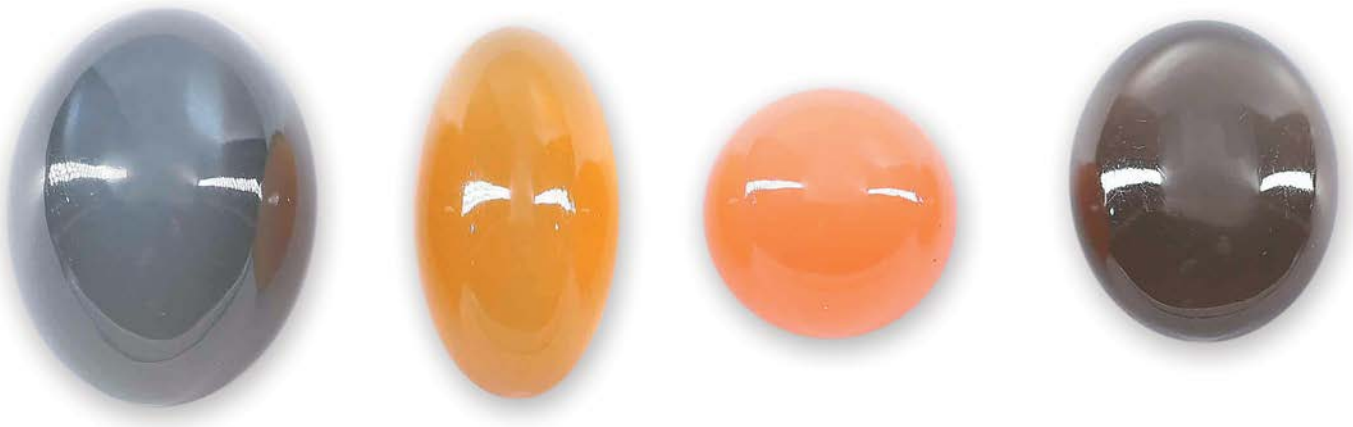
Each individual category is then divided into grades based on the size (gram weight or millimetre), colour and clarity. For example. a stone weighing between 0.5 to 0.7 grams with a strong, vivid saturation and exceptional clarity will be allocated a grade at top of the secondary grading system.

After a year of intensive training and evaluation the sorter would be considered competent. This does not just involve the skill of identifying rubies from the balance of the concentrate but also working at a certain speed and efficiency. ■

Rough rubies ready for grading.

All images courtesy of Gemfields.

Opaque moonstones of varying body colour from India. From left to right: 19.65 carat grey moonstone, 10.89 carat orange moonstone, 7.86 carat peach moonstone, and a 9.12 carat grey/brown moonstone.



Shopping for Schiller

Is it possible to determine the origin of a moonstone just from its appearance? What should one look for when buying? *Gems&Jewellery* visited Hatton Garden-based gem dealer, Marcus McCallum to discuss moonstones from Burma, Sri Lanka, Tanzania and India, and photograph some fantastic examples.

Moonstones have been used in jewellery for thousands of years. The Romans believed moonstones were solidified rays of moonlight that fell to earth and changed colour depending upon the phases of the moon. The Ancient Greeks associated moonstones with the powers of their lunar goddesses; carrying a moonstone was thought to bring good luck and protection, but they were also associated with femininity, fertility and love throughout much of antiquity. In the Middle Ages, it was thought that holding a moonstone in your mouth, or staring into its heart before sleep, would conjure visions of the future.

The romantic storytelling that surrounds moonstones contributed to the gem's popularity during the Art Nouveau design movement of the late 19th and early 20th centuries. Famed designers like René Lalique used moonstone cabochons and carved moonstone cameos to enhance the mysticism of part-fairy, part-dragonfly creations. The next resurgence of moonstone took place in the 1960s, when the ethereal, glowing light of moonstone cabochons captured the imagination of the 'free love' and 'flower child' movements.

No matter the time period, it has always been the soft, glowing light of moonstones that makes them a universally-loved gemstone.

UNDERSTANDING MOONSTONES

Moonstone is a potassium-rich member of the feldspar group of minerals and is composed of very fine, microscopic layers of the end member minerals, orthoclase and albite. Minerals in the feldspar family each vary slightly in chemical composition, and together constitute around 60% of the earth's rocky crust, which makes moonstone, labradorite, sunstone and amazonite relatively abundant gem materials.

A pear-shaped moonstone cabochon from India at 3.62 carats. Note the hints of gold that appear to flash across the stone.

In this article we mention moonstone and rainbow moonstone. It is important, particularly to students of gemmology, that we point out the following: to the trade 'a moonstone is a moonstone' and they will refer to moonstone and rainbow moonstone. The intention is not to deceive, since they are both feldspars, however they are very different feldspars. Moonstone is an alkali feldspar, while what the trade refers to as 'rainbow moonstone' is, by composition, a plagioclase feldspar and a variety of labradorite. On a ternary plot of the feldspar group, moonstone falls between the potassium/orthoclase endmember and the albite/sodium endmember, while labradorite lies between albite and anorthite/calcium.

The characteristic sheen of moonstone – adularescence, commonly referred to

as schiller – is caused by the scattering of light from the smallest of the alternating layers of orthoclase and albite making up the stone. The scattered light returns the blue and violet light to our eyes, offering the stone that blue glow that appears to emanate from within. If the layers are larger, white light will be scattered, and a less desirable white sheen is observed (as an aside, it is the same mechanism that causes the sky to appear blue and clouds, white). Some moonstones also display chatoyancy, also known as the cat's eye effect. A warning for jewellery lovers though, as moonstone is just 6-6.5 on the Mohs scale it does have a tendency to chip. Protective, rub-over settings are advised, especially if a moonstone is to be worn as a ring.

Sometimes inclusions can be so specific to a particular gemstone that they serve as a diagnostic tool for gemmologists. Moonstone is one such example thanks to its characteristic 'centipede' inclusions, which are cracks with shorter cracks emanating perpendicularly along the length of the fissure — similar to the many legs on a centipede.

BUYING MOONSTONES

There are three key factors to consider when purchasing moonstones: body colour (or the background colour), the sheen colour and the location or orientation of the sheen. Moonstone body colours can vary widely, they can be semi-transparent or completely opaque, and can present a blue, white or silvery adularescence.

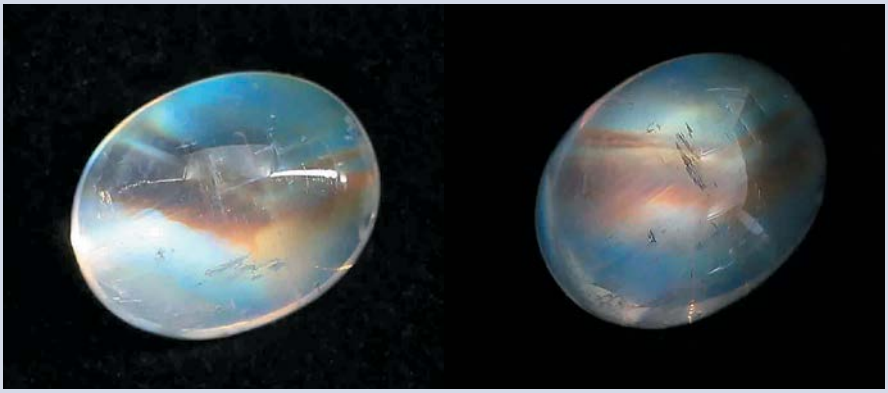
It is widely considered that the best moonstones are colourless, semi-transparent to nearly-transparent in appearance without obvious inclusions, coupled with a striking and bold blue adularescene that is centred within the stone, but visible from as many directions and angles as possible.

Moonstones are most commonly sold as high-domed cabochons because this way of cutting the gemstone shows its characteristic blue sheen to the best possible advantage. Oval shapes are common, but there are some lovely teardrop and pear-shaped cabochons on the market too.

Moonstones can also have a range of body colours, from yellow, orange and grey to pink, brown and peach.

A 2.34 carat rectangular 'rainbow moonstone' (plagioclase labradorite) cabochon from India with a strong blue sheen.

A 8.50 carat oval 'rainbow moonstone' (plagioclase labradorite) cabochon from India.



A 7.36 carat 'rainbow moonstone' (plagioclase labradorite) cabochon from India. Note the combination of blue and gold and the reflection under different lighting conditions.

A selection of 'rainbow moonstones' (plagioclase labradorite) from India where a broad range of material is available in abundance.

A 24.21 carat Burmese moonstone with a characteristic bright, ethereal glow.

A 3.06 carat moonstone from Burma with a characteristic sunbeam effect.

A 23.88 carat moonstone from Sri Lanka with its slightly milky appearance.

A 34.43 carat Tanzanian moonstone. Note the characteristic grey tone in the body colour.

Capturing the blue sheen in a 21.85 carat Tanzanian moonstone.

All images courtesy of Marcus McCallum and Henry Mesa.

> ...there remains something mysterious and subjective about choosing the one that is right for you.

The two Tanzanian moonstones alongside the round Sri Lankan moonstone cabochon (as featured in the top row of photos on this page).

MOONSTONE ORIGINS

Although the feldspar group of gemstones is considered relatively common and abundant, it is surprisingly rare to find moonstones with a large size, good colour and bright blue sheen, according to Hatton Garden gem dealer, Marcus McCallum. Different localities produce surprisingly different moonstones, with the trained eye able to make an educated guess as to origin by appearance alone.

Moonstones from Sri Lanka – perhaps one of the most widely-known localities for moonstone – tend to exhibit a strong blue sheen, but can be milky in appearance. Some moonstones can be milky when viewed from one direction and yet completely transparent when viewed from a different angle. Overall, the greater the clarity and transparency of the gemstone, the more valuable it is likely to be. Moonstones from Myanmar (Burma) have a characteristic and reflective bright light that seems to emanate from the centre of cabochons like a sun beam; something which is particularly noticeable in-person. Material with a golden or bluish-sheen (or a combination of both) can be particularly valuable, with McCallum suggesting prices of around £300 per carat.

Tanzanian moonstones have hints of grey in their body colour and often do not have the same transparency when viewed from a side-on angle like examples from Sri Lanka and Myanmar.

WHAT ABOUT LABRADORITE?

Labradorite is another type of feldspar that can display an optical effect. Although it differs in chemical composition to moonstone, it is also composed of interlocking layers of two feldspar end member minerals – in this case, albite and anorthite. The most common type available on the market is noted for the vibrant blue and green colours observed on movement of the stone. This effect is known specifically as 'labradorescence', and is caused by light diffracting and interfering between the layers of alternating minerals. Transparent labradorite is also available, and does look very similar to moonstone, with the same blue schiller. Therefore, it is often marketed as 'moonstone' or 'rainbow moonstone', despite the fact that it is a different variety of feldspar.

SUMMARY

Although there are physical properties that indicate the best quality moonstones, there remains something mysterious and subjective about choosing the one that is right for you. Perhaps it is a flash of gold that catches your eye? Or the body colour reminiscent of storm clouds that inspires your imagination? Whatever your personal preference, there are countless benefits to getting hands-on with moonstones from a variety of localities, allowing you to see the subtle differences that distinguish one from the other. ■

An antique Sri Lankan carved moonstone with a cherub face – sometimes known as 'man in the moon'.

"No amount of online social networking can do the job as well as personal contact"

Gem-A President, Maggie Campbell Pedersen FGA ABIPP, offers her thoughts on the benefits and learning opportunities at gemmological conferences across the world, including the first event hosted by the Danish Gemmological Association in March 2019.

Attaining a Gemmology Diploma is a sufficient goal for some people, and, once accomplished, they have no need to continue their gemmological education. Yet for many of us, continuing our learning is extremely important as gemmology does not stand still. It is vital to keep abreast of new developments, new ideas, and to update and possibly even to correct the learning we have, as new information and research results come in. Anyhow, learning something new is always fun!

It is hardly necessary to mention that Gem-A presents opportunities to continue and enhance our knowledge, both through magazines and the website. Just as important though are the courses and the annual Gem-A Conference and activities offered by gemmological groups worldwide, as it is where we not only hear lectures but also have the chance to network.

Networking is essential for me because it is often how I connect with people who have the information that I am seeking. Or I meet somebody who knows somebody who has the right information! No amount of online social networking can do the job as well as personal contact. In February, I attended the Gem-A Midlands Branch Conference in Birmingham. It was very well attended and had a variety of lecture subjects, from jade through to 20th century jewellery and synthetic diamonds. It was a chance to catch up with friends and colleagues, and the relaxed and happy atmosphere made for a very enjoyable weekend.

A month later, I went to Copenhagen to attend the first Gemmological Conference held by the Danish Gemmological Association. It was organised by president, Niels Ruddy Hansen, diamond expert and Danish CIBJO representative. Among the lecture subjects were diamond treatments, the gem materials of Greenland and those of Brazil. Dr Gaetano Cavalieri, president of CIBJO, brought us up to date with international developments and the aims of the organisation.

We are of course fortunate that gemmologists love to share their knowledge — indeed it is often difficult to stop them talking! We are enthusiasts and we love to share. In times past, conferences often seemed to be a bit heavy-going, with many subjects only truly appreciated by scientists. By contrast, today's conferences present a mix of subjects, some technical and some much less so, but all adding to our store of knowledge and deepening our understanding of our fascinating subject. After a talk we can interact face-to-face with both the lecturer and with colleagues, exchanging views and sometimes literally comparing notes.

Networking at the Gem-A Conference 2018. Photo Credit Henry Mesa.

> We are of course fortunate that gemmologists love to share their knowledge — indeed it is often difficult to stop them talking!

At Gem-A, we are fortunate to have branches throughout the country. They are all self-supporting and are kept going by dedicated and generous people who are willing to give their time and energy for the benefit of others — and because they love the subject. If you want to meet like-minded people and talk about anything gemmological, contact a local gemmological society or branch. These organisations hold a fount of knowledge, just waiting to be tapped. Personal contact is such a valuable addition to reading books, magazines, and working online. ■

1: The Goddess of Enlightenment carved by Master Xuesong Zhang.

Developments in Jade

Jessica Han FGA, head of China for Gem-A, speaks to Mr. Yan Ao, the dean of the School of Jewelry and Art Design at the Beijing Institute of Economics and Management and the president of Bo Guan Auction, as well as Mr. Bo Wang of Bo Guan Auction, to provide this report on current developments in Chinese jade carving.

The history of jade can be traced back 8,000 years. It is safe to say that it appeared and was used by humankind long before the words to describe it were developed. China is one of the pioneer countries that explored, mined, manufactured and used jade. Chinese jade culture is so deeply immersed in our history and ideology that we cannot ignore the effect it has had on our national civilization. The diversity of jade carving has contributed to this process.

Chinese jade carving culture has its own heritage and history of innovation. The topic of traditional Chinese jade carving, and examples of such carvings, are studied extensively and highly-appreciated by a global audience, and the artistic community in general. In contrast to the traditional style of jade carving, contemporary jade carving is in a very dynamic stage of its development and great progress is being made. Its origins can be seen as a creative echo of the deep-rooted national pride Chinese artisans feel about their traditional culture, coupled with economic growth. This has provided a solid foundation for innovation and development in a newer form of jade carving.

To explain this in more detail, it is often most helpful to study pieces themselves — a picture is worth a thousand words! Religious themes are the most characterised in contemporary jade carvings, as well as those that demonstrate belief in China's citizens and the ethical ideology of the nation. It is also a genre that aptly displays the deeply-embedded principles of good fortune that are present in Chinese culture. This particular jade carving – titled The Goddess of Enlightenment – has been chosen as an example because of how different it is from traditional carving methods (**1**). It is a true masterpiece that has been recognized by Chinese scholars and collectors.

The craftsmanship used to form this piece is incredibly advanced; the structure of the Buddhist figure is suited to more modern tastes and has been intricately achieved thanks to developments in carving tools. Innovations in carving machines have certainly made the lives of master craftsmen easier, allowing them to formulate techniques that bring their

2: Nephrite table set crafted using the special technic of 'Bao Tai' by Master Yu.

4: Nephrite tablet (front and back) carved by Master Yiwei Zhai.

5: A close up of the detail on Master Yiwei Zhai's nephrite tablet.

> In contrast to the traditional style of jade carving, contemporary jade carving is in a very dynamic stage of its development...

ideas to life. Inspiring ideas can flourish as a result of these advances, rather than dry up as before. More detailed carvings can be achieved and the control of each individual stroke is smoother. Most importantly, as methods of sourcing jade become more sophisticated, more intriguing materials of higher quality can be used within the jade carving industry by masters. The varying textures and colours of good jade have the power to influence the design and creativity of master carvers across China.

Contemporary jade carving is more focused on artistic value when compared to traditional pieces, which had a more ceremonial element. This particular table set uses the 'Bao Tai' carving method – considered to be a 'lost skill' or dying art form – to the most exquisite degree (**2**). The shape of the bowl is inspired by and imitates pieces from the royal collection. In fact, the bowl is translucent because it is as thin as a sheet of paper (**3**). To be able to handcraft this piece in addition to the very fine sculpture on top of it requires years of practice and experienced teaching passed down by generations of masters.

In traditional Chinese culture, jade was not only seen as a decorative wearable item, but also as a symbol that its owner belonged to high society. It was believed that only intellectuals and royals were worthy of jade. As a result, there was a strong trend towards wearing jade tablets in the Ming and Qing dynasty. Now, following years of development, carved jade tablets have pushed boundaries to accommodate more modern tastes, while still maintaining their traditional essence.

Historically, the themes of tablets were more focused on flowers, birds, fish, insects and other figures associated with good wishes. There were certain forms and shapes religiously followed by carvers from one generation to the next. Today's contemporary carvers have taken advantage of improved techniques to add variety and create new artistic illustrations. Surprisingly, this has had the effect of creating a new 'signature' for our current time period.

This *nephrite tablet* by Master Yiwe Zhai is inspired by a mountain view on a rainy spring day (**4**). The structure and composition of the work has vividly captured the view and expresses a yearning for tranquility, peacefulness and harmony in life (**5**).

With the rapid growth of the Chinese economy, the people are taking the development and inheritance of traditional arts more seriously than ever before. At the same time, we can clearly conclude that the past 20 years of development in the jade carving industry in China has been one of the most significant periods in Chinese jade carving history overall. The growth of jade trade communities, the increasing number of award winning pieces, and the diversity and creativity of the genre are alerting the wider world to China's jade caving past, present and future. Jade culture is one of the most tangible aspects of Chinese history and will continue to be an inseparable part of our identity. ■

3: A closer look at the details of Master Yu's nephrite table set.

7 STEPS TO SUCCESS

When it comes to determining the value of a jewellery piece, who better to turn to than Shirley Mitchell FGA DGA FIRV? Here, she takes us through her step-by-step process and shares some top tips for making accurate assessments.

There is no doubt that 'valuing' has become more technical and professional over the last 10 years or so; the standard expected by insurers and members of the public has also increased. Fellows and members of the Institute of Registered Valuers have seen a huge increase in requests specifically for IRV valuations, so much is the trust in our methodologies and recognition of our professionalism.

STEP ONE: The Whole Picture

Everyone has their own way of working when presented with an item of jewellery for valuation. I prefer to start by looking at the piece and assessing it as a whole first; once I have determined that it is not a piece of costume jewellery, or rather that it is not a collectible piece of costume jewellery, then I check that all stones are natural and secure in their settings and the piece does not require repairing before I start.

Any items needing repair are discussed with the client before continuing. There is no point in valuing a diamond ring if the diamond is about to fall out because the mount is worn. An insurance company would look at this as a bad risk and not insure it until it was safe to wear — so off to the workshop it will go to be restored to its former glory.

STEP TWO: Customer Relations

Most insurers will have a set value at which all items at or above will require listing separately on the policy, so this is an important discussion to be held with a client. We have to determine if they want all their jewellery and watches valued or just the items over the single item limit as determined by the insurer. Personally, I think it is better to have everything that is approaching this limit valued regardless, as the client can rest assured that should the unthinkable happen, they are adequately covered and they have all the information to hand to aid a speedy claim should they need to.

Once the items have been initially assessed it is time to appraise them first, they are all put in alphabetical order: bangles, bracelets, earrings, pendant and rings etc. This makes it much easier for the client to find an item on the schedule if needed.

STEP THREE: Create Your Own Order

Time to set to work appraising the items: it is imperative to have a set order to do this, and we are all different so probably work in a different order to another valuer. For me, I always weigh the item first. Then I assess the gemstone and diamonds, testing stones in their settings can be a little difficult depending on the mount – imagine trying to determine a doublet or triplet in a rubover setting when one cannot see the girdle and therefore the join line (not so bad with an opal if you can see the base material, but if it is in a closed back setting as well, that makes a definitive identification a little harder).

Top Tip: Never Make Assumptions

One must always test every gemstone presented, never assume that because it is blue, it must be a sapphire, or if yellow, that it must be a citrine. I have seen older valuations accompanying items for valuation when, on testing, a sapphire turns out to be an iolite and sometimes even a kyanite, or the citrine that was a heliodor. Of course, there will always be the age old ruby and red spinel mix-up, so handling and testing as many gemstones as possible is essential for valuers.

STEP FOUR: Analysing the Mount

Once all the stones have been tested, measured and assessed for quality and the essential 'working notes' updated, it is time to look at the mount. Is it cast, handmade, designed by CAD? How good is the mount? Is it a low-end production line piece or a high-end bespoke piece? This is very significant in determining a value. The quality of the mount is also an indicator of the quality of a gemstone. It would be very unusual, and unlikely, to have a very poor quality 9ct gold one-piece cast mount that has not been cleaned up too well, set with a top quality 'Royal Blue' sapphire. One has to determine whether that sapphire is indeed natural or if it is more likely to be a synthetic.

STEP FIVE: Spotting Signed Jewels

Back to the mount — is it signed? For branded or signed pieces, the process takes a different path. Is it a Cartier piece that is still available today? If so, then this is where the 'Price' becomes the 'Value'. But first one must be sure that the signature is authentic; we all know there is a thriving piracy business out there copying iconic pieces of jewellery and selling for a fraction of the cost of the 'real thing'. Many designer houses will not authenticate jewellery for valuers

or the public, which is understandable because if they did they would never spend any time with their clients, so it is up to us, as valuers, to make sure we know what the various houses' jewellery looks and 'feels' like.

STEP SIX: Develop Your Working Notes

Once all the gemstones, diamonds and the mount been appraised, all the information is written up and forms the valuers 'working notes'. These notes are extremely important and should contain:

- Gemstones and diamonds — tests and results, identification and quality
- Quality factors — colour, clarity, cut, any factors that are taken into consideration when calculating a cost per carat
- Mount details — quality and any factors that have been taken into consideration when determining the likely cost to replace
- Research — any dialogue with specific jewellers, auction houses, designers
- Hallmark details
- Bullion and exchange rates
- Any workshop margins and mark-ups applied

In fact, everything that has helped with forming an opinion as to the likely cost and subsequent value.

STEP SEVEN: Tough Conversations

Members of the public often do not have the time, or the desire, to take all their jewellery into town to leave it with a jeweller for several days, so prefer to have a 'home-visit' service at a time to suit them. This is the part of my job that I love the most as I can talk to clients and answer all their questions as I work. It is particularly satisfying to be able to tell a client that they have something very special, especially when they thought their granny's ring was just a bit of costume jewellery! Although it can be much harder the other way around, when a piece is not as valuable as they thought. Jewellery has something that very few other things have — emotional value! By speaking to the client in the comfort of their own home we develop a rapport and it is very much how you tell the client that it is not what they thought that is important.

Top Tip: Managing Client Expectations

Managing situations like this is a very important skill to learn when dealing with members of the public. In a similar vein, if an item has seemingly been under or overvalued before, it is how this is handled that is important. One must never be negative towards the previous valuer under any circumstances; mistakes happen, we are all human, instruments have developed, lighting is better and there are a are a whole host of reasons why something may have been valued differently years ago.

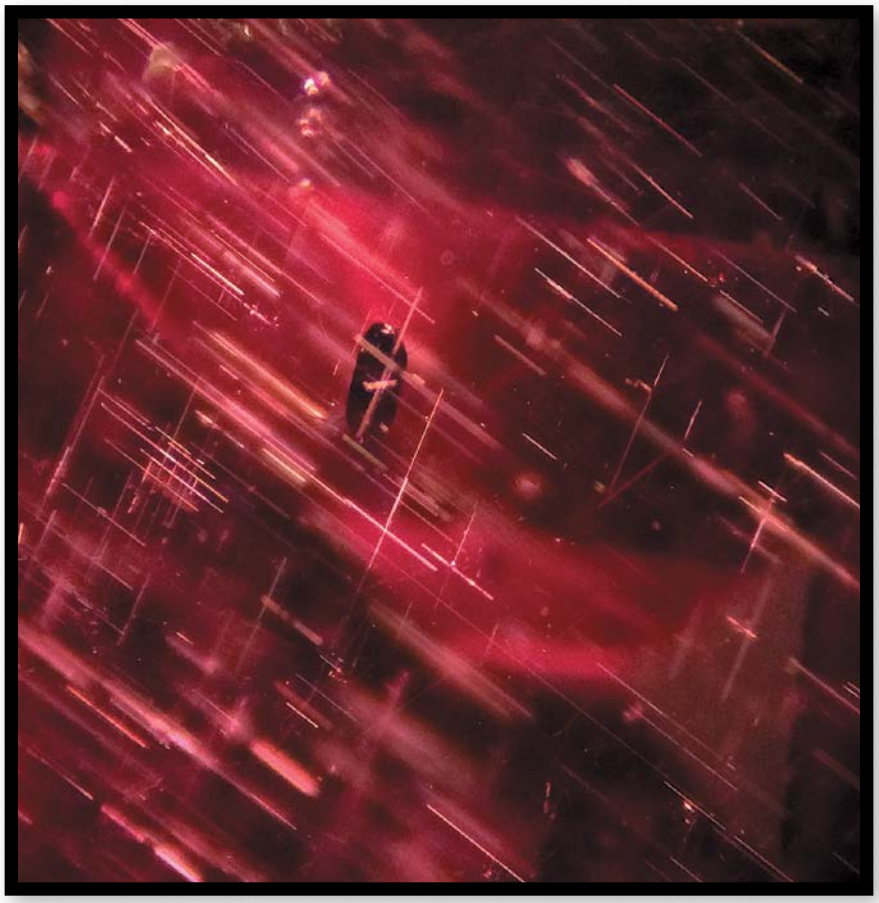
Treatments were around years ago that were not identified until a few years after they hit the market — if no-one knew the treatment existed, how could they know how to identify it? Market forces may have played a part in the difference in value. For example, in 2011 the gold price soared to $1,895 per ounce yet as of April 2019 the gold price has stabilised and is now approximately $1,307 per ounce.

One of the pre-requisites for becoming a member of the Institute of Registered Valuers is that a candidate should have a recognised gemmology and diamond grading certificate. My role as a Gem-A ODL tutor has shown me that many new students have enrolled on the Foundation course because they wish to become a 'valuer' and this is really exciting to see. I look forward to meeting the next generation of professional valuers as they further hone their skills and develop their passion for jewellery. ■

Shirley Mitchell FGA DGA FIRV PJValDip PJGemDip FNAG will host two workshops at Gem-A HQ in May and June 2019. The first, titled 'Understanding Valuations' will take place on Friday, May 31, at 10am-4.30pm. The second, 'Assessing and Testing Mounted Gemstones' will be conducted on Friday, June 7, from 10am-4.30pm. To find out more and buy tickets, please visit gem-a.com/education/courses/workshops

Find out more about Shirley's services at sdmvaluations.co.uk.

Shirley Mitchell FGA DGA conducting a valuation. Photo credit Shirley Mitchell.



6: Rutile with a dark crystal inclusion in an almandine garnet.

THE ART OF PHOTOMICROGRAPHY

Inspired by his own passion for photography, David Pregun FGA DGA shares a condensed version of his Gemmology Diploma project dedicated to the incredibly intricate and imaginative world of photomicrography.

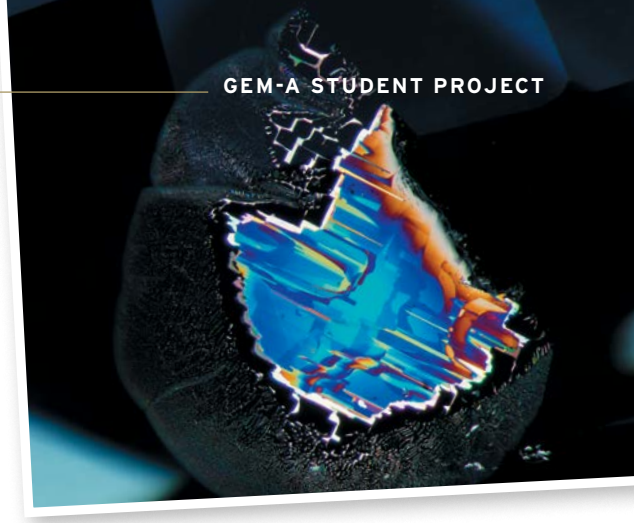
In this paper I would like to focus on a subject that caught my attention during my studies: photomicrography. I am a very visual person and seeing all the fascinating images in our course notes helped me immensely to better understand the world of gemmology. I have chosen a somewhat controversial title because photomicrography is first and foremost considered a scientific field, but most of the images produced are beautiful and pleasing to the eye, so it can be considered art or at the very least artistic.

TERMINOLOGY

Gemmology is very clearly dependent on the microscope and the related discipline of photomicrography: education, research, publication and laboratory documentation would be almost impossible without it. Gemstones and gemmology are about colours and forms, subjects that are not easily addressed with words alone.

There are two quite similar terms that we cannot mix up when talking about this subject: photomicrography and microphotography. These terms do not have the same meaning and are not interchangeable.

Microphotography is the technique used to reduce macroscopic images to one that is too small to be resolved by the unaided eye (Koivula, 2003). In other words, a microphotograph is a photograph shrunk to microscopic scale. The preservation of images produced this way is done by using a special negative, known as a microfilm. Microphotography, also known as microfilming, has proved useful for libraries wanting to preserve visual history in a space-saving fashion.



A fingerprint in untreated sapphire. Photomicrograph by E. Billie Hughes/ Lotus Gemology.

> ...the scientifically correct term for taking pictures through a microscope is photomicrography

On the other hand, the scientifically correct term for taking pictures through a microscope is photomicrography (Bradbury et al., 1989 In Koivula, 2003) and this is what I will be focusing on in this paper.

One other term I came across in some studies was macrophotography. Images illustrating objects that are usually too large to be photographed through a microscope are called photomacrographs (Gübelin and Koivula, 2005). In any other scientific paper they would most probably be referred to as 'just' photographs, but in these studies it is important to emphasise the difference between a photomicrograph and a photomacrograph.

HISTORY OF PHOTOMICROGRAPHY

The history of photomicrography is, not surprisingly, in direct correlation with the study of inclusions. Once gemmologists started to study the internal and external properties of gems under magnification it became apparent that recording what they saw was imperative. It is said that the first English language description of an inclusion in a mineral was written in 1672 by Robert Boyle (Gübelin and Koivula, 2005).

The first person who proposed the possibility of photomicrography was Thomas Wedgwood. There is no indication that he ever succeeded in capturing an image, but it has been suggested that he and Sir Humphry Davy attempted such experiments in the early 1800s. The first photomicrograph using a solar microscope was created by William Henry Fox Talbot somewhere around 1834. He used small cameras to record images on paper with magnifications below 20× (Overney and Overney, 2011).

The first satisfactory series of photomicrographs were produced by Rev. Joseph Bancroft Reade in 1837, however, it is still questioned whether he had accomplished the task before 1839, as several sources state conflicting information. Some scientific papers also mention the name of Christian Joseph Berres, an Austrian professor who created photomicrographs before or in 1839.

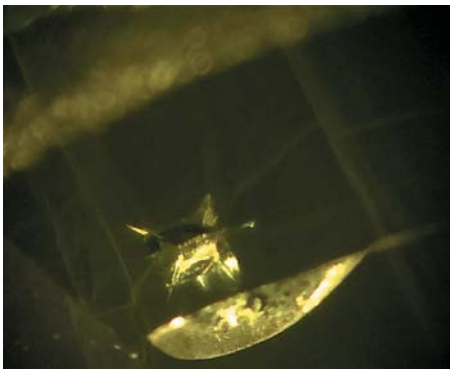
The next scientist in chronological order that I would like to mention is Alfred Francois Donné who produced images using the daguerreotype method around 1840. The first advanced publications in this subject date from the 1860s (Overney and Overney, 2011). There are three very important works that are said to be the foundational tutorials for the study of inclusions: *Einschlüsse von Mineralien* written in 1854; a lengthy publication titled *On the Microscopic Structure of Crystals, Indicating the Origin of Minerals and Rocks* published in 1858; and *Microscopical Petrography* dating from 1876 (Gübelin and Koivula, 2005).

The first vertical photomicrography setup was built around 1886 by Ludwig Leitz. The famous Leitz Panphot microscope was introduced around 1933 and over the following decades the technology quickly reached a very sophisticated level using film emulsions, light detectors and illumination techniques (Overney and Overney, 2011).

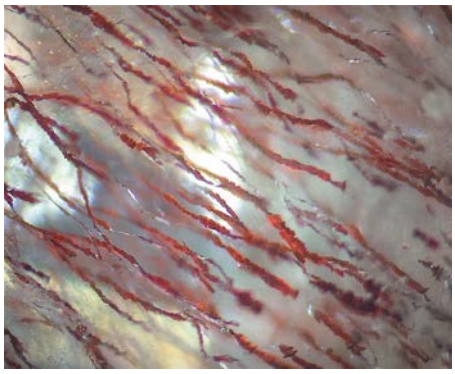
SCIENCE OR ART?

Earlier in my introduction I referred to the artistic side of photomicrography. I would like to talk a little bit more about this subject before we go further into detail about the techniques and equipment necessary to produce such images. A photograph taken through a microscope can reveal a whole new world that we maybe knew existed in theory, but did not see when looking at a stone without magnification. We have already established that in-depth knowledge of the subject is essential in order to create satisfactory images that convey the intended information. Proper illumination is also key, but I am most fascinated by the idea of taking photomicrographic images that are pleasing to the eye. This is when vision, imagination and concept come into play. With the development of digital photography and editing, images of certain inclusions and features of gems are produced with the intention of being artistic.

Mexican opal – 2.1mm FOV, with 58 images stacked for a total approximate depth of 0.48mm. Image courtesy of Danny Sanchez.



1: Fuzzy image of a chromite inclusion in a peridot.



2: Iron oxide in a faceted quartz.

In a 1997 article Robert Hughes, art critic and author, said that a work of art is something that is made with the declared intention to be a work of art and then placed in a context where it is seen as a work of art (Wallach, 1997). Going forward, I would like to take the liberty of being able to call a photomicrographic image art, as long as it fits the above criteria of aesthetics and intention. This establishes that once a gemmologist refers to his or her image as art or artistic it can be called and referred to as a work of art.

REQUIREMENTS AND EQUIPMENT

Until recently, the preferred medium for capturing images through the microscope was film, primarily due to the resolution limitations of digital cameras. In most of the important studies for this field, almost all images were produced from 35mm film, but as predicted by Koivula (2003) the limitations of film have been eliminated by digital photomicrography and this technology is now equal, and in many ways superior, to the quality of film (Renfro, 2015). With the takeover of digital cameras, photography has become much more cost effective. It is possible to capture as many images as we want at no additional expense. Camera choices can vary from something as simple as a smartphone to professional-grade DSLR cameras.

The type and choice of the microscope is vitally important. The most practical choice is a trinocular microscope to allow image capture and traditional observation simultaneously. Not the easiest to use, but binocular microscopes can be suitable too. The key component is the quality of the optics. The next important step and challenge is to adapt the digital camera to the microscope. It saves a lot of time if parfocality can be achieved, which occurs when the camera sensor is in focus at the same time as the image viewed in the microscope oculars (Renfro, 2015). When I was trying to take photographs with my smartphone camera, I had difficulties getting the image in focus as sometimes even after adjusting the microscope the image became fuzzy due to the lack of parfocality (**1**).

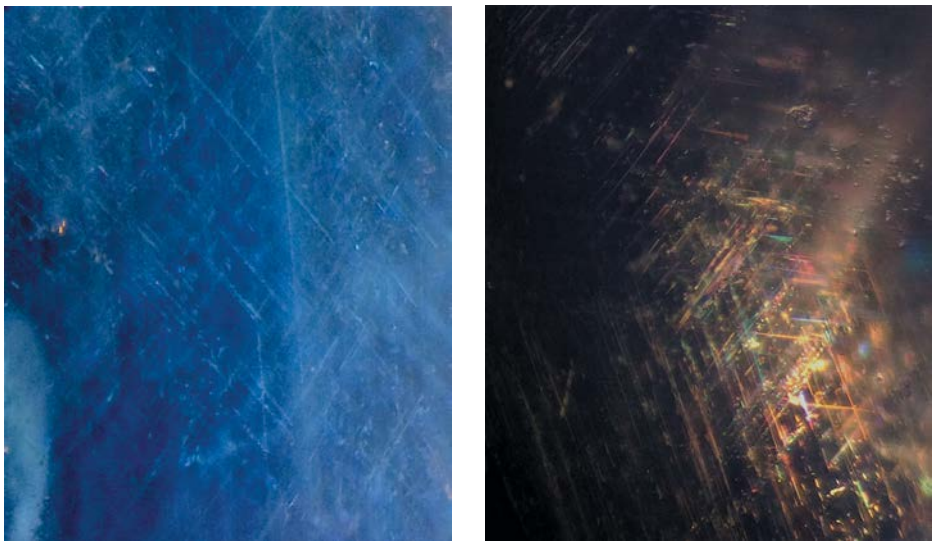
> I would like to take the liberty of being able to call a photomicrographic image art...

There are several essential practical factors that need to be considered for photomicrography. I would like to highlight a few of the most important ones:

Cleanliness: An oily or greasy lens will result in blurry or smudged images as dirt particles block light and create dark spots on the photographs. Just as importantly, specimens also have to be cleaned properly to ensure that oily surfaces and fingerprints do not diminish clarity (Gübelin and Koivula, 2005). Some gemmologists also state that gems to be photographed should have an excellent polish to get the sharpest shot possible.

Vibration control: Vibration can be either human induced or camera induced. There are two main solutions to tackle this: the first is to try and eliminate causes of movement (this may be done by making the microscope as rigid as possible), the second is to decrease the exposure time (suitable camera settings required) (Renfro, 2015).

Lighting techniques: This is arguably the most important factor in taking a good photomicrograph. In gemmology, there are typically three types of illumination techniques used: dark-field, bright-field and reflected light (or top illumination). On top of these there are several other types of modifications and environments that can greatly influence the final image. The expertise lies in knowing what technique to use for a given inclusions scene (Renfro, 2015). Oblique fibre optic illumination can reveal features that otherwise may be unseen.



3: Rutile in a Madagascan star sapphire cabochon in standard dark-field conditions (left) and using a fibre-optic lamp (right).

4: Flashes of pink, purple and orange in a fracture-filled diamond.

A relatively new technique is called differential interference contrast (DIC) that has produced some of the most vibrant colour patterns ever observed in gemmology.

Image processing: During the times when film was the preferred medium to create images, techniques like 'hot spot control' and 'quick polish' were used to capture an image as best as possible. All of these were applied during photomicrography with time consuming and difficult options to consider for analog editing afterwards (Koivula, 2003). With the wide range of post-processing tools of digital photography there are endless techniques available to improve image appearance. However, there is a fine line between natural appearance and digital over-enhancement (also called developing) and whatever the final image may be, it is recommended that images made for gemmological purposes represent inclusions as accurately as possible, while artistic images primarily created to please the eye may divert from these strict guidelines.

Another important post-processing technique is called focus stacking. There are various image stacking softwares available such as Zerene Stacker and this method can enable better focus throughout the image and an overall better depth-of-field (Prince, 2014).

MY PHOTOMICROGRAPHS

I have selected only a few of my photos that I feel are relevant to this study. I edited the images on my computer to try and create informative, accurate photomicrographs, some more artistic than others. The photos were taken between January and May 2018 using an iPhone camera and basic gemmological equipment (microscope, tweezers and fibre-optic lamp). I have chosen a simple example to start: it captures a fairly rare inclusion in quartz, iron oxide. This type of quartz is often referred to as 'strawberry quartz'. I used bright-field illumination and after a few attempts I managed to get an image that is moderately in focus (**2**).

Secondly, two images side by side to show how important fibre-optic illumination can be. I discovered this when I taking photos of a star sapphire cabochon. I decided to include these images in my paper to showcase the importance of different lighting techniques (**3**).

As diamond treatments and the synthesis of diamonds becomes a more sophisticated field, education and adequate visual material should be made available to a wider audience. Fracture filling is relatively easy to detect, however, and the following photograph shows flashes of colour in a 5.05 carat fracture-filled diamond (**4**).

I would like to include two more of my images, both taken while studying different varieties of garnet. One shows an inclusion that is specific and diagnostic to the demantoid variety, the so called 'horsetail' inclusion (**5**).

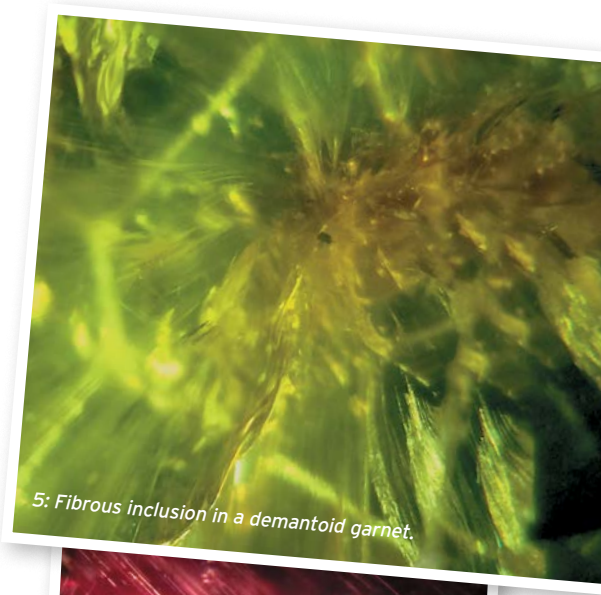
Lastly, a photomicrograph of another garnet that sums up my journey from the blurry images I started with (**2**) to this one: an example that is artistic in some ways and educational at the same time (**6**).

CONCLUSION

Taking photomicrographic images is not easy and I now have first-hand experience of that. However, it is indeed possible to produce satisfactory images even for someone with little experience or without expensive equipment. By having a standard gemmological microscope with adequate built-in lighting, a smartphone, a fibre-optic lamp and a lot of patience, anyone can succeed. ■

A full list of references and a bibliography are available upon request.

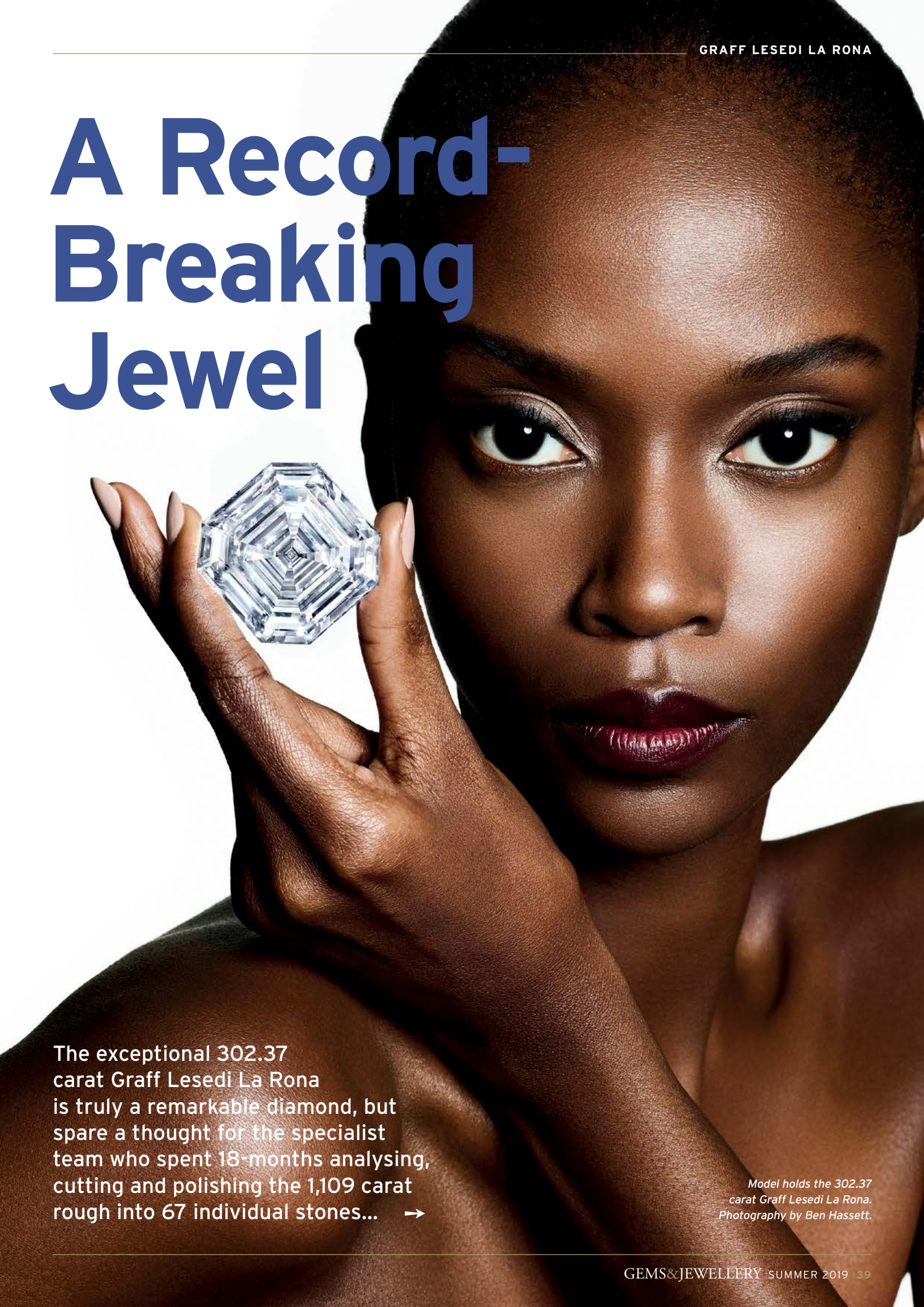
All images by David Pregun, 2018 unless otherwise stated.



5: Fibrous inclusion in a demantoid garnet.

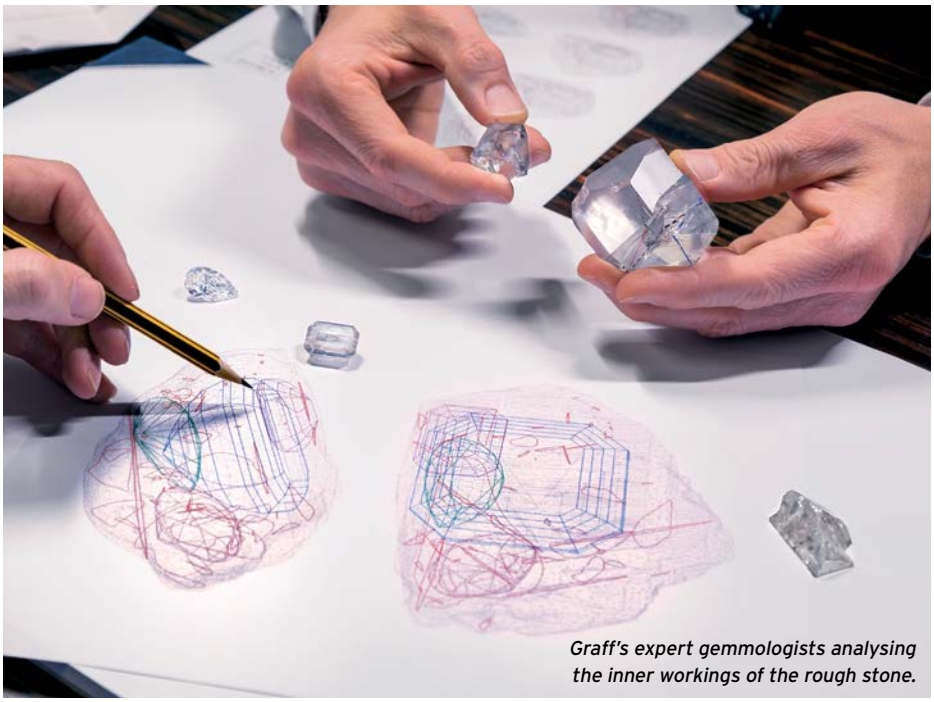
6: Rutile with a dark crystal inclusion in an almandine garnet.

A Record-Breaking Jewel



The exceptional 302.37 carat Graff Lesedi La Rona is truly a remarkable diamond, but spare a thought for the specialist team who spent 18-months analysing, cutting and polishing the 1,109 carat rough into 67 individual stones... →

Model holds the 302.37 carat Graff Lesedi La Rona. Photography by Ben Hassett.



Graff's expert gemmologists analysing the inner workings of the rough stone.

Let's start with the big one, the headline grabber, the 302.37 carat Graff Lesedi La Rona. Unveiled in April, this breath-taking diamond is the largest, D colour, highest clarity diamond ever graded by the Gemological Institute of America (GIA). It also boasts the title of being the largest square emerald cut diamond in history.

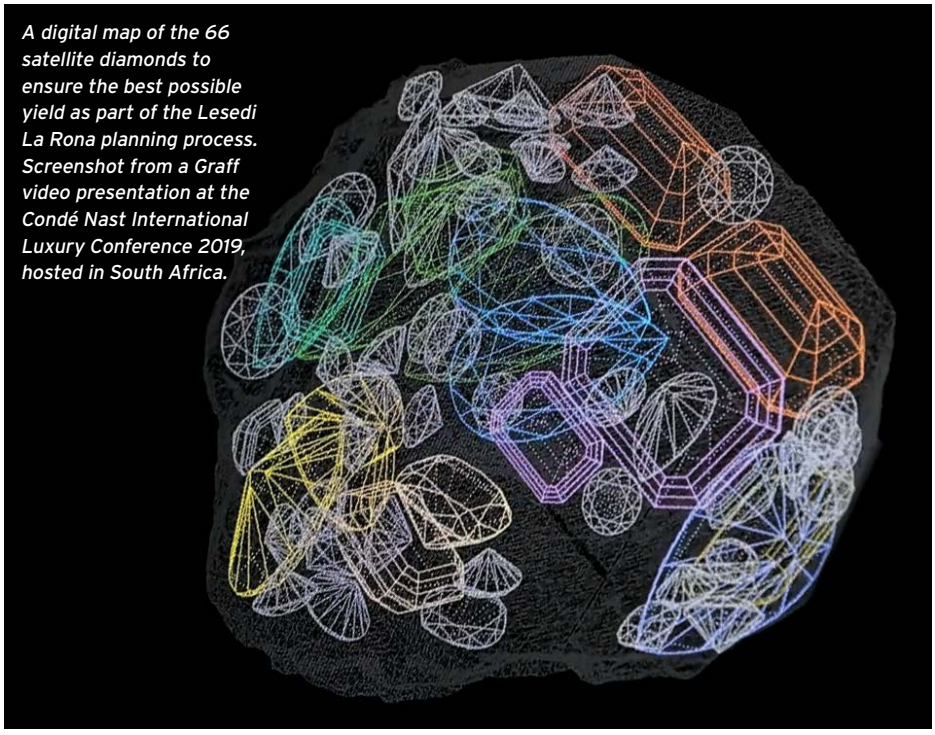
The Graff Lesedi La Rona was cut from the 1,109 carat Lesedi La Rona, with its name meaning 'Our Light' in Tswana, the official language of Botswana. It is the second largest diamond ever discovered and officially the largest gem quality rough diamond discovered in over 100 years. It was first unearthed at the Lucara Karowe mine in north-central Botswana in 2015. According to the GIA, the Lesedi La Rona is part of a group of "super deep" diamonds formed three times deeper than most other diamonds. Because of this unique geology, Graff has donated parts of the Lesedi La Rona to the Smithsonian Institute in Washington D.C. to aid in further diamond research.

Laurence Graff, the founder of Graff, negotiated with Lucara Diamond Corp to secure the stone, supposedly closing the deal "with a handshake after more than a year of negotiations" in 2017. The next challenge was deciding how to cut the stone, with Laurence Graff quoted as saying: "We had an immense duty to cut the very, very best diamond imaginable from this rough. All our expertise, skill and accomplishment went into crafting this incredible diamond masterpiece, which is extraordinary in every way."

> We had an immense duty to cut the very, very best diamond imaginable from this rough...

When Graff acquired the Lesedi La Rona, Laurence Graff noted that the "stone will tell us its story, it will dictate how it wants to be cut," which holds true from a gemmological perspective. However, Graff had some useful insights into the cutting and polishing process already... it already owned a 373 carat rough diamond that was believed to be part of the original Lesedi La Rona rough. Purchased in May 2016, Laurence Graff believed this diamond – produced under the same geological conditions – would help his team of cutters and polishers predict the behaviour of the 1,109 carat Lesedi La Rona.

Even with this insight, Graff encountered a problem almost immediately; the rough diamond was too large for its existing equipment. A scanner had to be custom built, complete with new imaging software capable of probing its expansive size. This technology allowed Graff's gemmologists to explore the diamond, mapping its maze of imperfections and using this information to carefully plot which cuts would yield the largest and highest clarity diamonds possible. The initial incisions on the stone were made using state-of-the-art lasers and overseen by a master craftsman who, according to Graff, used his training as a



A digital map of the 66 satellite diamonds to ensure the best possible yield as part of the Lesedi La Rona planning process. Screenshot from a Graff video presentation at the Condé Nast International Luxury Conference 2019, hosted in South Africa.

Laurence Graff overseeing the polishing process at Graff's cutting and polishing facility in Antwerp.

Final stages of polishing the 302.37 carat Graff Lesedi La Rona. Photography by Donald Woodrow.

All images courtesy of Graff.

classical musician and highly-attuned ear to listen for the smooth progression of the laser.

At the Condé Nast International Luxury Conference, hosted in South Africa in April 2019, Graff presented a video that offered fascinating insights into this three-dimensional diamond-mapping process. At first, technical analysis of the Lesedi La Rona suggested that cutting a diamond of 300 carats from the rough was simply not possible. Within 18-months, however, Laurence Graff unveiled the record-breaking 302.37 carat Graff Lesedi La Rona, along with a dizzying array of 'satellite' diamonds. According to the team behind the Graff Lesedi La Rona, it took hundreds of hours to polish the table facet alone.

The 66 additional diamonds secured from the Lesedi La Rona were mapped out in the rough like pieces in a jigsaw puzzle. These diamonds range in size from under a carat to in excess of 26 carats. Each one is inscribed with Graff, Lesedi La Rona and its unique GIA number, and accompanied with a certificate of authenticity from Graff and the GIA.

Speaking on the satellite diamonds, Laurence Graff said: "Cutting a diamond of this size is an art form, the ultimate art of sculpture. It is the riskiest form of art because you can never add and you can never cover up a mistake, you can only take away. You have to be careful and you have to be perfect."

Of course, British business Graff is no stranger to exceptionally large and significant diamonds. Having cut and polished many of the 20 largest diamonds discovered this century, Graff has presented such treasures as The Graff Venus (D colour flawless, Type IIa 118.78 carats, heart-shaped); The Lesotho Promise (a 603-carat diamond transformed into a 26-piece diamond necklace); The Delaire Sunrise (the largest square emerald cut fancy vivid yellow diamond in the world at 118.08 carats); The Wittelsbach-Graff (internally flawless, 31.06-carat deep-blue diamond); The Graff Pink (24.78 carat, fancy intense pink, emerald cut) and The Golden Empress (132.55 carats, fancy intense yellow). ■

To find out more, visit the Graff website at graff.com.

> These diamonds range in size from under a carat to in excess of 26 carats.

The 1,109 carat Lesedi La Rona rough diamond. Photography by Donald Woodrow.

Pioneering laser technology was used to make the first incisions upon the stone.

GEMSTONE CONVERSATIONS: AMETHYST

In the second of a four-part series, jewellery historian and valuer John Benjamin FGA DGA FIRV considers how amethyst has been used by jewellery designers throughout history.

A 19th-century amethyst-mounted gold Bishop's ring, with an octagonal-shaped amethyst set in yellow gold with the inscription 'dic' in Latin to each shoulder, which translates to 'to tell' or 'to say'.

This transparent variety of crystalline quartz is surely one of the most distinctive and recognisable gemstones ever used in decorative jewellery. It has never really declined in popularity, no doubt because of its instantly recognizable colour, its availability and, going back to earliest times, its strong association with spiritual goodness, virtuous behaviour and, as far as the Ancient Greeks were concerned, its defence against intoxication.

Setting aside its many reputed magical and talismanic benefits, amethyst's eye-catching colour had the added advantage of suggesting wealth and status, so it was perhaps inevitable that it frequently became the gemstone of choice for prosperous merchants and powerful dignitaries in Rome and Egypt. No doubt it helped that it provided the ideal medium for cutting into cameos or engraving as intaglios — lapidarists tended to favour pale lilac colour examples since they tended to exhibit greater detail than the deeper purple varieties.

Their use continued right through the Middle Ages where knobbly and irregular cabochons were often set into gold rings, ring brooches and as a decorative embellishment to the bosses of earrings and buckles. Its popularity spread throughout Europe and no doubt due to its associations with piety, humility and celibacy amethyst was adopted by the Church, becoming the gem we most closely associate with massive gold rings worn by Popes and Bishops.

A pair of Regency amethyst and gold cannetille drop earrings, the two-section earrings each centred with a pear-shaped amethyst and set with smaller amethysts.

A Neoclassical amethyst intaglio, the oval-shaped amethyst plaque engraved with a scene depicting sea nymph Nereid riding a hippocampus possibly on the way to the wedding of Poseidon and Amphitrite, with a pseudo signature for the ancient engraver Gnaois (active 40-20BC) quartered with seed pearls beneath a hinged seed pearl pendant loop in yellow gold.

By the 16th century amethyst was considered to be the ideal antidote curing everything from drunkenness to nightmares and, indeed, Mary Queen of Scots wore an amethyst to dispel her natural (and not unreasonable) tendency towards melancholia. There are a number of pale amethyst forming part of the incomparable Cheapside Hoard. These plain, oblong-shaped tablets are quite pale in colour and were generally known by the term 'Rose de France'. Early 17th century examples such as these have a wonderful 'monumental' quality especially when set as finger rings in plain gold mounts coated in solid white enamel.

Advances in diamond cutting and polishing by the middle part of the 18th century resulted in large and colourful semi-precious stones – especially amethyst, aquamarine and topaz – being

An Edwardian gold amethyst and seed pearl set necklace with pendant, the gold necklace mounted with five graduated oval-shaped amethysts with seed pearl set fringe. Suspending a detachable amethyst and graduated seed pearl brooch/pendant (one section missing).

mounted in clusters of 'old-mine' cut diamonds in the form of cushion and pear-shaped earrings, brooches, necklaces and diadems. Invariably set in silver, these gems would often be foiled at the back to reflect the light, a particular feature of the Georgian jewel at a time when much of it was being worn at formal events such as balls that were lit by twinkling candlelight in chandeliers and candelabrum. This was very much the era of experimentation in colour and amethyst was often set in bright yellow gold filigree frames known as 'cannetille work' with other compatible gemstones especially chrysolite, turquoise, half pearl and peridot.

A French amethyst and gold cased parure, comprising riviere necklace, a pair of bracelets, a pair of earrings, a brooch and comb. The necklace is set with 28 graduated oval shaped amethysts, while the hair ornament is formed with a row of slightly graduated foliate open work scrolls, surmounted with fifteen oval shaped amethysts and with a gilt metal comb section. Circa 1815.

By the early 19th century the discovery of large amethyst deposits in Brazil inevitably led to an increase of the gem on the market, no doubt helped by the fact that members of the aristocracy favoured the rich opulence of its colour. In 1837, the Russian Emperor Alexander I presented Frances, Third Marchioness of Londonderry, with a splendid set of Siberian amethyst and diamond jewels. Without doubt, these Russian specimens are the most desirable colour of all — a deep 'Imperial' purple with a distinctive red secondary hue.

Less valuable – but equally popular – amethyst continued to be used throughout the 19th century. By the Edwardian era, pale Indian specimens were the gemstone of choice for simple fringe necklaces, inexpensive brooches and pendants with seed pearl decoration. The stone dwindled in demand through the 1920s and 1930s but saw a revival in post-war 'Retro' jewellery in which larger, emerald-cut and pear-shaped specimens were often set in angular or three-dimensional combinations with other bold coloured gems including turquoise and ruby. These are very much jewellery for the purist but certainly make a dramatic impact, a good example being the amethyst, turquoise and diamond Bib Collar made by Cartier for the Duchess of Windsor in 1947.

Availability and affordability are key attributes where gemstones are concerned and through the 1960s and 1970s designer-jewellers in London such as Andrew Grima and John Donald produced striking and highly original creations using amethyst in abstract and unusual gold settings, recognising that amethyst would always be a gemstone to catch the eye and make an impression. It is the sheer beauty and versatility of this beautiful gem which has meant that it has never lost its appeal over literally thousands of years. ■

> By the 16th century amethyst was considered to be the ideal antidote curing everything from drunkenness to nightmares...

A pair of amethyst and turquoise double clips, c.1950, set with graduated emerald-cut and circular-cut amethysts and turquoise cabochons in yellow gold.

All images courtesy of Woolley & Wallis.

John C Benjamin FGA DGA FIRV is an independent valuer, jewellery historian and author of *Starting To Collect Antique Jewellery*. Find out more at johnbenjamin.co.uk

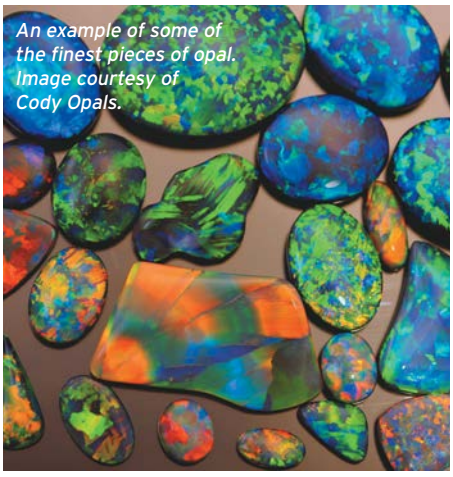
AN OPAL AFTERNOON

In April, Gem-A HQ was pleased to welcome Andrew Cody FGA (Hons), director of Cody Opal, for an afternoon dedicated to the challenging world of opal grading. Here, Gem-A tutor Barbara Kolator FGA DGA and Gem-A operations manager Charles Evans FGA DGA, share their experiences of the workshop...

Andrew Cody (far right) sharing his insights with the Gem-A team, including Charles Evans (second from left).

"WE ARE VERY PROUD TO SAY THAT ONE OF ANDREW CODY'S OPAL MASTER REFERENCE SETS IS NOW AT GEM-A HQ IN LONDON," SAYS CHARLES EVANS FGA DGA

The famous American gemmologist and former Gem-A student, Richard T. Liddicoate (okay, he also founded GIA and lends his name to the magnificent library and media centre at GIA's Carlsbad campus) is quoted as having once said that if the challenge of classifying diamonds was a '1' on the scale of difficultly, opal would be a '10'.



An example of some of the finest pieces of opal. Image courtesy of Cody Opals.

Personally, I have always thought he was being kind! When we heard Andrew Cody was in London, we asked nicely for a visit and Andrew, as generous as ever and at short notice, gave Gem-A teaching staff an afternoon of his time. After a presentation on opal, we were introduced to the Opal Master Reference Set — perhaps one of the most remarkable gemmological endeavours in our time.

Cody Opal has always been at the forefront of efforts to support and promote opal worldwide. No one has ever attempted to create a comprehensive master set for opal, but the Cody brothers – Andrew and Damian – have succeeded in doing so. The world now has 50 Opal Master Reference Sets, each with 216 stones set into nine boards. A total of 12,000 stones were selected from over 200,000 and sourced from opal localities around the world — all cut and graded to uniform perfection. The set includes simulants of opal as well as opal from Mexico, the USA, Europe, Ethiopia and Peru.

A large opal with beautiful flashes of blue and green.

We are proud to say that one of these sets is now at Gem-A HQ in London.

Set in numbered acrylic, tamper-proof boards, the opals in the Master Reference Set are classified according to their locality, type, grading and morphology. The set is accompanied by a handbook of notes that is created in such a way as to allow for the insertion of updates as times change. The hope is that labs will use terms that are recognisable and consistent, and that educational bodies will adopt uniform terms to introduce some welcome consistency throughout the industry.

> The world now has 50 Opal Master Reference Sets, each with 216 stones set into nine boards.

Embarking on a project like this means that, along the way, you get involved with creating museums, generating support among scientific and academic communities, rewriting nomenclature rules and, overall, massively raise the profile of opal among miners, dealers and consumers. It continues to be an amazing journey for the team at Cody Opal as science continues to uncover fascinating details about this amazing gemstone.

Tuscon 2020, Andrew Cody! We look forward to seeing you there.

"AS OPALS BECOME MORE EXPENSIVE AND DESIRABLE THERE IS A NEED FOR SOME SORT OF ORDER," SAYS BARBARA KOLATOR FGA DGA

We were incredibly fortunate to have Andrew Cody visit us at Gem-A to talk about opals, offer insights into his opal grading system and dispel a myth or two about these fascinating and alluring stones.

Firstly, opal is a very complex gemstone that has its origins in different geological time periods, as a result of varying methods of formation. Opals may be either cryptocrystalline or amorphous and may contain different amounts of water; some absorb water, while others do not. It is important to not lump all opals together.

For instance, some hydrophanes can vary from translucent to highly transparent according to how much water they contain or absorb. However, we were warned not to drop opals in water to demonstrate this, as increasing the stress to which the stone is subjected can cause it to fracture.

Andrew started a fantastic project to put opals into some order some years ago, as the nomenclature available was very out of date. He started by putting together an Opal Master Reference Set, comprising 216 sample stones laid out in nine separate boards. This array of opals is displayed with numbers, which can be cross-referenced in a handbook to discover further information about each specimen, as well as serving as a training tool. The set also includes synthetic and treated opals.

Part of the Opal Master Reference Set created by Andrew Cody showcasing opalised fossil specimens.

Andrew Cody shows opal specimens to Gem-A tutors, Barbara Kolator and Pat Daly (centre).

As opals become more expensive and desirable there is a need for some sort of order, especially as full disclosure is increasingly demanded by major buyers. However, how can this order be achieved when there are no grading rules to follow? Andrew, CIBJO (The World Jewellery Confederation), the American Gem Trade Association (AGTA) and The International Colored Gemstone Association (ICA) are all working towards this end.

What has been created so far? There are 10 categories that can be referenced on a report, starting with Natural, Treated, Synthetic and Imitation. Natural can then be further divided into Impervious or Absorbent. From here, considerations are made for play of colour. Other varieties may also be divided into whether they are on the host (boulder opal) or the host is mixed in with the opal (matrix). Treated opals and composites are also factored in, along with synthetics and imitation stones.

Colour in specimens is graded from N1 (black) to N9 (white), which Andrew believes will simplify opal grading and will make reporting and classifying stones more consistent. Of course, no talk from Andrew could be purely factual and he recounted some wonderful anecdotes to those in attendance, followed by a discussion of world trends. He also showed some photos of exquisite specimens, including a balanite (opalised ancient squid!) and a stunning black opal.

When asked about opal myths, Andrew gave us a handy tip... the hardness of an opal can vary from 4.8-7! That's certainly not in the textbooks. Overall, the afternoon at Gem-A HQ offered fascinating insights into the world of opals from one of the leading experts, who just so happens to be an amusing and entertaining speaker! ■

Gem-A instruments manager, Sam Lloyd with a customer.

A group of attendees admiring the work of Scotland's most eminent enameller, Maureen Edgar.

Spotlight on Scotland

Workshop attendees.

The Gem-A team enjoyed a long-weekend of talks, workshops and networking at the annual Scottish Gemmological Association Conference, hosted at Dullatur, near Cumbernauld, from May 3-6.

With a whole host of inspiring speakers, workshops and entertainment, the Scottish Gemmological Association Conference is one of the highlights of Gem-A's annual calendar. This year's event at the Westerwood Hotel in Dullatur got off to an excellent start on the evening of Friday, May 3, thanks to a talk by jewellery historian and valuer, John Benjamin FGA DGA, followed by an informal dinner and a chance to catch up with friends old and new.

The next day Gem-A board member and owner of American Gemological Laboratories, Chris Smith FGA, spoke on the topic of clarity enhancement in emeralds, swiftly followed by a fascinating talk on the 'Coming of Age' of laboratory-grown diamonds by Lucent Diamonds chief executive officer, Alex Grizenko. Also on Saturday, John Andrew, curator of the highly-regarded Pearson Silver Collection, spoke on the career of Scottish enameller, Maureen Edgar, followed by sessions by Stuart Robertson, vice-president of Gemworld International Inc., teacher and workshop facilitator, Sylvia Gumpesberger, and jewellery historian Jack Ogden.

The inspiring talks continued on Sunday, May 5, with a second session hosted by Chris Smith, and an introduction to the 'Nature of Jewels' by Clare Blatherwick, an independent jewellery consultant based in Edinburgh. In the afternoon, a range of workshops proved exceptionally popular with guests, including John Andrew's discussions on British silver and his personal collection of post WWII designer silver. Gem-A's own Pat Daly FGA also gave an insightful workshop on the topic of visual optics and showcased a nifty new hand-held device invented by a former Gem-A student, the SpectroAid. ■

Gem-A would like to thank the entire team at the Scottish Gemmological Association for hosting such an informative and entertaining weekend.

Photographer Kim Rix holding a selection of her travel guide series, 'Gemstone Detective'.

GEM-A SCHEDULE 2019

Want to say hello to us? Take a look at our upcoming schedule of trade shows and events:

AGTA GemFair
Las Vegas, May 30-Jun 3

Gem-A HQ Open Evening
London, Jul 16

IJL
London, UK, Sep 1-3

Institute of Registered Valuers Conference
Loughborough, Sep 14-16

Hong Kong Jewellery & Gem Fair
Hong Kong, Sep 18-22

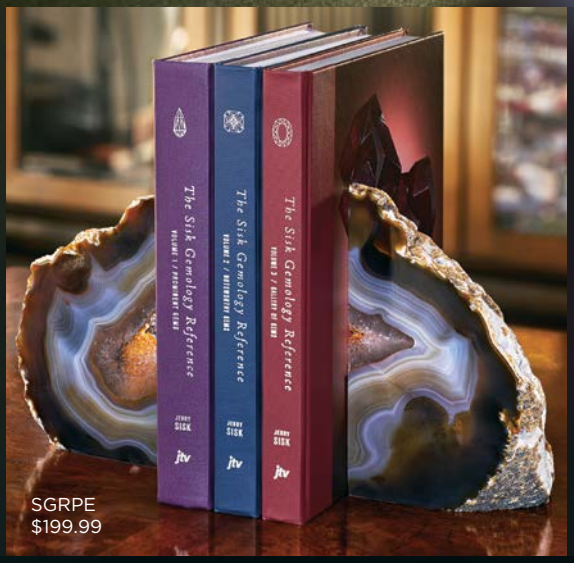
Photos courtesy of Kim Rix Photography.

SAVE THE DATE!

Gem-A Conference 2019

November 2-3

etc.venues
County Hall
London, UK



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