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# The Journal of Gemmology

The Gemmological Association and
Gem Testing Laboratory of Great Britain

# The Journal of Gemmology

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## Cover Picture

Watch set in a crystal of Colombian emerald found during excavations in Cheapside in the City of London in 1912. The crystal measures 42mm deep and 20mm across (see 'The Cheapside Hoard confusion', page 395)
*Photo: courtesy of the Museum of London.*

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# In this issue...

The topics covered in this issue of *The Journal of Gemmology* again comprise a range from the historical to the modern. The first paper concerns a rather enigmatic hoard of jewellery and jewellers' materials discovered in London in 1912. Mystery still surrounds the precise origin and recovery of the cheapside Hoard, but most of it is now on display in the Museum of London. The Hoard has been attributed to the early seventeenth century and is a fascinating assemblage of precious stones and decorative materials in a wide range of different qualities. The gemmological identities of some exceptional items augment the historical account of the discovery of the Hoard and perhaps, with the continued development of historical analysis techniques, answers may yet be forthcoming for the still unsolved aspects of the Hoard's origin.

Another source of continued speculation concerning its origin is the gem material moldavite. It is now more or less agreed that the spread of specimens over areas formerly known as Bohemia and Moravia is the result of a massive meteorite impact with the Earth in an area to the east of Stuttgart in Germany. The energy released on impact melted the local materials and in the glasses generated some very beautiful inclusions which were preserved by the quenching process. These unusual phenomena are illustrated in the paper by Anthony de Goutière.

Glass of a different nature turned up in the form of a cat's-eye cabochon among the items submitted for testing at the Bahrain Laboratory. Different synthetic corundums are also described and, considering that much of the Laboratory's work concerns natural and cultured pearls, the rather rare incidence of X-ray radiographs which depict perfect pearl structure is discussed.

Two papers on instruments highlight the continuing quest towards more reliable gem identification. One concerns development of an accessory on the well-established gem refractometer and should lead to improved speed and accuracy of refractive index readings. The second paper describes the infrared microscope and its application to certain problems difficult to solve by standard gemmological techniques.

With the rapid growth of information it becomes increasingly difficult to find the time to absorb the information of most relevance. But to absorb relevant information one must first find it or be made aware of it. After that come the processes of assimilation and assessment as to its reliability. The compilation of abstracts of current investigations can speed this process enormously and in this issue more than a hundred abstracts relating both to important aspects of gemmology and to related topics are printed.

Diamonds continue to fascinate investigators of the depths of the earth and there are abstracts of significant papers on the variety of ages of diamond and of their chemical and isotopic variation. At first sight these investigations may seem of marginal interest to gemmologists but with the increasing possibilities of encountering treatments, synthetics and imitations on the market, fundamental information of this kind could give rise to effective methods for identifying natural untreated stones.

Journals not normally seen by gemmologists from time to time contain papers of considerable gemmological interest and potential and one abstract printed here offers hope of being able to determine the origins of different ambers. *The World of Stones* is a new journal from Russia abstracted by Michael O'Donoghue and this is beginning to reflect the increased activity in gemmology in the area of the former USSR. Some of the secrets of polishing are also starting to come to light with detailed analysis of surfaces and it seems that to obtain the best results for certain stones it is crucial to find the best recipes.

R.R.H.

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# The Cheapside Hoard confusion

*James G. Gosling*

Pattingham, Staffordshire WV6 7BU

**Abstract**

A summary of the accounts of when and how the Cheapside Hoard, a collection of jewellery found in London in 1912, is given. The role of G.F. Lawrence is described but some details are shrouded in mystery. Most of the Hoard is displayed in the Museum of London and gemmological details of some exceptional items are described.

## Introduction

In the summer of 1912 a unique treasure of some 340 items was unearthed in Cheapside near St. Paul's Cathedral in London. The Hoard is believed to be the 'stock in trade' of a Jacobean goldsmith, pawnbroker or perhaps a fence who buried it, in unknown circumstances, in about 1630 and presumably was unable to return to claim it.

Most of the collection, known as the Cheapside Hoard, is now on display at the Museum of London in the Barbican, but in 1916 the treasure was divided largely between the London Museum and the Guildhall Museum - with some items going to the British Museum and some to the Victoria and Albert Museum. In 1976 the Museum of London was formed by the amalgamation of the London Museum and the Guildhall Museum which presented the opportunity of bringing together most of the Cheapside Hoard. The Hoard contains elaborate gold and enamel chains, a rock crystal chalice, polished gems and watches (see Figures 1-4), one of which is set in an emerald crystal (see also cover illustration). The collection gives a wonderful insight into the social background of the period and also raises many questions.

## Previous accounts

There appears to be no eye-witness account of the actual discovery, no record of the date nor details of the find itself. The 1928 catalogue[1] prepared by the then new director of the London Museum, Dr Mortimer Wheeler (later Sir Mortimer Wheeler, the charismatic participant of the 1950s television programme Animal, Vegetable, Mineral) has been out of print for decades and is now virtually unobtainable. However, in that catalogue reference is made to workmen digging on the site of Wakefield House at the corner of Friday Street and Cheapside, the property of the Lord Mayor of London, in 1912. A workman put his pick through a box which lay, it is said, below a chalk floor. Although the box was much decayed, it was thought to have been fitted with trays, but further details of the recovery of the treasure are lacking.

In her book *History of jewellery*[2] published in 1953, Joan Evans refers to 'The hoard from a jeweller's shop of about 1615 found beneath the floor of a cellar between St. Paul's Cathedral and the London Central Post Office in 1912.'

Another publication that refers to the Cheapside Hoard is the *Handbook of the Museum of London*[3] published in 1985. This refers to workmen demolishing an old

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*The watch* (A14162) shown on the front cover has been dated to *c.* 1610. The mechanism is badly corroded and cannot be removed without the risk of damage. The enveloping crystal (and the cover) contain the typical spiky Colombian emerald inclusions with halite cubes, liquid and gas bubbles. Colombian emeralds only became available in Europe around 1500 and this sets the earliest date for the completion of the watch.

Fig. 1. Watch set in a Colombian emerald crystal. *Photo: by courtesy of the Museum of London*

shop in Cheapside, opposite the church of St. Mary le Bow, a considerable distance from the site mentioned in Wheeler's catalogue of 1928. The workmen discovered the remains of a wooden box filled with jewellery in 1912 and the jewellery was recovered by George Lawrence visiting the public houses frequented by these workmen and buying back from them 'at a modest price' the whole collection.

The only book that deals in any detail with the Cheapside Hoard is *The treasury of London's past*[4] by Francis Sheppard published in 1991. He gives a date for the find of about 18 June 1912 when workmen were excavating a building site at the corner of Friday Street and Cheapside. They discovered 'a bucket' - rather than a box - containing what was thought by the finders to be a collection of beads. George Lawrence managed to buy 'the greater part of the find' from the men for ready cash but there appear to be no details of how this was achieved.

It appears that the initial discovery was not given any publicity. Indeed, a bitter wrangle broke out between the London Museum, which had opened to the public in April 1912, the Guildhall Museum and the Corporation of the City of London concerning the laws of Treasure Trove[5] as applied by the Corporation of the City of London. This dispute was not settled until 1916.

In his book *In search of London*[6], H.V. Morton introduces another account which has to be considered in relation to the vexed question of Treasure Trove. He states that he believed Lawrence declared the Hoard as Treasure Trove, was awarded around £ 1000 and astonished two navvies by giving them something like £100 each. Morton also gives an eye-witness account of the same two navvies handing over an immense mass of clay found in Cheapside.

> 'It was like an iron football and they said there was a lot more of it. Sticking in the clay were bright gleams of gold. When they had gone, we went to the bathroom and turned the water onto the clay. Out fell pearl earrings and pendants and all kinds of crumpled jewellery. That was how the famous hoard of Tudor jewellery which occupied a room to itself in the London Museum was discovered.'

The only public announcement that I have been able to trace appeared in *The Times* in 1914. This referred to the sudden exhibition in the London Museum of the

Cheapside Hoard which was described as having been found in the City of London.

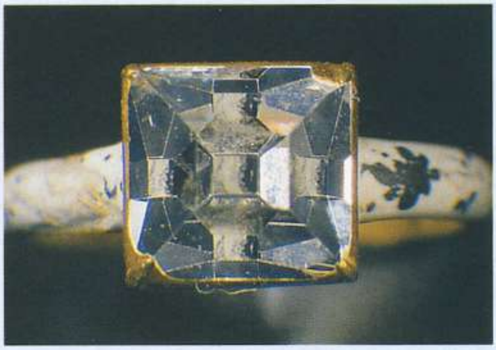
In 1991 an exhibition entitled 'Treasures and trinkets' opened at the Museum of London and in the catalogue[7] it is stated that the Cheapside Hoard was discovered in the foundations of a house in Cheapside near St. Paul's Cathedral in 1912. Many of the pieces are described in detail with illustrations. The only other major work on the Cheapside Hoard is by E.A. Jobbins[8] in which a scientific and scholarly account of some of the major items in the collection is given. Surprisingly there is no modern catalogue of this national treasure.

**G.F. Lawrence**

The key person in this mystery seems to be a vague and shadowy figure - George F. Lawrence who, with a delightful touch of nineteenth-century pedantry, called himself an 'antiquary'.

I was fortunate enough to be shown a copy of an article which was printed in the *Daily Express*[9] dated 1928 and written by H.V. Morton as a personal tribute to George F. Lawrence on his retirement, aged 67, as Inspector of Excavations from the London Museum.

It would appear that this quiet, gentle man, victimized by asthma, contributed some 15 000 objects out of the soil in the years he worked for the London Museum. He instructed the London navvies how to save anything of archaeological interest and with his capacious carpet bag and ready supply of half crowns he had become a familiar figure at all the London building sites and was affectionately known as 'Stony Jack'. The secret of his success with the navvies was that he was kindly, honest and sincere and never sent them away empty-handed. Even if they brought him something worthless he



Figs. 2a and b. Table-cut diamond. *Photo by E.A. Jobbins by courtesy of the Museum of London*

The diamond in the ring (A14244) measures 8.4 x 8.0mm with the table approximately 3.4 x 2.8mm. Although the nature of the setting makes weight estimation difficult, the stone is probably between three and four carats. The crown is table cut and the pavilion a modified 'scissors cut', but the detail was difficult to establish because of dominating reflections and the short time available for study. This stone is possibly an exceptional survivor of the old scissors cut many of which had been recut by about 1700 (personal communication, H. Tillander, 1991). The date of burial of the Hoard is commonly believed to be in the second quarter of the seventeenth century which makes it virtually certain that the diamond is of Indian origin.

would always give them the price of a pint of beer. He might have been a character created by Dickens and Morton also creates a picture of this delightful man who, in his old age, became a spiritualist to be in even more intimate contact with former ages.

Morton goes on to explain that George Lawrence had an antique shop on West Hill, Wandsworth, and many of London's workmen brought their finds to him after work. He relates that a most sensational event took place one Saturday night a few years before the 1914-18 War, when workmen arrived with a sack and spilt on the floor many great lumps of caked earth: 'We've struck a toy shop I think guv-nor!' was the comment of one navvy as he indicated various bright streaks in the earth. When the men had gone Lawrence took the earth to the kitchen and washed it. To his astonishment he saw tangled chains of Tudor design and other delicate objects. Morton then goes on to explain that the workmen returned over a period of the next month carrying knotted handkerchiefs full of jewels.

In 1937 when George Lawrence was 76 years old there was a further tribute to him by H.V. Morton in the *Daily Herald*[10] when he refers to the famous hoard of Tudor jewellery which was passed over the counter at Wandsworth wrapped in newspaper and embedded in clay.

It would certainly seem that G.F. Lawrence is one of London's unrecognized benefactors. In his article, H.V. Morton declares it was his belief that

> 'when the archaeological history of the last forty years is written "Stony Jack" will stand in this period as Roach Smith did in Victorian London. No other man has saved so many relics of ancient London for the education and pleasure of future ages.'

In his book *Still digging*[11] Sir Mortimer Wheeler - who was appointed Keeper of the London Museum in 1926 - had some harsh words to say about the general conditions of the Museum.

> 'It had to be cleaned, expurgated and catalogued; in general, turned from a junk shop into a tolerable, rational institution.'

The catalogues were published from 1927 and *The Cheapside Hoard of Elizabethan and Jacobean jewellery*[1] appeared in 1928. As late

The blue sapphire in the ring (A14245) has a hexagonal outline in a rub-over setting and measures 12.3 x 8.4mm. It displays a most unusual cut; the curved edges to the girdle facets lend support to the suggestion that it was originally cut as a cabochon. The remainder of the crown is covered with a series of small (mostly triangular) facets; the pavilion is step cut. Internally there is abundant rutile silk and pronounced hexagonal zoning at angles of 120°.

The shape, style of cutting and the mounting of this stone show a marked resemblance to the Stuart Sapphire in the English royal regalia.

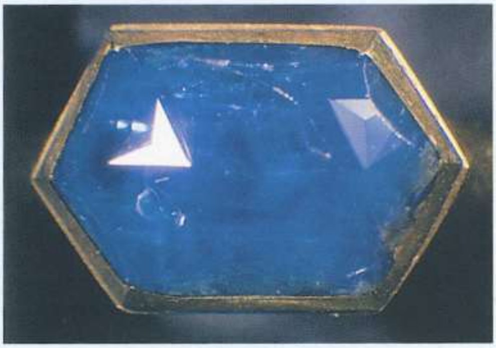


Fig. 3. Hexagonal sapphire in rub-over setting. *Photo by E.A. Jobbins by courtesy of the Museum of London*

Fig. 4a. Amethyst and emerald grape pendants. *Photo courtesy of the Museum of London*

The bunches of grapes are fashioned from amethyst (A14063-4) and emerald (A14112). At a distance the appearance is very realistic; close examination reveals an ingenious method of manufacture. It would appear that annular drills have been used to 'attack' a roughly conical or ellipsoidal piece of gem material from many angles ensuring that all the margins of the resultant borings were in close contact with each other. The material between the cylinders so-produced was then removed and the shallow cylinder ends were rounded off to produce the closely packed 'hemispherical' grapes. This method of manufacture is clearly demonstrated in Figure 4b.

Fig. 4b. Detail of the amethyst 'grapes'. *Photo by E.A. Jobbins by courtesy of the Museum of London*

as 1927 F.L. Lawrence, the son of George Lawrence, presented the London Museum with two amethysts from the Cheapside Hoard.

## Discussion

George Lawrence had been employed at the Guildhall Museum part-time, when his main job was the revision and condensation of the manuscript catalogue. In 1911 Lawrence was invited to join the staff of the London Museum to acquire newly discovered archaeological material on site for the museum. It is clear that when he joined the museum in 1926 Dr Mortimer Wheeler held George Lawrence in high regard.

It would seem reasonable to assume that in the year Lawrence retired he would have assisted Dr Wheeler with the catalogue on *The Cheapside Hoard of Elizabethan and Jacobean jewellery* and given some first-hand account of the discovery.

References to the chalk floor of unknown thickness in the cellar and to the treasures buried in the clay would seem to be quite feasible. There were a considerable number of bore holes in that area and they would have penetrated London clay before encountering any chalk, and chalk may well have been brought to the surface as a result. Alternatively it could have been transported to London as ballast in barges from chalk outcrops further down the Thames and then used to cover the cellar floor. The London clay would act as an impervious layer and keep the surface material quite wet. This would probably hasten the decay of the box and some of its contents and allow the treasure to mingle with the silty clay below the chalk floor.

## Conclusion

Clearly there is a considerable case for a new illustrated, authoritative catalogue of the Cheapside Hoard and perhaps a need to bring the whole collection together. The items of the Hoard that are in the British Museum were back on display in the summer of 1994. In the Victoria and Albert Museum seven items of the Hoard are elegantly exhibited in the Jewellery Gallery. Of these seven items the necklace was purchased by the Museum in 1921 and the other six pieces of the Hoard have been on loan from the Museum of London since that time. There are many questions still to be answered about this national treasure and some confusion to be settled but we are fortunate that the major part of the Cheapside Hoard is beautifully displayed at the Museum of London in the Barbican.

## Acknowledgements

The research for this article was undertaken by the author in response to an invitation to prepare a lecture for the Bewdley Festival. The author would like to gratefully acknowledge the contribution of illustrations and their captions by Mr E.A. Jobbins and for his assistance in discussions throughout the project.

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## Further Reading

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# Notes from the Gem and Pearl Testing Laboratory Bahrain - 4

*Ahmed Bubshait, B.Sc., FGA, and Nick Sturman, FGA, DGA*

Abstract

Much of the work of the Bahrain laboratory concerns pearls but only a small number show clearly defined growth structure on radiographs. Synthetic corundum of emerald colour and a filled synthetic ruby are described, emeralds offered for a suspiciously low price turned out to be synthetic, and a greenish-grey cat's-eye was found to be made of glass.

## Natural pearl structure

Considering that 95 per cent of the laboratory's work is related to pearl testing, it is surprising that natural pearls with very good to extremely good concentric growth structures are not seen more often on the radiographs we examine. The radiograph shown in Figure 1, however, is of a pearl submitted to us in 1994, which shows extremely good growth structure. It is the clearest example we have seen to date of the concentric structure of a natural pearl in fine detail.

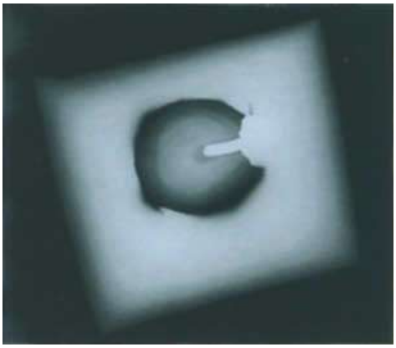

Fig. 1. This radiograph clearly shows the excellent concentric structure of a natural pearl.

It is unclear why some pearls show such good structure and others so little structure on radiographs, but perhaps the conditions experienced by the oyster during the period the pearl formed within it are the most likely cause. These conditions include such factors as water temperature, availability and type of food, disease and locality. All these factors are interrelated to some degree. The species of oyster, its age and the position of the pearl in the oyster (Gutmannsbauer and Hänni, 1994) will also influence the formation of the pearl and probably its radiographic structure. It is thought that natural pearls with very fine to extremely fine structures that are not readily visible on a radiograph, are formed under 'ideal conditions' (Farn, 1986) whereas pearls formed under less than 'ideal conditions' show more pronounced structure. This implies that a pearl with fine structure formed under conditions that changed little over many seasons, whereas a pearl with more pronounced structure reacted to seasonal changes and variation by depositing more conchiolin than calcium carbonate at certain times. Being less radio-opaque and more transparent to X-rays than calcium carbonate, it is the conchiolin that shows up as the dark concentric rings on radiographs.

## Synthetic corundum

On a recent trip to a local jeweller, one of

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the authors noticed a box of loose faceted stones being sold as glass. Amongst these variously coloured stones was one 'emerald- green' 'emerald-cut' stone weighing 1.05ct, that looked just like an emerald at first glance. On closer examination with a loupe it looked even more like an emerald, as it was faintly doubly refractive and, although clean, displayed what appeared to be green colour zoning. After informing the owner of the shop that his

Fig. 2. The curved colour bands in the synthetic green sapphire become readily apparent when the stone is immersed in methylene iodide.

'glass' was not glass, but could be something more valuable, he was only too willing to let the laboratory examine the stone on a verbal assessment basis and wait to hear the result at a later date. Back in the laboratory the identification proved to be straightforward. After obtaining refractive indices of 1.760-1.768 (birefringence 0.008, uniaxial negative), a specific gravity of 3.99, a weak but noticeable line in the red of the absorption spectrum (Hughes, 1990, p. 58), and observing minute to small bubbles and curved colour bands through the microscope (Figure 2), it was clearly apparent that, although not an emerald as hoped, the stone was not glass, but synthetic corundum. Although this colour is available in synthetic corundum, it is certainly a shade of green that is rarely encountered in normal day-to-day laboratory testing and probably even in the market place.

**A treated synthetic ruby**

In our last report from the laboratory (*J.Gemm.*, 1994, 24(1), 42-4) we mentioned a group of crackled synthetic Verneuil rubies that had some solid radio-opaque material, most probably glass, filling their surface-reaching fractures. Since examining these stones, another customer has submitted a filled crackled synthetic Verneuil ruby. The fractures in this particular stone were very interesting for two specific reasons: first the fractures showed numerous clear flattened bubbles trapped within them (Figure 3) and secondly the characteristic difference in surface lustre between the corundum and filler was very evident in virtually all the surface-reaching fractures.

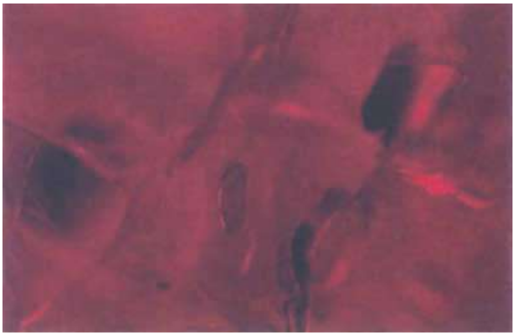

Fig. 3. A large flattened bubble trapped within one of the induced fractures in a Verneuil synthetic ruby.

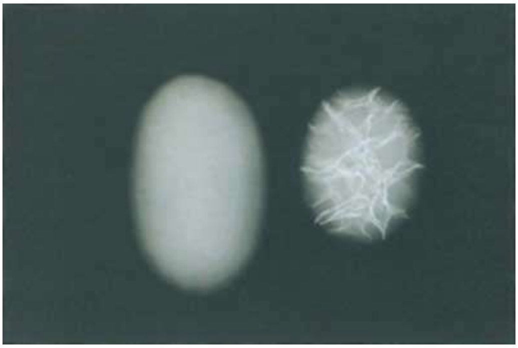

Fig. 4. This comparison radiograph clearly shows the opaque white lines running through the induced fractures of the treated synthetic ruby and the absence of these white lines in the untreated synthetic ruby.

Just for interest, we radiographed this stone with an untreated crackled Verneuil ruby for comparison (as we did with the previous stones) and the resulting image (Figure 4) clearly shows the difference between the two stones. The opaque filler can be seen as bright lines in the treated stone.

The customer who submitted this stone informed us that he purchased it on a trip to Thailand, but the stone was actually obtained in Burma, brought across the border for him to look at by the seller, and negotiations went from there.

It is not clear why some crackled synthetic Verneuil rubies have had their fractures filled. Does it really matter? With a natural stone certainly, but with a synthetic? It seems strange to think that it could have been done on purpose, unless as a trial run with a greater goal in view, maybe in order to treat more natural rubies! However, on the basis of our customer's story, it may be that someone thought the stone was a natural ruby and tried to heat-treat it in order to improve its appearance. It is already known that some natural rubies have their surface cavities and surface reaching-fractures filled with glass and, although this is thought to be an accidental result of the heat treatment process (Hughes, 1990, p. 120) in some cases, it is still considered to be an unacceptable form of enhancement. How this stone and the others we previously examined became treated in this way and whether such treatment occurred by accident is not known, but no doubt we will find out exactly how and why one day.

**Hydrothermal synthetic emeralds**

Five loose green faceted stones ranging from 0.22ct to 1.00ct were submitted to us by a customer because his suspicions were aroused when the seller asked a price per carat for them as natural emeralds that was 'too good to be true'. When the customer informed us that the dealer selling the stones wanted US$650 per carat for the stones, we too had doubts about their origin. A price of US$1500 per carat or more would have been more realistic in our view. Like most if not all laboratories we know, our laboratory does not give opinions on the values of stones or items of jewellery we examine, but we do try to keep up to date with all aspects of the trade, including market values.

During routine gemmological testing we obtained RIs of 1.569-1.575 for four of the stones and 1.565-1.570 for the fifth, a mean SG of 2.68 for all the stones and very clear spectra diagnostic of emerald. As a result there was no doubt that they were emeralds, so it only remained to determine whether they were natural or synthetic. Owing to the information given to us by the customer, the slightly low RI readings on four of the stones, the very low RI reading on the fifth stone and the low SGs obtained, we were not expecting to find any inclusions that would prove the stones were natural and indeed this was the case.

The four stones with identical RI readings all contained very similar inclusions. The main features seen were chevron type zoning (a characteristic of hydrothermal synthetics), minute white pinpoints running in trails throughout the stones (these were especially clear when immersed in benzyl benzoate and examined in dark-field lighting), clear two-phase feathers and in one particular

Fig. 5. The minute nail-head inclusion seen in one of the synthetic emeralds.

Fig. 6. The distinct zoning noted in all but one of the synthetic emeralds.

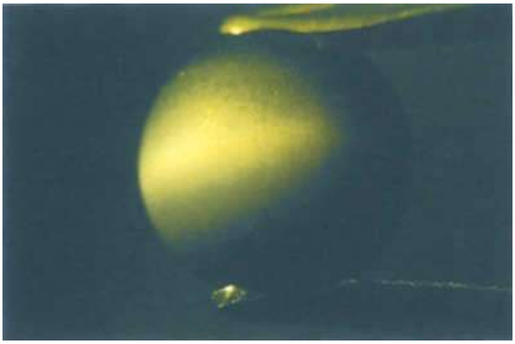

Fig. 7. The chatoyant drilled bead.

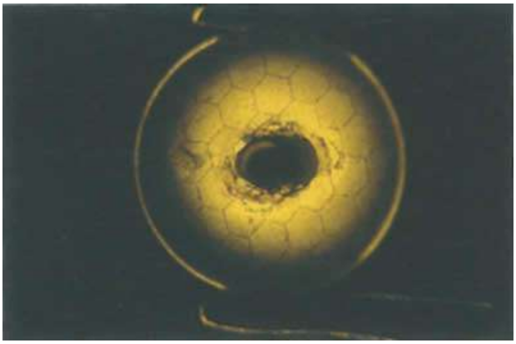

Fig. 8. The very pronounced hexagonal pattern seen down the length of the fibres.

stone a very clear (although extremely small) nail-head or spicule inclusion (Figure 5). When the chevron zoning was observed down its length rather than parallel to it, a distinct V-shaped or wedged pattern was observed (Figure 6). The fifth stone with the lowest RI reading did not contain the same types of inclusions as the other four. Instead the most obvious features were two groups of small acicular colourless crystals that each formed 'stars' (one distorted) and zoning that was more banded than chevron in form. The inclusions in this last stone are similar in some respects to those noted in some Seiko synthetic emeralds (Kennedy, 1986), whilst the features observed in the first four stones are more characteristic of Biron or Russian hydrothermal synthetic emeralds.

## Fibre optic glass bead

Recently we were asked to examine a drilled, greenish-grey chatoyant bead (Figure 7) that turned out to be fibre optic glass. Although the RI was very indistinct by the distant vision technique, a vague reading of about 1.62 was obtained. The SG of the bead was obtained with a great deal more accuracy and was found to be 3.33. A very pronounced hexagonal pattern (Figure 8) was seen when the bead was examined in the direction of the drill-hole and, as in the natural stone ulexite and other examples of fibre optic glass, print placed in contact with one end of the fibres was transmitted the length of the fibres and clearly reproduced on the surface at the opposite end. Coincidentally, the week after examining this bead we received the Summer issue of *Gems and Gemology* (Vol. 30 (2)) which contains the account (p.127) of a comparison between a fibre-optic glass cabochon and a sillimanite cat's-eye. The glass described and the bead we examined appear to be very similar.

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# The declinometer for refractometers : the latest developments

*Agustí Moliné i Sala*

Asociacion Española de Gemologia, Paseo de Gracia 64, 08007 Barcelona, Spain

**Abstract**

The declinometer is the best mechanical accessory for any gemmological refractometer because it enables the user to obtain the maximum amount of information about the stone being examined.

The following is an analysis of the modifications introduced in the current model of the declinometer and their possible uses.

## The new declinometer

A detailed description of the declinometer and its operation has been published previously (Moliné Sala, 1985). During recent years several parts of the declinometer have undergone modification in order to enhance its features. In the course of this process, the opinions and suggestions contributed by its users have been invaluable. This discussion will be limited to changes made in the current model of the declinometer.

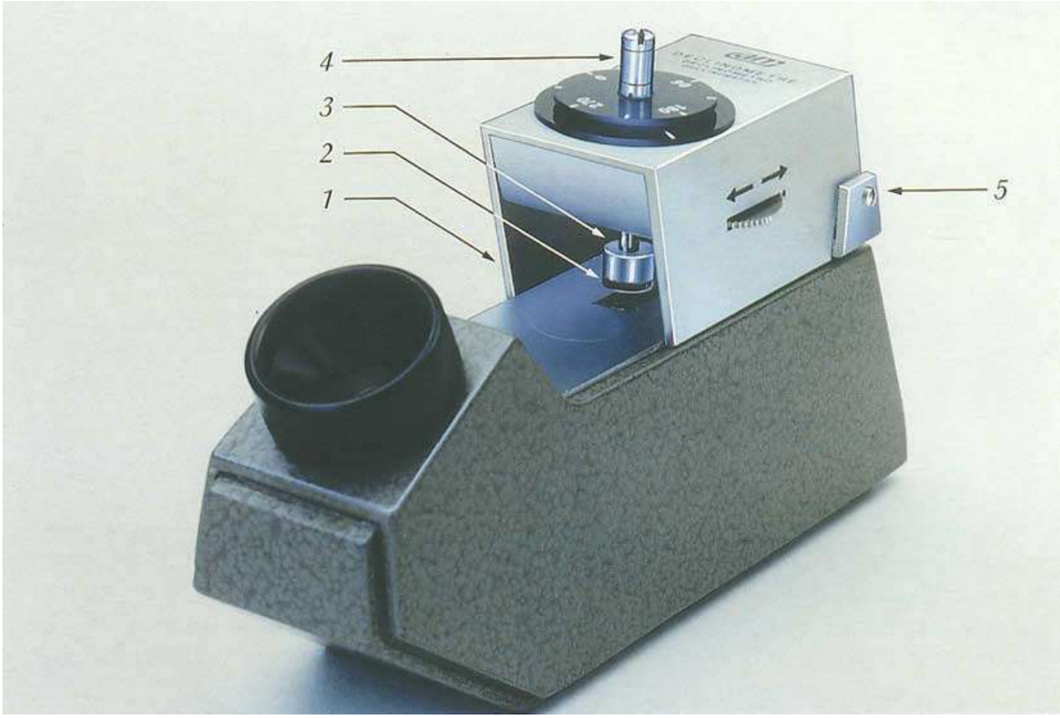


Fig. 1. The current model of the declinometer fitted on a Topcon refractometer. The numbers refer to the parts that have been modified (see the text).

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Fig. 2. The declinometer is fitted on a Rayner refractometer by means of an additional base-piece.

The improvements introduced are the following (Figure 1):

1. the sleeve/flange of the front part has been lengthened to avoid the consequences of lateral light falling on the stone being examined;
2. a new elastic pad with a grooved surface adapts better to the pavilions of the stones and makes them easier to rotate. The material used in the pad is cross- linked polyethylene foam, which is far more compact and is highly resistant to a range of chemical substances and solvents;
3. the position of the cup with the elastic pad may be vertically adjusted to adapt it for the study of very small or very flat stones. It is also advisable to readjust the height of this cup when the declinometer is attached to Rayner refractometers;
4. a small spring has been added to the main vertical shaft to strengthen the traction movement on the stone and to improve the contact between the stone and the glass of the refractometer prism;
5. the piece that attaches the declinometer to the refractometer, one of the most important parts of the device, has been completely redesigned. Each declinometer of the preceding model could only be attached to one specific type of refractometer and that was a serious drawback when the user was equipped with several different refractometers. The new piece has adjustable lugs that allow the user to fit the declinometer with equal ease on the three most frequently used types of refractometers, such as the Rayner, the Shibuya (which includes Fuji, Kyowa, System Eickhorst, Krüss, etc.) and the Topcon;
6. the middle base-piece that enables the attachment of the declinometer to the Rayner refractometer has been simplified (Figure 2). This additional piece is necessary since the hinge of the cover of

the Rayner has no vertical slots to fit the declinometer.

**Main applications of the declinometer**

The declinometer is a mechanical precision instrument which was designed, first and foremost, so that the user of a gemmological refractometer could avoid the disadvantages resulting from the movement of the stone on the refractometer prism. Any direct handling of a stone on the prism of a refractometer entails a number of problems which must be taken into account, principally related to the contact, centring and rotation. To avoid them, the user must work with extreme care. In addition, he must combine the handling of the stone with the rotation of the polarizer and also note the readings. Carrying out these processes carefully is time-consuming and, even when every precaution is taken, the results obtained with very small stones may be inaccurate.

Besides overcoming all these mechanical obstacles, the declinometer provides direct data on the optical properties of the stone. However, often the user will not need such complete information and will opt for a simplified manipulation of the declinometer using only some of its features. Two very different applications of the declinometer can be outlined, depending on the requirements of the user.

a) *A 'practical' application*
When different stones must be separated as quickly as possible, as is the situation with parcels of mixed stones, the declinometer can be used to control the movement of the stone, utilizing the three-fold feature of turning it centred, quickly and with complete contact maintained during the entire revolution. This allows gemmologists to devote their full concentration to the eyepiece. It is obvious that in such a case it is advisable to use a refractometer with an internal scale, allowing direct reading through that eyepiece.
In the vast majority of situations the gemmologist will easily obtain approximate values of the refractive indices and birefringences. The optical character and indications of the optical sign can also be detected, since the use of the declinometer eliminates the possibility that the oscillations of the shadowy lines observed are in reality due to an unsatisfactory displacement of the stone on the prism of the refractometer. The data obtained in this manner, although approximate, are sufficient for an initial selection of the stones.

b) *An 'analytical' application*
The declinometer can demonstrate its full potential for providing more accurate and more detailed data than can be obtained by any conventional procedure in which this device is not used. For this application the declinometer has two wheels positioned at the top. The main wheel is graded in sexagesimal degrees and turns together with the shaft of the device in such a way that each reading on the refractometer scale, corresponding to a direction (or 'declination') of the facet of the stone being examined, is associated with a reading in that graded wheel. The other wheel serves as the reset, zeroing or reference for the main wheel and allows the user to note the readings that are optically significant (i.e. the 'optical declinations'), corresponding to the maximum and minimum values and the inflection points of the refractive index and to the maximum birefringence. It also enables the user to take as many repeated and revised readings as are considered necessary.
The theoretical concept and the possibilities of a declinometer for refractometers have already been described by Figueras (1976). Utilizing a declinometer model, Figueras made a study of what are described as refractometric graphics. A refractometric graphic is the graphic representation of

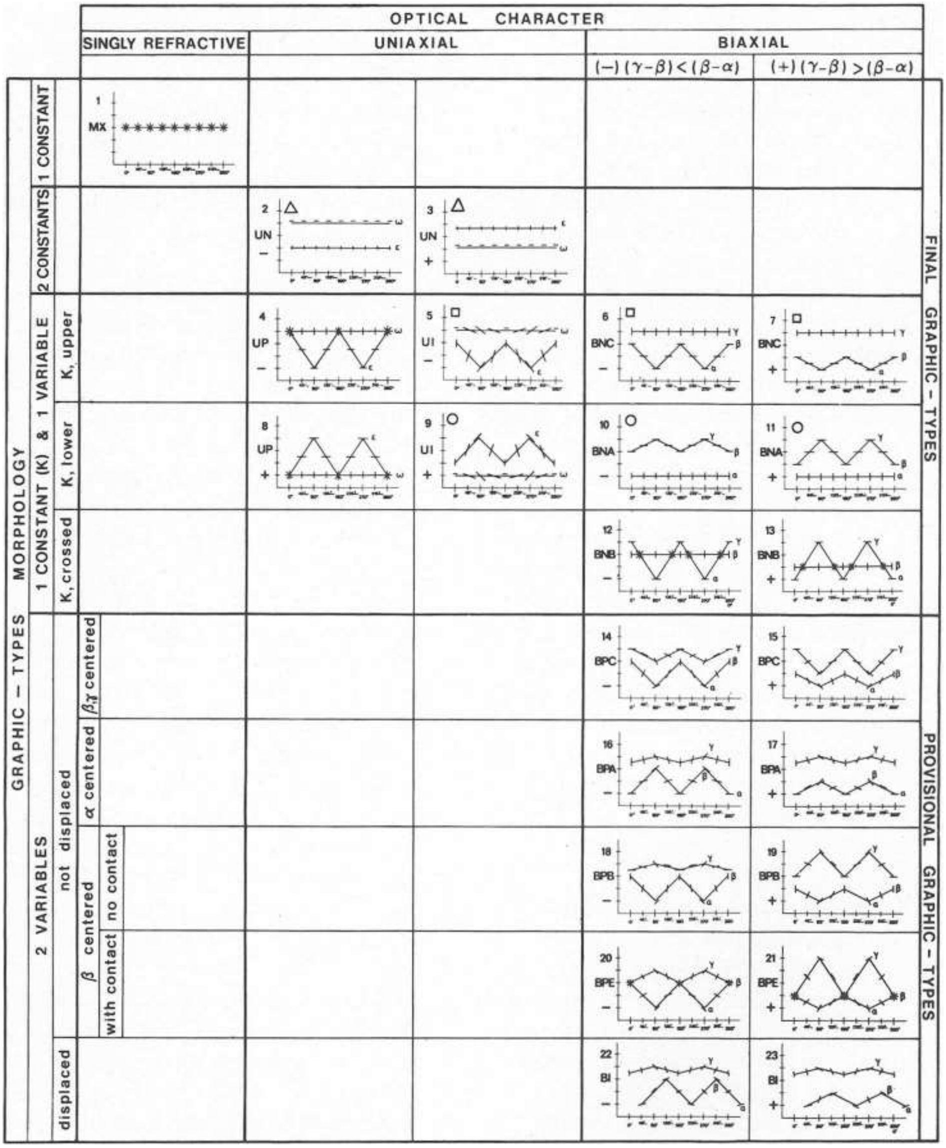


Fig. 3. Diagram of the graphic types established by J. Figueras.

the refractive indices and of the polarization traces corresponding to all the optical declinations of a facet. The polarization traces are the graphic expression of the polarization plane of the rays that determine the reading of a refractive index.

Each refractometric graphic is formed by one or two refractometric curves, deduced from a sequence of readings on rotation of the stone and through calculations with stereographic projection. Although the theoretical and real form of refractometric graphics is a continuous curve, it is easier and more functional to represent them by broken lines linking their measured points of inflexion and of single refraction. The author has established the existence of 23 types or patterns of refractometric graphics (Figure 3). This is believed to be comprehensive and that, whatever stone is being studied and whatever facet is chosen, a refractometric graphic will be obtained which is comparable to one and only one of these 23 graphic types. Further work with the declinometer is continuing.

**Acknowledgement**

The author is grateful to Mr Jordi Figueras, Director of Courses of Asociacion Española de Gemologia, for his assistance and critical reviewing of this article concerning the subject of his refractometrical theory.

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# The infrared microscope and rapid identification of gemstones

*Gao Yan, Li Jingzhi and Zhang Beili*

National Gemstone Testing Centre, Beijing, China

**Abstract**

Infrared spectroscopy is now widely used in gem laboratories to characterize natural, treated and synthetic stones. Because of technical limitations the method is not appropriate for all gems but use of the infrared microscope can widen this application. The spectrum is obtained from a beam of reflected light and characteristic spectra in the mid-infrared region analyzed. It is an important method of gem identification for stones difficult to determine with classical gem testing methods and results for diopside, kornerupine and sillimanite are discussed.

## Introduction

Infrared spectroscopy was first used in mineralogy during the 1950s. With the development of Fourier transform infrared (FT-IR) spectrometers the study of minerals became faster and easier. Initially only a few research laboratories used infrared methods for identifying gems, concentrating more on methods for distinguishing natural from treated or synthetic stones. Many of the original experimental procedures involved measurement of powders or thin slabs of material, but development of reflectance accessories enabled gems with at least one polished face to be analyzed (Martin *et al.*, 1989). The above methods are of limited use in gem identification but the infrared microscope has wider application and can provide results on gems difficult to identify by other means. The method can be used on uncut or polished gems, loose or mounted in jewellery, and is non-destructive. The reader is also referred to the reviews by Fritsch and Stockton (1987) and Fritsch and Rossman (1990).

## Principles of the method

The infrared (IR) spectrum is an indication of vibration energy levels in the atomic structure of a substance and may display a characteristic pattern for a particular substance. The fundamental vibration energies in the structures of many gemstones are located in the mid infrared region, typically between 1500 and 400cm$^{-1}$ (i.e. between wavelengths 6.67 and 25 μm) and use of reflectance techniques can detect these. The infrared absorption caused by structural vibrations is determined by bond lengths and bond angles between the atoms and has been described as the 'fingerprint zone'.

Because of the directional arrangement of atoms in many minerals, the absorption of infrared radiation may be directional. So, although the locations of the absorption peaks in the spectra should remain constant in different directions, the degree of absorption may vary. So the characteristic absorption pattern and the presence or absence of infrared pleochroism are important features of a mineral or gem.

Most natural minerals, and particularly silicates, are opaque to infrared radiation between 1500 and 400cm$^{-1}$ when of significant thickness; thus investigation of

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transmitted infrared radiation in this critical region is not possible. However with reflected radiation and the infrared microscope it is possible to obtain spectra which can be diagnostic for certain minerals. Although this science is young, infrared spectra for many substances have been published and form the basis for this method of identification.

## Instrumentation and experimental procedures

For this study the Nicolet Magna-IR 750 infrared spectrometer, an IR-plan infrared microscope and a 486 computer system were used (Figure 1). The gem to be tested was cleaned and dried and stuck with plasticine to a sample board so that it could be examined face (table facet) up on the microscope stage (Figure 2). Large samples can be placed directly on the microscope stage.

The microscope contains two light systems, one visible and one infrared. The visible system is used first to locate the sample and focus on the face or facet to be investigated. Then the infrared system is switched in and the data are collected

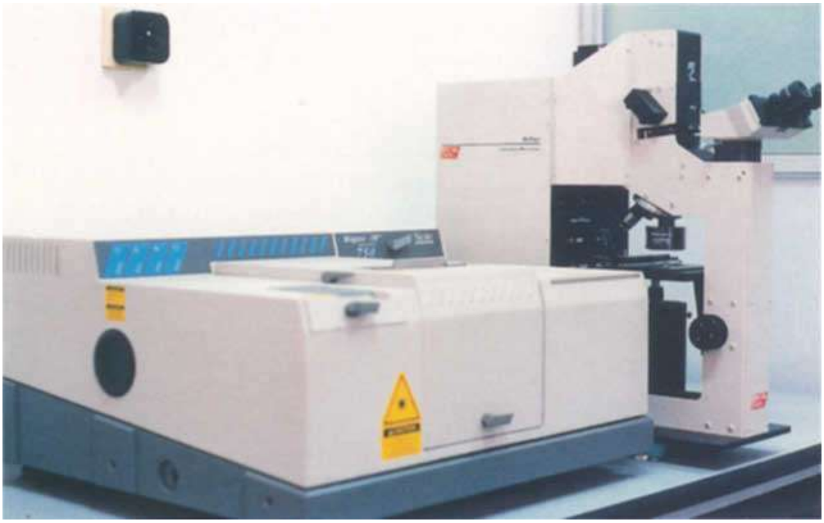

Fig. 1.
The infrared spectrometer and the infrared microscope.

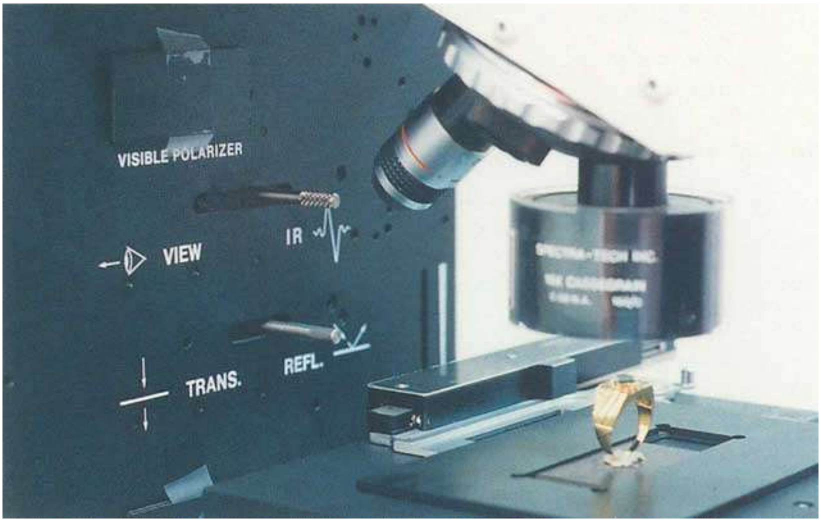


Fig. 2.
The sample stage of the infrared microscope and the jewellery stuck to the sample board with plasticine. The visible light objective lens is used to find and focus a sample and the infrared light objective is used to measure the spectrum.

using the computer. Normally the range 2000 to 400cm$^{-1}$ is scanned 64 times for each sample. Resolution is 8cm$^{-1}$ and it takes 30 seconds to measure each sample.

**Application of the method: distinction of three cat's-eyes composed of diopside, kornerupine and sillimanite**

Diopside, kornerupine and sillimanite cut and polished as cabochons may all show chatoyancy (Figure 3). Using classical gemmological methods it is very difficult to distinguish these three gems, especially if they are mounted in jewellery.

Nevertheless, they are three different minerals with different chemical compositions and structures. Diopside is $CaMgSi_2O_6$ and belongs to the monoclinic crystal system, kornerupine is $Mg_3Al_6$ (Si, Al, B)$_5O_{21}$(OH) and is orthorhombic, and sillimanite is $Al_2SiO_5$ and orthorhombic. The features of these three gems are listed in Table I, and the infrared spectra are

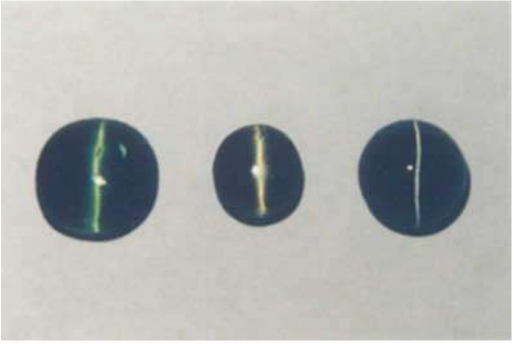

Fig. 3. The samples (from left) are diopside, kornerupine and sillimanite. All are chatoyant and similar in appearance.

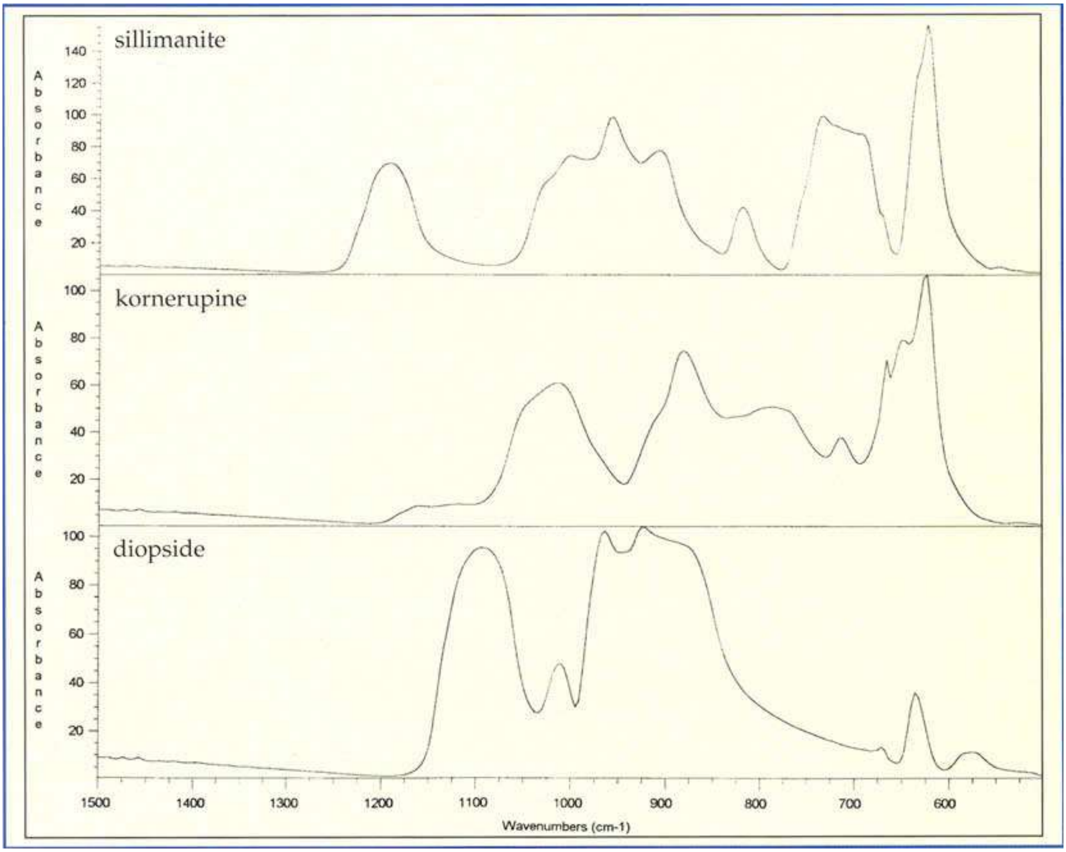


Fig. 4. The infrared reflectance absorption spectra of diopside, kornerupine and sillimanite (non-directional).

**Table I: Properties of samples of diopside, kornerupine and sillimanite**

| *Mineral name* | *Diopside* | *Kornerupine* | *Sillimanite* |
|---|---|---|---|
| Colour | Dark green | Dark brown | Brownish-purple |
| Phenomena | Chatoyancy | Chatoyancy | Chatoyancy |
| Refractive Index (spot reading) | 1.68 | 1.68 | 1.67 |
| Specific Gravity | 3.33 | 3.37 | 3.28 |
| Absorption Spectra | Not diagnostic | Not diagnostic | Not diagnostic |
| Ultraviolet Fluorescence | | | |
| LW | Inert | Inert | Inert |
| SW | Inert | Inert | Inert |
| Semiquantitative analysis by energy dispersive X-ray fluorescence (EDXRF) | | | |
| Main composition | $CaO, MgO, SiO_2$ | $MgO, Al_2O_3, SiO_2$ | $Al_2O_3, SiO_2$ |
| Trace element | Fe | Ca | Mn |

shown in Figure 4.

It is apparent from Table I that the gemmological properties of the three gems are very similar. However the different chemical compositions and structures give rise to distinctive infrared spectra which, together with the gemmological properties, are diagnostic for these gems. It is concluded that the infrared microscope is a very useful instrument for gem identification and may provide diagnostic information for gems whose other properties are similar.

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# Photogenic inclusions in moldavite

*Anthony de Goutière, GG, CG*

Victoria, BC, Canada

**Abstract**

Natural glasses in the form of tektites are found in many regions around the world. This article with accompanying photographs is intended to acquaint the reader with the unusual and very photogenic inclusions and occasional occlusions that occur in the moldavite tektites from two southern areas of former Czechoslovakia. This article also looks briefly at tektite specimens from Thailand.

## Introduction

It has been predominantly agreed that tektites were formed when large meteorites struck the earth's surface (Horn, 1985). The extremely high pressures and temperatures that were generated at the point of impact melted the hard rocks, loose overburden and soils and ejected the molten material in a direction dependent on the angle and direction of the impacting body (Bouška, 1993). The hot gases and vapour from the impact explosion threw the molten, congealing material into (and in some cases above) the atmosphere where it was fragmented into small pieces (tektites) by turbulence. Tektites have been found on most of the continents around the world and their landing sites are referred to as 'strewn fields'. The most important of these sites are: the Australian strewn field, 750 thousand years old; the North American strewn field, 35 million years old; the Ivory Coast strewn field, 1 million years old.

About 15 million years ago a massive meteorite travelling from a westerly direction struck the earth about 85 kilometres east of Stuttgart in southern Germany, forming the Nördlinger-Ries crater (Chao, 1977; Chao *et al.*, 1992). In the case of the moldavite tektites (named after the river Moldau), the molten masses that were formed as a result of this impact were thrown into the atmosphere and rained down as tektites over the southern Czech Republic in areas formerly known as Bohemia and Moravia, about 320km and 450km respectively, east of the impact site (Horn, 1985).

## Historical aspects

Moldavites have been recovered in archaeological sites in Austria and the Czech Republic, and these sites have been dated back to 30 000 BC (Hrabanek and Malley, 1988). It can be assumed that prehistoric man used these moldavites as implements and also probably as jewellery. Most of the moldavites that appear on the jewellery market today are of the strongly corroded or 'sculptured' variety. They can resemble leaves and ferns and can even look like chipped stone arrow heads (see Figure 1). Their colour can be described as translucent bottle-green. Although these sculptured specimens are heavily textured with ridges and grooves they are quite lustrous and can be made into attractive jewellery. Moldavite was quite popular in jewellery up to the end of the last century and in recent years has enjoyed a minor renaissance. Some of the sculptured mol-

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Fig. 1. Various shapes of moldavite tektites and a faceted specimen. Note the difference in the texture - in some specimens the ridges and grooves are quite deep and others have a pock-marked texture. Some of the shapes are very attractive and lend themselves to modern jewellery design.
The arrows point to the two specimens described in this paper. The length of the faceted oval stone is **14mm.** *Photo: A. de Goutière.*

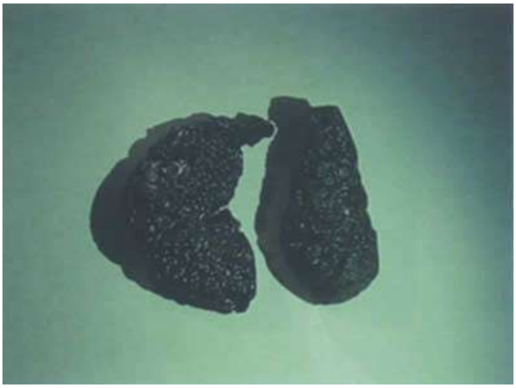


Fig. 2. Two tektite specimens, purportedly from Thailand, are not as delicate looking as the moldavite specimens, but are distinctive nevertheless. The larger specimen measures **50 x 27 x 17mm.** *Photo: A. de Goutière.*

davite has been cut into cameos, effectively combining nature's sculpting with that done by gemstone carvers. Recently, sculptured moldavite has appeared on the market as a cult talisman with attributed 'magical healing powers'.

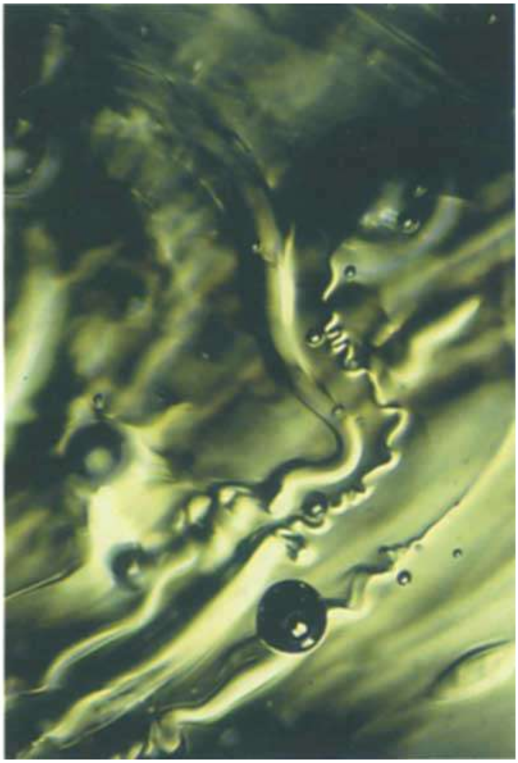
Some moldavites have been faceted and it was just such a stone that came into the author's hands recently. It is an oval modified brilliant-cut measuring 14.0 x 12.0 x 9.2mm, and weighs 6.40ct. Its colour could be described as translucent bottle-green and as a gemstone is not very attractive. However, it is the interior of this specimen that is beautiful as the accompanying photomicrographs illustrate.

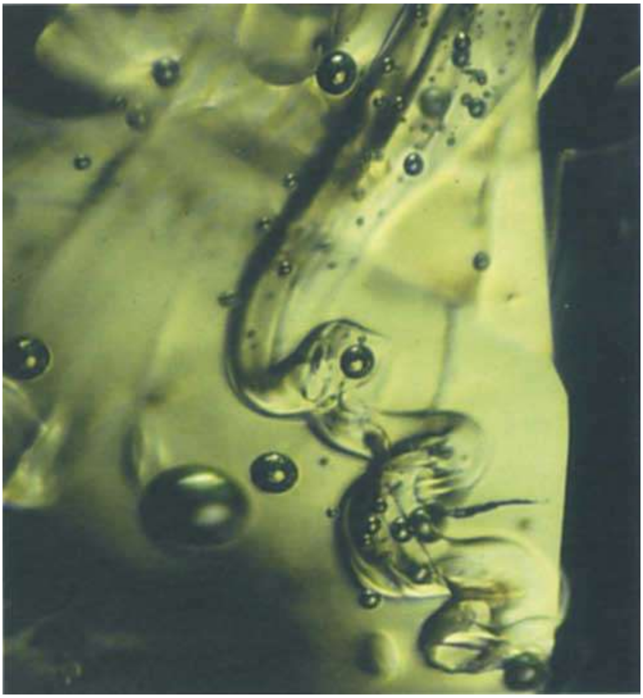
Some tektite specimens purportedly from Thailand were also examined. These particular tektites were found by miners who screen alluvial gravels in their search for rubies. The material is very dark blackish-brown with a faint translucency at the thin edges. They are more massive than moldavites and have a distinctive pock-marked surface, see Figure 2.

A 4mm thick polished slice revealed swirls in parts of the specimen and variously shaped 'Schlieren' containing small gas bubbles. Examination using crossed polarizers revealed strain but only faint interference colours when combined with the first-order red compensating filter. Figures 10 and 11 illustrate the inclusions.

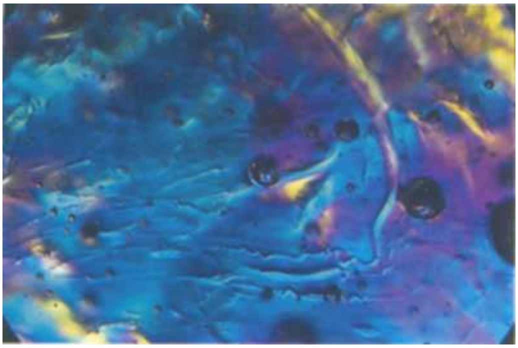
**Inclusions**

The most fascinating inclusions in moldavite glasses are the lechatelierites with their strange spiral and meandering shapes. These lechatelierite glasses are composed of pure silica and because of their higher melting point did not homogenize with the surrounding glass although they did become fluid to the extent that they were influenced by the flow of the molten glass (Bouška, 1993). Other inclusions found in moldavites are gas bubbles of various sizes, both oval and spherical in shape, and the 'Schlieren' which are elongated inclusions with a treacly appearance (Schliere is German for treacle.) These combinations of inclusions are not necessarily found in all moldavites but when present they indicate the source as probably the České Budějovice-Třebon region in southern Bohemia or the Třebic area in Southern Moravia.





Figs 3, 4 and 5.
Spiral and meandering lechatelierite inclusions and gas bubbles in moldavite. The vermicular lechatelierite inclusions resemble tendrils on a grape vine. In Figure 4 one can imagine a small bird among the vines. These three photomicrographs were taken using transmitted plus side illumination. The magnifications are 60x, 50x and 50x respectively. *Photos: A. de Goutière.*



Figs 6 and 7.
Internal strain is present in most moldavites and was obvious in this specimen under crossed polaroids. As an experiment the author inserted a first-order red compensating filter between the specimen and the lower polarizer and produced these spectacular interference colours. Slide magnifications are 14x and 40x respectively. *Photos: A. de Goutière.*

According to Bouška (1993), the refractive index of moldavite ranges from approximately 1.485 to 1.491 and the specific gravity varies from approximately 2.31 to 2.37. The hardness is approximately 5 on Mohs' hardness scale. However, the 6.40ct oval faceted specimen described in this paper has a refractive index of 1.498, higher than the figures quoted. The specific gravity, determined using the hydrostatic method and taking the average of three measurements, worked out to

Fig. 8. Hook-shaped lechatelierite occlusion on the surface of a moldavite. Dark field illumination, magnified 30x. *Photo: A. de Goutière.*

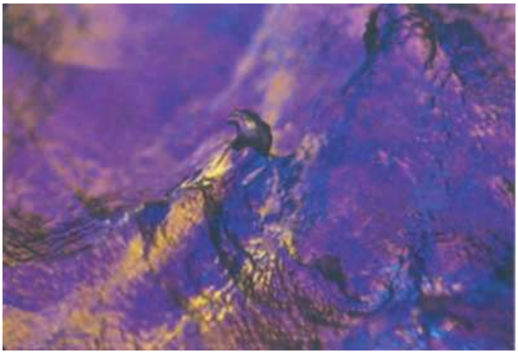
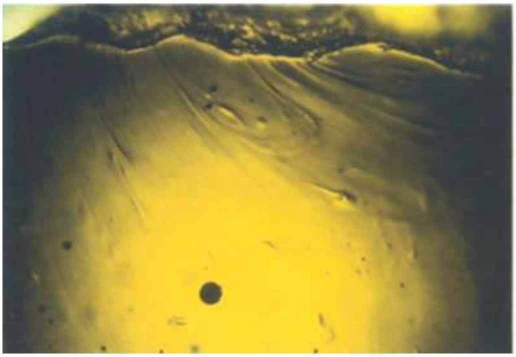
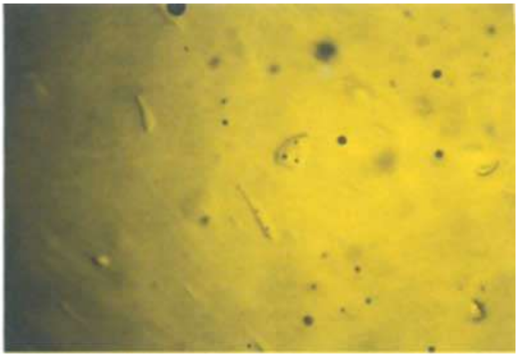


Fig. 9. Occlusion pictured in Fig. 8 from a slightly different angle. Transmitted polarized illumination plus a first-order red compensating filter. Magnified 30x. *Photo: A. de Goutière.*





Figs 10 and 11. These two photomicrographs illustrate the inclusions occurring in tektites from Thailand. There is a slight resemblance to the inclusions in moldavite especially in Fig. 10. In Fig. 11 two of the included 'Schlieren' appear to contain small gas bubbles Fig. 10 magnified 17x; Fig. 11 32x. *Photos: A. de Goutière.*

2.356 and falls within the range reported above.

The polished slice of tektite from Thailand described in this paper has a refractive index of 1.50 and its specific gravity, determined using the hydrostatic method and taking the average of three measurements, worked out to 2.955.

## Summary

Although moldavite will probably never be a particularly popular gemstone, it is a fascinating material for study. The endless variety of shapes in the sculptured specimens is intriguing and the fact that they are the direct result of a cataclysmic event that took place millions of years ago gives moldavite a certain aura of mystery.

Moldavites are readily obtainable and the author suggests that gemmologists interested in the study of inclusions should have at least one faceted (or windowed) specimen and one sculptured specimen in his/her collection. There is also the added bonus of observing the beautiful colour reactions when the moldavite is rotated between crossed polarizers in combination with the first-order red compensating filter.

## Acknowledgements

The author would like to thank Rogerio Graca and Gerry Vaulkhard of Victoria BC, and also Stéphane Salerno of Edmonton, Alberta, for supplying the specimens used to illustrate this article.

A special thanks to Dr Vladimír Bouška, Professor of Geochemistry, Charles University, Prague, Czech Republic, for research advice and for his interest in the author's photomicrographs.

I would also like to thank my referee *inconnu* for his valuable comments and suggestions in the preparation of this paper.

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# Abstracts

Diamonds | Gems and Minerals | Instruments and Techniques | Synthetics and Simulants

## Diamonds

**Interstellar grains in meteorites: I. Isolation of SiC, graphite, and diamond; size distributions of SiC and graphite.**

A. AMARI, R.S. LEWIS AND E. ANDERS. *Geochimica et Cosmochimica Acta*, **58** (1), pp 459-70.

Isolation of these three minerals involved dissolution of silicates in HF-HCl, destruction of kerogen by $Cr_2O_7^{-2}$, KOH and $H_2O_2$, with recovery of the microdiamonds as colloids. Graphite is recovered by density and size separations. Spinel is dissolved in the residue in $H_2SO_4$ leaving SiC (~6 ppm), hibonite and corundum. Size distribution measurements of SiC (0.2-6 µm) show a mainly log-normal distribution. R.K.H.

**Evaluation de la masse de Dresde Vert par calcul.**

H. ASTRIC, B. ASTRIC, H. MERIGOUX AND P. ZECCHINI. *Revue de Gemmologie*, **120**, 1994, pp 13-14, 1 photo in colour, 2 figs (1 in colour).

The mass of the Dresden Green diamond is calculated and the stone weight is given as 40.67ct. Previous calculations are summarized. M.O'D.

**Interstellar grains in primitive meteorites: diamond, silicon carbide, and graphite.**

E. ANDERS AND E. ZINNER. *Meteoritics*, **28** (4), 1993, pp 490-514.

Primitive meteorites contain a few ppm of pristine interstellar grains that provide information on nuclear and chemical processes in stars. Their interstellar origin is proved by highly anomalous isotopic ratios, varying more than 1000-fold for elements such as C and N. Most grains isolated thus far are stable only under highly reducing conditions (C/O >1), and apparently are 'stardust' formed in stellar atmospheres. Microdiamonds, of median size ~10Å, are most abundant (~400-1800 ppm) but least understood. They contain anomalous noble gases including Xe-HL, which shows the signature of the *r* and *p*-processes and thus apparently are derived from supernovae. Silicon carbide, of grain size 0.2-10 µm and abundance ~6ppm, shows the signature of the *s*-process and apparently comes mainly from red giant carbon (AGB) stars of 1-3 solar masses. Some grains appear to be > $10^9$ yr older than the Solar System. Graphite spherules, of grain size 0.8-7µm and abundance < 2ppm, contain highly anomalous C and noble gases, as well as large amounts of fossil $^{26}$Mg from the decay of extinct $^{26}$Al. They seem to come from at least three sources, probably AGB stars, novae and Wolf-Rayet stars. R.H.J.

**Investigations modernes du diamant vert de Dresde et interprétation des résultats.**

G. BOSSHART. *Revue de Gemmologie*, **121**, 1994, pp 4-12, 7 photos (5 in colour).

## ABSTRACTORS

| | | | |
|---|---|---|---|
| **P. Browne** | **P.Br.** | **M. O'Donoghue** | **M.O'D.** |
| **C.H. Donaldson** | **C.H.D.** | **R.J. Peace** | **R.J.P.** |
| **H. Effenberger** | **H.E.** | **K.A. Riggs** | **K.A.R.** |
| **K. von Gehlen** | **K.v.G.** | **P.G. Read** | **P.G.R.** |
| **R.K. Harrison** | **R.K.H.** | **R.E. Samson** | **R.E.S.** |
| **R.A. Howie** | **R.A.H.** | **E. Stern** | **E.S.** |
| **R.H. Jones** | **R.H.J.** | **I. Vesselinov** | **I.V.** |
| **M. Lagache** | **M.L.** | **J.A. Zilczer** | **J.A.Z.** |

For further information on many of the topics referred to consult *Mineralogical Abstracts* or *Industrial Diamond Review*.

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The Dresden Green diamond was subjected to laboratory examination, the full results of which are given. The stone is classified as Type IIa.

M.O'D.

**A preliminary study of $^{15}N/^{14}N$ in octahedral growth form diamonds.**

S.R. BOYD AND C.T. PILLINGER. *Chemical Geology*, **116** (1-2), 1994, pp 43-59.

The $\delta^{13}C$, $\delta^{15}N$ and N concentrations have been determined in 43 octahedral diamonds from South Africa, Australia and North America. The N in 'high-$\delta^{13}C$' diamonds was generally depleted in $^{15}N$ relative to atmospheric N, similar to the results obtained previously from fibrous diamond. It is believed that the volatiles from which these diamonds grew are primitive, being derived from a source located beneath the continental lithosphere. The 'low- $\delta^{13}C$' diamonds contained N generally enriched in $^{15}N$ relative to air. It is suggested that the major C isotope heterogeneity within the mantle, as represented by diamonds such as these, is located in deep, mechanically unstable regions of the continental lithosphere. The isotopic compositions of both C and N are consistent with this heterogeneity resulting from the subduction of crystal material, though isotope fractionation related directly to diamond growth cannot be ruled out. R.E.S.

**The story of Russian diamond occurrences.**

W.E. BOYD. *Canadian Gemmologist*, **15**(1), 1994, pp 8-13, 2 photos.

Report of a visit made to the Siberian diamond fields in 1993 with notes on production and occurrence. M.O'D.

**On the importance of fluids for diamond growth.**

P. DEINES AND J.W. HARRIS. *Mineralogical Magazine*, **58A**, 1994, pp 219-20.

A systematic investigation of carbon isotope geochemistry and sulphide inclusion chemistry is undertaken for diamonds from southern Africa. Specimens are taken from deposits at Koffiefontein, Orapa, Premier, Roberts Victor, Jagersfontein, Sierra Leone, Star mine, Mwadui and Alamasi. Data are used to determine the role of fluids in diamond formation. M.O'D.

**[Mineralogical criteria for determination of diamond content in kimberlites.]** (Chinese with English abstract)

Z. DONG, A. CONG AND Z. HAN. *Mineral Deposits*, **12 (1)**, 1993, pp 48-54.

In kimberlites diamond is associated with pyrope, picotite, ilmenite, clinopyroxene and olivine, whose physical and chemical properties partly reflect their high T-P formation conditions. The higher the *a*, D, $Cr_2O_3$, Cr/(Cr + Al), ($Mg_3Cr_2Si_3O_{12}$) and Cr component in pyrope, the higher the content of diamond in the kimberlites. Picotite from diamond-rich kimberlites contains higher $Cr_2O_3$, Cr/(Cr + Al), Cr/(Cr + Al + $Fe^{3+}$), $MgCr_2O_4$, and Cr than that from diamond-poor kimberlites. The lower the IR absorption frequencies of pyrope and spinel in kimberlites, the higher the content of diamond in kimberlites. With increasing MgO, $MgTiO_3$ and $Cr_2O_3$ in metacrystalline and coarsely-crystallized ilmenite, the diamond content of kimberlites tends to increase. Compared with clinopyroxene in diamond-poor kimberlites, clinopyroxene in diamond- rich kimberlites contains lower (Ca/(Ca + Mg), Ca/(Ca + Mg + Fe) and tschermak molecule, but higher Mg/(Ca + Mg + Fe), $Cr_2O_3$ and $Al^{[vi]}/Al^{[iv]}$. Olivine in diamond-bearing kimberlites is rich in MgO, $Cr_2O_3$ and NiO. R.E.S.

**Isotopic composition of lead and its use to date Siberian kimberlites.**

N.N. FEFELOV, S.I. KOSTRAVITSKIY AND N.V. ZARUDNEVA. *Akademia Nauk Russian Doklady, Earth Sciences Section*, **321A**(9), 1994, pp 186-9.

The isotopic data are tabulated, plotted and discussed. In the Malaya Botuobuya field the age of the Mir pipe is 362 m.y., the age of the Anomaliya-21 is 360 m.y. and the age of the Internatsionanalaya pipe is 450 m.y. The Aykhal pipe has an age of 344 m.y. The Udachnaya pipe has an age of 348 m.y. In the Daldyn-Alakit field the Lipa pipe has an age of 352 m.y. The veins of the Ingashi field have an age of ~1250 m.y. or a Rb-Sr age of 1268 m.y. K.A.R.

**Carbon-isotope composition of diamonds from Arkhangel'sk-Region kimberlite pipes.**

E.M. GALIMOV, O.D. ZAKHARCHENKO, K.A. MAL'TSEV, A.I. MALKIN AND T.A. PAVIENKO. *Geochemistry International*, **31**(8), 1994, pp 71-8, 3 figs.

The Arkhangel'sk diamond region in the north of European Russia is a recent discovery. The carbon isotope composition of diamonds obtained from kimberlite pipes in the region is examined and the value of $\delta^{13}C$ ranges from -2.9 to -22.2‰ but with most specimens showing values greater than -10‰. The $\delta^{13}C$ distribution is similar to that for diamonds world-wide but is different in detail from those for diamonds in other regions. The carbon isotope composition is related to the morphology of the diamond with the widest range of $\delta^{13}C$ occurring in dodecahedroids. Stones containing inclusions characteristic of eclogite paragenesis are on average isotopically lighter than those containing ultrabasic paragenesis-type inclusions. The diamonds examined were found at the Zolotitsk kimberlite field. M.O'D.

**The origin of diamonds in western Minas Gerais, Brazil.**

G.M. GONZAGA, N.A. TEIXEIRA AND J.C. GASPAR. *Mineralium deposita*, **29**, 1994, pp 414-21, 3 maps.

Diamonds are found in an alluvium/colluvium in the Brasilia Orogenic Belt, western Minas Gerais, Brazil. The age of the Belt is estimated at 700-450 m.y. The relationship between diamonds and a variety of formations is discussed. Analysis of the field relations shows that the majority of the diamonds were transported by glacial events from the São Francisco craton further east.

M.O'D.

**Lower mantle mineral associations preserved in diamonds.**[1]

B. HARTE AND J.W. HARRIS. *Mineralogical Magazine*, **58A**, 1994, pp 384-6

Minerals with (Mg,Fe)O composition are found in inclusions in some natural diamonds and it is possible that these originated in the lower mantle. The question is discussed with reference to diamonds from São Luiz, Brazil.

M.O'D.

**Trace element characteristics of the lower mantle: an ion probe study of inclusions in diamonds from São Luiz, Brazil.**[1]

B. HARTE, M.T. HUTCHISON AND J.W. HARRIS. *Mineralogical Magazine*, **58A**, 1994, pp 386-7, 1 fig.

Diamonds are found in an alluvial deposit at São Luiz, Matto Grosso, Brazil. They contain syngenetic inclusions of 50-400 μm diameter, indicating parageneses stable at pressures corresponding to the transition zone and lower mantle. One suite of these inclusions shows majorite garnet coexisting with calcic pyroxene while another, discussed in the paper, shows periclase-wustite probably existing with $CaSiO_3$ and $(Mg,Fe)SiO_3$. M.O'D.

**Diamondiferous eclogites from Udachnaya: a subducted component in the Siberian upper mantle.**[1]

D.E. JACOB, E. JAGOUTZ, D. LOWRY, D. MATTEY, M. ROSENHAUER AND G.P. KUDRJAVTSEVA. *Mineralogical Magazine*, **58A**, 1994, pp 448-9, 1 fig.

Eight diamond-bearing bimineralic eclogite xenoliths from the Udachnaya mine, Yakutia, Siberia, were investigated to establish major element content and oxygen isotopic ratios with a view to extending knowledge of Siberian mantle history and to compare it with that of the South African craton. The aim was also to examine the homogeneity of eclogite-forming processes on a global scale. M.O'D.

**Chemical properties of Central African carbonado and its genetic implications.**

H. KAGI, K. TAKAHASHI, H. HIDAKA AND A. MASUDA. *Geochimica et Cosmochimica Acta*, **58**(12), 1994, pp 2629-38.

Analyses are reported of alluvial carbonado stones from the Central African Republic; these are aggregates of polycrystalline diamond particles with non-carbonaceous inclusions. The results include photoluminescence spectra, thermal (TG-DTA) data, IR spectra, *REE* elemental and isotopic analyses. On the basis of spectral profiles three groups are identified with very intense photoluminescence bands resulting from radiation-damaged defects. Group B carbonado has been exposed to a higher *T* than Group A; the transition from Group A to B arose between 400-500°C. Group A carbonado has a narrow exothermic peak at 800°C while Group B has a broad exothermic band at 790°C. An absorption band at 1384cm$^{-1}$ in IR spectra indicates $N_2$ platelets in the diamond lattice. Crystallization of microdiamond by high *P* and *T* in the upper mantle was followed by binding of the microcrystals in the crust under U and Th irradiation, with hydrothermal etching causing a range of the physio chemical properties identified. R.K.H.

**An update on filled diamonds: identification and durability.**

R.C. KAMMERLING, S.F. MCCLURE, M.L. JOHNSON, J.I. KOIVULA, T.M. MOSES, E. FRITSCH AND J.E. SHIGLEY. *Gems & Gemology*, **30**(3), 1994, pp 142-77, 2 tables, 43 illus. in colour.

This is an important review with very impressive colour photomicrographs. It was centred on the products from Yehuda/Diascience, Koss & Shechter Diamonds (Genesis II), and Clarity Enhanced Diamond House (a subsidiary of

Goldman Oved Diamond Co.). Treated diamonds from all three firms were purposely damaged by direct heating and by repolishing facets intersected by filled breaks. Some stones were adversely affected by some standard cleaning procedures and wear conditions. Lead-containing filling materials could be detected by X-radiography and EDXRF spectroscopy but it was found that flash effects were the most distinctive characteristic of fracture filling. The increased proliferation of filled diamonds (as small as 0.02ct) is a cause of concern as detection is essential and the initial reported durability of these fillings has been challenged.

None of the Koss treated stones showed any signs of 'easily detected fluorescing filler' reported in the trade press. Treated by two differing fillers viz. halogen glasses and halogen-oxide glasses, the results showed that the apparent clarity improvement was of a variable nature. (Some doubt was thrown on the 'typical nature' of these stones from examination of stones obtained by a third party.) In brightfield illumination blue and green flashes predominated whilst in darkfield illumination orange and pink flashes predominated although other spectrum colours except green were seen.

Examination of Goldman Oved treated stones showed an improvement in apparent clarity in all cases and the apparent colour grade was not lowered as in some of the Koss stones. Flash colours typically of the Goldman Oved stones are bluish-green and yellow in brightfield illumination and for darkfield illumination violet, purple and pink.

Earlier Yehuda treated-diamonds showed the filler to have a light brown to brownish-yellow or orange-red colour. Later filled stones showed no such colouring but the most recent specimens showed a noticeable yellow body colour of the filler. This filling treatment was found to lower the apparent colour grade in some cases. Also encountered were areas of reduced transparency, a white cloud effect.

Fracture-filling treatments of all three firms could be detected by use of a normal binocular gemmological microscope together with suitable lighting techniques. Durability tests showed that commonly employed cleaning techniques could damage the filler as would direct heating. In view of the limited scope of the 'destructive testing' employed it was advised that filled stones be treated with due caution. R.J.P.

**Zircon from the mantle: a new way to date old diamonds.**

P.D. Kinny and H.O.A. Meyer. *Journal of Geology*, **102**, 1994, pp 475-81, 1 photo, 1 map.

A very small single inclusion of zircon in a diamond from a kimberlite at Mbuji Mayi, Zaire, was identified by the SHRIMP U-Pb method. Diamonds from this locality are a composite suite of contrasting compositions, ages and origins, including stones from characteristic ultramafic and eclogitic parageneses as well as diamonds with a fibrous coating which formed in equilibrium with a volatile-rich fluid phase. The zircon and diamond are thought to have formed together and the probable age (628±12Ma) is the youngest found so far from a diamond originating in the upper mantle. M.O'D.

**Gem News.**

J.I. Koivula, R.C. Kammerling and E. Fritsch. *Gems & Gemology*, **30**(2), 1994, pp 122-32, 1 table, 18 illus. in colour.

A second major upgrade will soon be completed at the Argyle mine. This is to maintain the level of diamond production over the remaining seven year life of the open-pit operation. Projected 1994 production is 39 million carats. Only 5 per cent is of gem quality but this generates 50 per cent of the revenue. De Beers' rough diamond sales were 41.5 per cent higher than the second half of 1993. Komdragmet, the Committee on Precious Metals and Gems of the Russian Federation offered 114 000 carats of rough for sale as part of the trading arrangement with De Beers. To double its production of polished diamonds several new units have been introduced by SKTB Kristall of Smolensk. Diamondiferous kimberlite pipes have been found in the North West Territories in Canada outside the 'Corridor of Hope' and should encourage further investigations. Although shallow alluvial reserves at the Ghana Consolidated Diamond Mines operation at Akwatia are nearing exhaustion there are substantial deep alluvial deposits being mined in the Birim River Valley.

In Zimbabwe the recovery plant at the River Ranch diamond mine will be upgraded to increase annual production from 130 000 carats to 300 000 carats for proven reserves of at least fifteen years. R.J.P.

**Some facets of diamond research.**

A.R. Lang. *Mineralogical Society Bulletin*, **104**, 1994, pp 3-6.

The paper reviews current thinking on the formation of diamond, diamond synthesis, the role of nitrogen impurities, electron microscopy of natural diamond coatings and the natural and artificial coloration of diamonds. There is a 22-item list of references. M.O'D.

**Diamant-vorkommen und Diamant-Produktion.**

A.A. LEVINSON, J.J. GURNEY AND M.B. KIRKLEY. *Mineralien Welt*, **5**(6), 1994, pp 17-38, 15 photos (12 in colour), 6 maps, 4 figs (1 in colour).

Survey of current diamond production with maps and discussion of world deposits. Crystals characteristic of some deposits are illustrated. M.O'D.

**Evidence for stable isotope and chemical disequilibrium associated with diamond formation in the mantle.**[1]

D. LOWRY, D.P. MATTEY, C.G. MACPHERSON AND J.W. HARRIS. *Mineralogical Magazine*, **58A**, 1994, pp 535-6.

A record of mantle conditions during diamond growth is preserved by syngenetic inclusions in the diamond. Very small samples of such inclusions can now be analysed by laser ablation techniques for the microanalysis of oxygen isotopes in silicates. M.O'D.

**Die Russischen Diamanten.**

V. NESENZEW. *Lapis*, **19**(11), 1994, pp 16-19, 7 photos (3 in colour), 1 fig.

Short account of the history and current conditions of diamond mining in the former USSR and in present-day Russia. At least one Siberian pipe mine extends to 1000m in depth. M.O'D.

**The characterisation and origin of graphite in cratonic lithospheric mantle: a petrological carbon isotope and Raman spectroscopic study.**

D.G. PEARSON, F.R. BOYD, S.E. HAGGERTY, J.D. PASTERIS, S.W. FIELD, P.H. NIXON AND N.P. POKHILENKO. *Contributions to Mineralogy & Petrology*, **115**(4), 1994, pp 449-66.

Graphite crystals in peridotites, pyroxenites and eclogite xenoliths from the Kaapvaal craton of southern Africa and the Siberian craton, Russia, have XRD patterns and Ramon spectra characteristics of highly crystalline graphite of high-$T$ origin and are interpreted to have crystallized within the mantle. Thermobarometry on the graphite peridotite assemblages using a variety of elemental partitions and formulations yeild estimated equilibration conditions that plot at lower $T$-$P$ than diamondiferous assemblages. Moreover, estimated $P$-$T$ for the graphite peridotites fall almost exclusively within the experimentally determined graphite stability field, and thus no evidence is found for substantial graphite metastability. The C isotope composition of graphites in peridotites from this and other studies varies from $\delta^{13}C_{PCB}$ = -12.3 to -3.8‰ with a mean of -6.7‰; this mean is within one standard deviation of the -4‰ mean displayed by diamonds from peridotite xenoliths, and is identical to that of diamonds containing peridotite-suite inclusions. The C isotope range of graphite and diamonds in peridotites is more restricted than that observed for either phase in eclogites or pyroxenites. The isotopic range displayed by peridotite-suite graphite and diamond encompasses the C isotope range observed in mid-ocean ridge basalt (MORB) and ocean island basalt (OIB). Similarity between the isotopic compositions of C associated with cratonic peridotites and the carbon (as $CO_2$) in the oceanic magmas (MORB/OIB) indicates that the source of the fluids that deposited C, as graphite or diamond, in cratonic peridotites lies within the convecting mantle, below the lithosphere. Textural observations provide evidence that some of the graphite in cratonic peridotites is of sub-solidus metasomatic origin, probably deposited from a cooling C-H-O phase permeating the lithosphere along fractures. Graphite in mantle-derived xenoliths appears to be restricted to Archean cratons. P.Br.

**Re-Os isotope evidence for a mid-Archaean age of diamondiferous eclogite xenoliths from the Udachnaya kimberlite, Siberia: constraints on eclogite petrogenesis and Archaean tectonics.**[1]

D.G. PEARSON, G.A. SNYDER, S.B. SHIRLEY, L.A. TAYLOR AND N.V. SOBOLEV. *Mineralogical Magazine*, **58A**, 1994, pp 705-6, 1 fig.

The Re-Os isotope system has been used to define the age of a well-characterized suite of eclogites from the Udachnaya diamond kimberlite pipe in Yakutia, Siberia. M.O'D.

**Kimberlites and diamond exploration in the Slave Structural Province, NWT.**

J. PELL. *Canadian Gemmologist*, **15**(3), 1994, pp 67-73, 2 maps.

Diamonds and diamondiferous kimberlites are described from the Lac de Gras region in the central Slave Structural Province of the

Northwest Territories, Canada. Notes on the establishment of mines are given. M.O'D.

**Diamonds and De Beers.**

P.G. Read. *Mineralogical Society Bulletin*, **104**, 1994, pp 7-9, 4 photos.

A review of some of the instruments used by the Diamond Trading Company (part of the Central Selling Organization, a group of De Beers companies), with particular reference to apparatus used in the sorting, sizing, counting and weighing of rough diamonds. (A printing error gives the number of sorting staff as 5000 instead of 500.) M.O'D.

**Trace element analysis of fluid-bearing fibrous diamonds from Jwaneng (Botswana) by neutron activation analysis.**[1]

M. Schrauder and M. Koeberl. *Mineralogical Magazine*, **58A**, 1994, pp 811-12.

Evidence given by diamonds on the fluid regime of the earth's mantle has been collected by means of NAA using specimens of fibrous fluid-bearing diamonds from the Jwaneng mine in Botswana. M.O'D.

**Hydrous and carbonatitic mantle fluids in fibrous diamonds from Jwaneng, Botswana.**

M. Schrauder and O. Navon. *Geochemica et Cosmochimica Acta*, **58** (2), 1994, pp 761-71.

Fluid inclusions trapped in fibrous diamonds and coatings of octahedral diamonds sampled upper mantle fluids. The composition of the major oxides, volatile speciation and secondary phases of mantle fluids trapped in 13 diamonds are reported. The fluids range between two end-members - a carbonatitic fluid rich in carbonate, CaO, FeO, MgO and $P_2O_5$, and a hydrous fluid rich in $H_2O$, $SiO_2$ and $Al_2O_3$. $K_2O$ is high in both end-members; Mg/(Mg+Fe) in the fluids is low and decreases to the hydrous end-member. Models of formation and evolution of fluids in the mantle are: mixing of hydrous and carbonatitic fluids, partial melting of a carbonate source-rock and fractional crystallization. R.K.H.

**Fluids in Yakutian and Indian diamonds.**[1]

M. Schrauder, O. Navon, D. Szafranek, F.V. Kaminsky and E.M. Galimov. *Mineralogical Magazine*, **58A**, 1994, pp 813-14, 1 fig.

Fluids trapped in micro-inclusions in diamonds from Africa prove the existence of a range of fluid compositions from a carbonatitic end-member to a hydrous end-member. Compositions are given for major oxides and volatile fluid species from six diamonds from Yakutia and four from India. M.O'D.

**Chemical zoning of garnets in peridotites and diamonds.**[1]

N. Shimizu, F.R. Boyd, N.V. Sobolev and N.P. Pokhilenko. *Mineralogical Magazine;* **58A**, 1994, pp 831-2, 2 figs.

Major and trace element data of zoned garnets from garnet harzburgite and dunite which show progressive chemical changes from diamond inclusion-like characteristics in the core to 'normal' lherzolitic features in the rim are examined and compared to chemically zoned diamond inclusion garnets. The data are used to improve knowledge of the nature and age of geochemical processes in the mantle. M.O'D.

**Emplacement ages of kimberlite occurrences in the Prieska region, southwest border of the Kaapvaal craton, South Africa.**

C.B. Smith, T.C. Clark, E.S. Barton and J.W. Bristow. *Chemical Geology*, **113**(1-2), 1994, pp 149-69, 2 maps.

Rb-Sr (mica) and U-Pb (perovskite) emplacement ages for kimberlites from the SW part of the Kaapvaal craton range from 170 to 74 m.y., similar to ages elsewhere in S Africa. Isotopically defined Group I and II kimberlites are found on the craton NE of the Doornberg and Brakbos lineaments with ages of 74, 108 and 118 - 125 m.y. Kimberlites in the craton margin area bounded by the two lineaments are exclusively Group II, with ages of 116-119 k.y. Kimberlites to the S of the craton boundary are of Group I affinity emplaced in two episodes at 74 and 100-103 m.y. The southernmost area is dominated by kimberlites petrographically, chemically and isotopically transitional between Groups I and II types, but with the oldest ages at 140 and possibly 170 m.y. Phlogopite from a peridotite xenolith from the Sanddrift kimberlite has retained an age of 2250 m.y., presumably the enrichment age of the nodule. R.E.S.

**Diamondiferous eclogites from the Udachnaya kimberlite pipe, Yakutia.**

V.N. Sobolev, L.A. Taylor, G.A. Snyder and N.V. Sobolev. *International Geology Review*, **36**, 1994, pp 42-64, 20 figs, 4 photos.

The mineralogy and petrography of 29 eclogite xenoliths from the Udachnaya kimberlite pipe, Yakutia, Siberia, are examined and the data combined with those from previous studies of the eclogites by the same workers. Five different petrographic groups are defined, the criteria being based on texture, mineral colour and degree of alteration. Evidence indicates that the Udachnaya eclogites may have originated in the mantle and there are no definite indications of a crustal origin. M.O'D.

**The origin, formation and emplacement of diamonds.**

M. STATHER. *Australian Gemmologist*, **18**(11), 1994, pp 342-5.

The article is primarily aimed at the recently qualified gemmologist and reviews the major advances in knowledge over the last fifteen years. Quoted examples include South Africa's Finsch mine which contains 3300 million year old peridotitic diamonds and 1580 million year old eclogitic diamonds that were emplaced at the same time 90-100 million years ago. In kimberlite pipes the total time for the ascent through 100km of rock may have been only four to fifteen hours. It was suggested that the original Kimberley volcano was about 1400m above ground level and that erosion would have distributed 500 million carats of diamonds into the drainage systems of Namaqualand and Namibia. R.J.P.

**L'analisi merceologia del diamante.**

M. SUPERCHI AND A. DONINI. *Gemmologia Europa*, **IV**, 1994, pp 77-108, 16 photos (in colour), 10 figs. (In Italian and English.)

The role of diamond as a commodity is discussed with particular reference to sales and certification which is examined in detail with relevant illustrations. M.O'D.

**Great Mogul: the largest diamond found in India.**

I. VIKAMSEY. *Indian Gemmologist*, 4(3/4), 1994, pp 18-19, 1 fig, 1 map.

The Great Mogul diamond whose present identity is open to question was recovered from the Vindhayan system of deposits at Kollur, in the Krishna gorge, Andhra Pradesh, India. The stone is said to have been found in 1650 or earlier. Weighing 280ct, according to Tavernier, it may be identical with the Orloff since both stones are rose cut and show a faint tinge of blue. M.O'D.

**A carbon-rich inclusion in a Chinese diamond and its geochemical implications.**

A. WANG, P. DHAMELINCOURT, H.O.A. MEYER, L. GUO AND A. ZHANG. *Contributions to Mineralogy & Petrology*, **117** (1), 1994, pp 15-24.

A multiphase inclusion in a 2mm diamond from a kimberlite in the Fuxian area, Liaoning Province, China, consists of an olivine covered with relatively large (90-3600 μm) plates of graphite. Both phases are enclosed in a thin layer of glass that separates the multiphase inclusion from the host diamond. Microcrystallites of diamond and graphite are embedded in the olivine and graphite plates. The structural form and morphology of the microcrystallites of diamond and graphite in the olivine suggest that they formed contemporaneously with the olivine and host diamond. An alternative suggestion is that they formed from carbon previously dissolved in the olivine at high *P* and *T*. The genesis of the large graphite plates on the surface of the olivine and beneath the glass film is not fully understood. This is the first record of diamond and graphite occurring within a silicate inclusion in diamond. R.A.H.

## Gems and Minerals

**[Changes in the *Y* and *Z* octahedra of the tourmaline structure during heating from the X-ray powder patterns.]** (Russian with English abstract.)

G.G. AFONINA, L.A. BOGDANOVA AND V.M. MAKAGON. *Proceedings of the Russian Mineralogical Society*, **122**(6), 1993, pp 89-98.

The change in ordering and the character of oxidation processes for cations in schorl, dravite, elbaite and ferritourmaline have been investigated using *dY-dZ* diagrams, under heating in different media. On heating in air, the degree of disorder in the tourmaline structure depends on two parameters; the number of cations in the *Y* position with valency > 2, and the abundance of cations whose valency increases on heating. The dimensions of unit cells and *Y* and *Z* octahedra of tourmalines heated in air for 15 min at 500-900°C are tabulated. R.A.H.

**$CO_2$ contents and formation pressures of some Kilauean melt inclusions.**

A.T. ANDERSON JR AND G.G. BROWN. *American Mineralogist*, **78** (7-8), 1993, pp 794-803.

Of 50 analyzed glass inclusions in olivine phenocrysts from the 1959 Kilauea Iki eruption, 41 formed at $P < 1$ kbar, 7 between 1 and 2 kbar, and two at $P > 2$ kbar. The surprisingly low formation

*P* suggest that most 1959 olivines, including most of those with pre-eruptive equilibration $T$>1200°C, crystallized in an upper part of Kilauea's summit magma storage reservoir.

J.A.Z.

**Achate von den Feldern des Landkreises Birkenfeld.**

G. ANDREE AND R. ANDREE. *Mineralien Welt*, **5** (4), 1994, pp 54-5, 4 illus. in colour.

All visitors to Idar-Oberstein know the Hunsrück and its potential for the agate-hunter. A selection of specimens from the Birkenfeld Kreis is shown with brief descriptive notes.

M.O'D.

**Infrared spectroscopy and crystal chemistry of the beryl group.**

C. AURISICCHIO, O. GRUBESSI AND P. ZECCHINI. *Canadian Mineralogist*, **32** (1), 1994, pp 55-68, 2 tables, 9 figs.

The IR spectra of 27 natural and 2 synthetic beryls were taken with the specimens in powdered form, the results showing water molecules in two different orientations (types I and II); it is shown that a positive correlation with Na content exists. The type II configuration is due to high alkali concentration. The presence of hydroxyl groups in a $H_2O$ [type II]-Na-(OH) configuration is proposed for alkali-rich beryl and the absorption frequencies for different samples are correlated with structural and compositional parameters.

M.O'D.

**Achate aus der Lausitz.**

W. BECK. *Lapis*, **20**(1), 1995, pp 27-31, 14 photos (12 in colour), 1 map.

Good quality ornamental agate is found, together with tektite, in the Senftenberg area, north of Dresden, Germany. Various agate patterns are described.

M.O'D.

**Copper and tenorite inclusions in cuprian-elbaite tourmaline from Paraíba, Brazil.**

F. BRANDSTÄTTER AND G. NIEDERMAYR. *Gems & Gemology*, **30**(3), 1994, pp 178-83, 1 table, 8 illus. in colour.

The three specimens examined contained numerous yellow metallic specks which at higher magnification showed a dendritic form that is typical for native copper. The samples were a greyish-green with typical pleochroism and with gemmological properties consistent with reported values. The platelets were orientated parallel to the *c*-axis of tourmaline and revealed the trigonal symmetry of the species. A few irregularly scattered grains were identified by SEM–EDS and confirmed by microprobe as tenorite in the form of subhedral platy crystals. Analyses showed a higher iron content than previous reports. Electron microprobe analysis traversed perpendicular to the copper platelets and to the *c*-axis of the host tourmaline showed a decreasing copper content of the tourmaline in the direction of the inclusions. No such variation was found around the tenorite inclusions. The existence of these inclusions and the high copper content in these tourmalines indicated that the elbaites formed under unusual conditions for a granitic pegmatite environment; the tenorite inclusions were interpreted as possible remnants of pre-existing copper mineralization.

R.J.P.

**An occurrence of sectored birefringence in almandine from the Gagon Terrane, Labrador.**

D. BROWN AND R.A. MASON. *Canadian Mineralogist*, **32** (1), 1994, pp 105-10. 1 illus. in black-and-white.

Birefringent almandine with a composition of $Alm_{0.79}$ $Grs_{0.173}$ $Prp_{0.024}$ $Sps_{0.015}$ is found in graphitic schists of the Gagnor Terrane, Grenville Front, south-western Labrador, Canada. Sectored extinction is observed in sections cut parallel to the X-Y plane, the birefringence estimated at 0.004-0.006. The garnets, which occur as grains, also show quartz intergrowths of cylindrical shape. X-ray diffraction analysis shows slight departure from cubic symmetry.

M.O'D.

**Mon aventure Vietnamienne. Part I.**

M. BRULEY. *Revue de Gemmologie*, **121**, 1994, pp 21-4.

Breezy account of a journey taking the writer through Kampuchea to Vietnam with observations on gemstones on the way.

M.O'D.

**The crystal chemistry of manganese-bearing elbaite.**

P.C. BURNS, D.J. MACDONALD AND F.C. HAWTHORNE. *Canadian Mineralogist*, **32** (1), 1994, pp 31-41. 7 tables, 5 figs.

A study of eight crystals of manganiferous elbaite showed both Mn and Fe to be completely in the divalent state in all the crystals. The conclusions were reached in the course of determining Li content in tourmaline by crystal structure refinement using an electron-counting technique with spatial resolution (SREF).

M.O'D.

**L'amazonite de Santa Maria de Itabira (continued).**

J.-P. CASSEDANNE. *Revue de Gemmologie,* **120,** 1994, pp 8-9, 2 photos in colour.

Details of amazonite from Itabira, Brazil, are given. Specimens have SG 2.55 and RI 1.519, 1.523, 1.526 with a birefringence of 0.007. Principal X-ray diffraction lines and their intensities are also given. M.O'D.

**The Jaguaraçu pegmatite, Minas Gerais, Brazil.**

J.-P. CASSEDANNE AND J.N. ALVES. *Mineralogical Record,* **25** (3), 1994, pp 165-70, 1 table, 8 illus. in colour, 1 map.

Some of the world's finest crystals of milarite (in the same family as sugilite) were found at the Jaguaraçu pegmatite in the Piracicaba river valley east of Belo Horizonte, Minas Gerais, Brazil. The finest crystals were transparent to translucent and tan coloured though a few exceptions were yellowish-green. Milarite has occasionally been faceted although it is brittle. Crystals occur as floaters (unattached to matrix). M.O'D.

**Time-pressure and temperature constraints on the formation of Colombian emeralds: an $^{40}Ar/^{39}Ar$ laser microprobe and fluid inclusion study.**

A. CHEILLETZ, G. FÉRAUD, G. GIULIANI AND C.T. RODRIGUEZ. *Economic geology.* **89,** 1994, pp 361-80, 4 tables, 11 figs.

$^{40}Ar/^{39}Ar$ induction and microprobe methods have been used to date two Colombian emerald deposits of the western emerald belt of the Eastern Cordillera, Coscuez and Quipama-Muzo. Studies were carried out on contemporaneous greenish Cr-V-rich potassium mica aggregates made up of muscovite as the dominant phase ± kaolinite, ± paragonite, ± quartz, ± albite, and ± chlorite, pyrite and calcite. Two distinct plateau and spot fusion ages of 35 to 38 Ma and 31.5 to 32.6 Ma were obtained for the Coscuez and Quipama samples respectively. Colombian emerald genesis is referred provisionally to a moderate-temperature epigenetic hydrothermal-sedimentary model. M.O'D.

**The 'Gems' Museum.**

V.S. CHERNAVTSEV. *World of Stones,* 4/94 , 1994, pp 58-60, 5 photos in colour.

Brief account of the State Museum of the Coloured Stones ('Gems Museum'), formed originally as the sectional exhibition of the 6th All-Union Industrial Association (Soyuzkvartssamotsvety-'Unionquarzgems') of the USSR Ministry of Geology. Some important specimens are described. M.O'D.

**La perliculture polynésienne.**

J.-P. CUIF, J.-P. DAUPHIN AND Y. DAUPHIN. *Revue de Gemmologie,* **120,** 1994, pp 2-5, 6 photos.

The formation and coloration of the pearls from *Pinctada margaritifera* var. *Cumengi* are described. Photographs illustrate characteristic surface structures. M.O'D.

**Notes on alexandrite chrysoberyl.**

S.J.A. CURRIE. *Australian Gemmologist,* **18** (10), 1994, pp 326-8, 4 illus. in black-and-white, 5 in colour.

Some personal observations are given including details of an alexandrite trilling twin from Brazil. R.J.P.

**Crystal-field analysis of $Cr^{3+}$ in grossular $Ca_3Al_2(SiO_4)_3$.**

M. CZAJA AND Z. MAZURAK. *Optical Materials,* **3** (2), 1994, pp 95-8, 2 figs.

The spectra of trivalent chromium in a grossular garnet are analysed with a $C_{3i}$ crystal-field Hamiltonian. Energy levels and crystal field parameters for the $Cr^{3+}$ ion, including spin-orbit and ligand-field interactions are calculated and the crystal field parameters *Bmm* satisfactorily fit the crystal field interactions of trivalent Cr in grossular. M.O'D.

**Budjet, budjet!**

F. DAMASCHUN. *Lapis,* **19/11,** 1994, pp 46-53, 19 photos in colour.

An account with some remarks on current conditions of some of the areas in Russia visited by Alexander von Humboldt's expedition of 1829. The expedition was commissioned to explore the mineral wealth of distant parts of the Russian empire. M.O'D.

**Mineralogical collection of the Mining Museum, St. Petersburg Mining Institute.**

N.N. DEVNINA, N.A. KULIKOVA AND E.E. POPOVA. *World of Stones,* **3/94,** 1994, pp 16-33, 35 photos in colour.

The work of and major specimens in the Mining Museum of the St. Petersburg Mining Institute are described. M.O'D.

**X-ray absorbtion spectroscopy of silicon dioxide ($SiO_2$) polymorphs: the structural characterization of opal.**

DIEN LI, G.M. BANCROFT, M. KASRAI, M.E. FLEET, R.A. SECCO, X.H. FENG, K.H. TAN AND B.X. YANG. *American Mineralogist*, **79** (7-8), 1994, pp 622-32, 7 figs.

The structures of the silica polymorphs stishovite, alpha quartz, alpha cristobalite, coesite, amorphous silica and opal were investigated by Si*K* and Si*L*-edge X-ray absorption spectroscopy. The local structures of two opals were found to show a mixture of alpha $SiO_2$ and alpha cristobalite structural units. M.O'D.

**Die ersten Edelopale Europas. Geschichte, Gewinnung, bedeutende Steine.**

R. DUDA. *Mineralientage München, Messethemenheft*, 1994, pp 42-5, 7 photos in colour.

Opal from the Dubnik area is described with notes on workings for opal. The area has been called Vereswagas and Czerwenicza at different times. M.O'D.

**The south Urals: a brief mineralogical guide.**

A.A. EVSEEV. *World of Stones*, 1/93, 1993, pp 31-5, 3 photos in colour, 1 map in colour.

Major mineral localities in the southern Urals, Russia, are listed with names of the minerals occurring. These include agate, kyanite, euclase, grossular and topaz (colourless, rose and blue varieties). M.O'D.

**Siberia's crystals and symmetry in the distribution of occurrences of minerals.**

A.A. EVSEEV. *World of Stones*, 1/93, 1993, pp 11-20, 15 photos in colour, 2 maps in colour.

A survey of major mineral deposits in Siberia with lists of minerals pertaining to each. Beryl, tourmaline, quartz, danburite and scheelite are among gem minerals listed. M.O'D.

**The Urals (from Middle to Polar): a brief mineralogical guide.**

A.A. EVSEEV. *World of Stones*, **2**/93, 1993, pp 35-9, 5 photos in colour, 1 map in colour.

Results of a literature search give details of mineral finds arranged in alphabetical order of locality name, covering the polar and middle Urals, Russia. Minerals known to have been deposited in museums are flagged, as are type localities and first finds in Russia. M.O'D.

**North and east Europe. A brief review of mineral localities.**

A.A. EVSEEV. *World of Stones*, **3**/94, 1994, pp 43-54, 8 photos in colour, 2 maps.

Mineral localities in north and east Europe (including parts of the former USSR) are listed with major minerals found. Type localities, first finds in Russia and outstanding specimens are flagged. M.O'D.

**Siberia and the Far East: a brief mineralogical guide.**

A.A. EVSEEV. *World of Stones*, **4**/94, 1994, pp 42-54, 10 photos in colour, 1 map, 1 loose insertion.

Mineral deposits of Siberia and the Russian far east are listed alphabetically with type localities, major specimens and first finds in Russia flagged. A loose insertion provides a numbered key to the map. M.O'D.

**Accreted terranes and mineral deposits of Myanmar.**

POW-FOON FAN AND KO KO. *Journal of Southeast Asian Earth Sciences*, **10**(1/2), 1994, pp 95-100, 3 maps.

Of the three identified terrains in Myanmar (Shan-West Malaysia-Sumatra, Central Burma Basin, Arakan Yoma) the first includes gem-quality jadeite and ruby. In the West Kachin subterrain jadeite occurs in boulders in late Tertiary conglomerates and alluviums and as dyke-like bodies in serpentine. It is associated with glaucophane schists formed probably by high-pressure metamorphism in Palaeozoic time. Jadeite can be found in serpentinized epidote, light green schist and in silicified amphibolite-albite. Jadeite may be formed as a result of desilication of albite. The serpentinite bodies intrude into Cretaceous limestone. Ruby associated with spinel and other gem minerals is found in the East Kachin subterrain, occurring in the vicinity of the contact of nepheline syenites and alaskites which intruded marble. M.O'D.

**Alexei V. Sverdlov: one must love and understand stone.**

V.S. FEODOROV. *World of Stones*, **1**/93, 1993, pp 43-55, 21 photos (20 in colour).

Biography with examples of the work of the mineral photographer A.V. Sverdlov. M.O'D.

**Causes of the purple and pink colours of manganoan sugilites from the Wessels Mine, South Africa.**

E. FRITSCH AND J.E. SHIGLEY. *Mineralogical Magazine*, **58**(4), 1994, pp 681-5, 2 figs.

Purple and pink colours observed in manganoan sugilite from the Wessels mine, South Africa, is ascribed to Mn with the two colours explained by different crystal fields resulting from two distinct compositions with pink as Al-rich, Fe-poor material compared to the purple variety. M.O'D.

**Flat pearls from biofabrication of organized composites on inorganic substrates.**

M. FRITZ ET AL. *Nature*, **371**(6492), 1994, pp 49-51.

It is shown that a highly organized composite 'flat pearl' can be biofabricated on discs of glass, mica and molybdenum sulphide inserted between the mantle and shell of *Haliotis rufescens* (red abalone). The implantation of inorganic surfaces recognized by mantle cells apparently governs a switch from aragonite to calcite biomineralization. After deposition of a partially oriented calcite-protein layer, there is a reversal to nucleation and assembly of columnar stacks of highly ordered aragonitic nacre. R.K.H.

**K-Ar and $^{40}Ar/^{39}Ar$ evidence for a Transamazonian age (2030-1970 Ma) for the granites and emerald-bearing K-metasomatites from Campo Formoso and Carnaíba (Bahia, Brazil).**

G. GIULIANI, J.-L. ZIMMERMAN AND R. MONTIGNY. *Journal of South American Earth Sciences*, **7** (2), 1994, pp 149-65, 5 tables, 7 figs.

The Campo Formoso and Carnaíba granites form part of a suite of middle Proterozoic magmatic rocks in the northern part of the São Francisco craton, Bahia, Brazil. They intrude the Archaean basement and Lower Proterozoic Jacobina volcanosedimentary series. Emeralds are developed by means of fluids percolating through serpentinites forming metasomatites at the contact with granite-related pegmatite veins. The Campo Formoso and Carnaíba mines exploit these deposits.

From the K-Ar and $^{40}Ar/^{39}Ar$ measurements it appears that emerald at the Carnaíba deposit is formed contemporaneously with pervasive muscovitization of the granite. M.O'D.

**Zur Kathodolumineszenz von Achat-erste Ergebnisse.**

J. GÖTZE AND H-J. BLANKENBURG. *Aufschluss*, **45**, 1994, pp 305-12, 13 photos (11 in colour).

Microphotographs of agate shown displaying cathodoluminescence are accompanied by a commentary discussing the varying responses of the layers. M.O'D.

**Recent developments at the Benitoite Mine.**

M. GRAY. *Canadian Gemmologist*, **13**(4), 1992, pp 118-20.

Processing techniques have enabled larger benitoite specimens to be recovered. Twinned crystals resembling six-rayed stars with sharp points and large neptunite crystals have been found. The largest cut benitoite known weighs 15.42ct. M.O'D.

**On a remarkable topaz crystal with a lepidolite inclusion from the Tolstopjatov collection.**

A.V. GROMOV. *World of Stones*, **1**/93, 1993, pp 5-6, 1 photo in colour.

Topaz with an inclusion of lepidolite is reported from the Tolstopjatov collection in the Vernadsky State Geological Museum (GGM). The lepidolite takes a platy form and it is assumed that lepidolite flakes became attached to the surface of a growing topaz crystal and hinders or even stops growth in some directions, thus altering the topaz form. M.O'D.

**Rose corundum from the Khitostrov locality of north Karelia.**

A.V. GROMOV. *World of Stones*, **2**/93, 1993, pp 2-4, 2 photos in colour.

Rose-coloured corundum crystals, not necessarily of gem quality, are reported from the oblasts Khitostrov, Diadina Gora, Varatskoe, Nigrozerskoe, Notozerskoe in North Karelia and from adjacent deposits in Murmansk oblast. Crystals, whose forms are fully described, occur in highly-metamorphosed rocks of amphibolite facies of the Belomorskii Archean complex but are confined to different stratigraphic series. Crystals have been found to contain garnet, plagioclase, biotite, hornblende, magnetite, rutile, ilmenite and wüstite. M.O'D.

**Contribution à l'étude des caractéristiques distinctives des saphirs du Cachemire. Part 1.**

H.A. HÄNNI. *Revue de Gemmologie*, **121**, 1994, pp 18-20, 2 photos, 1 fig.

Properties of Kashmir sapphire are discussed with notes on the history of the site and on the colour of the stones. The cause of the characteristic turbidity seen in many Kashmir sapphires is tentatively ascribed to rutile. The absorption spectrum is compared to spectra given by sapphires from Sri Lanka, Burma and Kampuchea. Some Kashmir stones contain small amounts of chromium, giving an emission line at 693nm. M.O'D.

**Edelopal: der feurig funkelde Harlekin.**

H. HARDER. *Mineraltage München, Messethemenheft*, 1994, pp 34-41, 14 photos (11 in colour).

Notes on opal with the harlequin pattern and on other opals are given, with an explanation of the cause of the play-of-colour. M.O'D.

**The structural redetermination and crystal chemistry of sinhalite, $MgAlBO_4$**

C.L. HAYWARD, R.J. ANGEL AND N.L. ROSS. *European Journal of Mineralogy*, **6** (3), 1994, pp 313-21.

EPMA results for a suite of four gem-quality sinhalites indicate that this species can accommodate excess Al and small amounts of Fe at the expense of Mg. Single-crystal XRD data show that sinhalite is isostructural with forsterite, with space group *Pbnm*, *a* 4.3320, *b* 9.8819, *c* 5.6813 Å. The structure was refined to R 0.017, R 0.019 with 427 reflections. The assumed ordering scheme of $[Mg_{0.91}Fe_{0.015}Al_{0.05}\square_{0.025}]^{M2}Al^{M1}BO_4$ is deduced from the EPMA results. Visible absorption spectra are indicative of extremely low $Fe^{3+}$ contents in these sinhalites, suggesting that the main substitutional mechanisms are $3Mg^{2+} \leftrightarrow 2Al^{3+} +$ and $Mg^{2+} \leftrightarrow Fe^{2+}$, where $\square$ represents a vacancy. R.A.H.

**Structural disparities between chalcedony and macrocrystalline quartz.**

P.J. HEANEY, D.R. VEBLEN AND J.E. POST. *American Mineralogist*, **79** (5/6), 1994, pp 452-460, 13 illus. in black-and-white, 2 figs.

Structural differences between chalcedony and bulk quartz are characterized by the nature of the individual crystals which form chalcedony. These are shown to be elongate along [110] and are twisted about the fibre axis. Under dark-field illumination the texture of a structural disorder shown by single fibres in the {100} and possibly the {011} planes appears dendritic. M.O'D.

**Translucent nepheline from Norway.**

U. HENN AND H. BANK. *Canadian Gemmologist*, **14**(2), 1993, pp 44-5.

Translucent reddish-brown nepheline is reported and described from Stalaker, near Tjolling, Sandefjord, south Norway. The area is noted for larvikite, itself associated with a nepheline syenite including pegmatite veins with rare minerals. M.O'D.

**Yellowish-green herderite from Brazil - a second occurrence.**

U. HENN AND H. BANK. *Canadian Gemmologist*, **15**(1), 1994, pp 40-2.

Transparent yellowish-green herderite up to 55ct was recovered during 1992 from Virgem da Lapa, Araçuai, Minas Gerais, Brazil. Notes on properties are given. M.O'D.

**Petrology of a jadeite-quartz/coesite-almandine-phengite fels with retrograde ferronyböite from Dora-Maira Massif, Western Alps.**

T. HIRAJIMA AND R. COMPAGNONI. *European Journal of Mineralogy*, **5** (5), 1993, pp 943-55, 1 map.

Ferronyböite is reported from a jadeite-bearing rock of the ultra high-*P* Brossasco-Isasca unit, S Dora-Maira Massif. At the ultra high-*P* climax, the rock was mainly composed of jadeite, garnet, phengite and coesite, then during an early stage of the retrograde path, omphacite, ferronyböite to katophorite, and albite developed at the expense of peak phases. As the retrograde process continued, omphacite changed via aegirine- augite to almost jadeite-free aegirine and the ferronyböite and katophorite rimmed by Si-poor katophorite and ferro-aluminotaramite. Ferronyböite and katophorite also occur as a reaction rim around garnet and as idioblastic tabular grains in the albite matrix. The most Fe-rich ferronyböite core has $SiO_2$ 46.91, $TiO_2$ 0.40, $Al_2O_3$ 12.86, FeO' 20.06, MnO 0.00, MgO 5.61, CaO 3.60, $Na_2O$ 7.85, $K_2O$ 0.50, = 97.79, i.e. the richest so-far reported in $Fe^{2+}$. Garnet-omphacite geothermobarometry gives ~500-570°C and 12-15 kbar for the early retrogression stage. It is suggested that ferronyböite rather than ferroglaucophane is stable in the local Na-, Al- and Fe-rich bulk compositions under low-*T* eclogite-facies conditions. R.A.H.

**On the morphology of malachite.**

O.V. IL'IN. *World of Stones*, **4**/94, 1994, pp 3-9, 12 photos in colour.

Forms of malachite from Russian deposits are described with notes on their mode of occurrence. M.O'D.

**Quasicrystals: novel forms of solid matter.**

J.A. JASZCZAK. *Mineralogical Record*, **25** (2), 1994, pp 85-93, 13 illus. in black-and-white.

Solid matter in which there are no single unit cells and which shows no periodic repetition of local structures through the body have been given the name quasicrystal. Some examples have been found to possess rotational symmetries, including 5-fold, which have not been observed before. M.O'D.

**Axinite: new finds in Russia.**

V.N. KALACHEV. *World of Stones*, **1**/93, 1993, pp 3-4, 4 photos in colour, 3 figs.

Fine quality brown axinite is reported from cavities in the Puiva Mountains in the Polar Urals of Russia. Crystal forms are described and illustrated and specimens are notable for their brownish-lilac pleochroism. Greenish-brown axinite from the Dalnegorsk mine and brown axinite from the Pribrezhnoye locality in the Magadan region are also discussed. At Puiva the axinite vein is embedded in an essentially slate Puiva formation of the Proterozoic which is often intruded by numerous meridian and basic dikes. Quartz veins and axinite mineralizing in them are from the middle Carboniferous to Early Permian. The Pribrezhnoye locality is 35km to the north-west from the Inchoun Settlement. Here axinite occurs in the carbonate-terrigenous sediments of the Utaveem formation of the Early Carboniferous, skarned with leucocratic granite stocks of the Early Cretaceous. Here both reddish-brown and greyish-brown axinites occur at different places. M.O'D.

**Update on mining rubies and fancy sapphires in northern Vietnam.**

R.C. KAMMERLING, A.S. KELLER, K.V. SCARRATT AND S. REPETTO. *Gems & Gemology*, **30**(2), 1994, pp 109-14, 7 illus. in colour.

Since organized mining started in 1989 millions of carats of rubies and fancy sapphires have been produced. The two main locations are at Luc Yen and Quy Chau. At Luc Yen a tripartite venture with a one-year concession was centred on a 200 acre site at Khoan Thong using hydraulic cannon. When the site was exhausted the whole operation was moved to a fresh site at nearby Nuoc Ngap. The gems are fashioned in Hanoi and a further cutting factory has been built in Yen Bai.

At Quy Chau access is controlled by the military which is difficult during the rainy season. Originally worked by thousands of independent miners, after two years of operation an area of 740 acres is worked by four companies. Future prospects will depend upon Government policy as well as gem reserves which could last up to fifty years. R.J.P.

**Gem News.**

J.I. KOIVULA, R.C. KAMMERLING AND E. FRITSCH. *Gems & Gemology*, **30**(2), 1994, pp 122-32, 1 table, 18 illus. in colour.

*Tucson Show*

A round modified brilliant cut green fluorite of 30.67ct of very high clarity from the Felix fluorite mine above Azusa in Los Angeles county was subsequently donated to the San Bernardino County Museum. Green stones on offer included chrysoprase chalcedony from Queensland and gaspeite, a nickel, magnesium and iron carbonate which originated in Western Australia. Cat's-eye sillimanite from the state of Orissa in India was very similar in appearance to fibre-optic chatoyant glass marketed as 'Catseyte', 'Cathaystone' and 'Fiber Eye'. Down the length of the fibres the fibre-optic glass revealed the hexagonal packing of its fibres whilst no such effect was visible in cat's-eye sillimanite. Freshwater pearls from Bangladesh all exhibited a strong pink overtone with an exceptional almost metallic lustre. 'Zebra' stones from Australia proved to be two distinctly different ornamental stones. Dolomitic marble which presented a dark grey-white striped appearance. A second type consisting of alternating parallel layers of medium-dark reddish-brown and tan from the East Kimberley region of Western Australia were reported to be a fine-grained siliceous argillite which is a clay- or mud-containing sedimentary rock that has reacted with silica-rich fluids to form a harder material.

A 'wagon wheel' tanzanite was described in which a single needle-like inclusion running from the culet to the centre of the table facet produced a symmetrical pattern of spoke-like reflections.

Burma (Myanmar) authorities have relaxed their gem controls allowing foreigners to purchase privately owned gems. Tiger's-eye quartz production in South Africa reached a new record in 1992 of 620.8 tons.

*Enhancements*

A new emerald treatment system from Israel which could handle many stones in a batch and used a hand operated vacuum pump followed by fracture filling under pressure. A wide range of oils and resins could be used. R.J.P.

**The Mining Museum in St. Petersburg.**

V.D. KOLOMENSKY AND L.A. FAINSTEIN. *World of Stones*, **3**/94, 1994, pp 6-15, 15 photos in colour.

A short history of the Mining Museum in St. Petersburg with notes on some important specimens, including gem minerals, housed there. The Museum was founded in 1773 as the Mining Technical School. M.O'D.

**Opal.**

J. Kourimsky. *Mineralien Welt*, 5/94, 1994, pp 32-40, 9 photos in colour, 1 fig.

The paper gives a general survey of opal with notes on the history and geology of the major world deposits. M.O'D.

**Carcass skeletal quartz crystals from the Indigirka river.**

V. Kurbatov. *World of Stones*, 3/94, 1994, pp 62-4, 1 photo in colour, 2 figs. in colour.

Carcass-skeletal quartz crystals were first reported from the Indigirka river basin, eastern Siberia, in the early 1970s. The crystals are described with notes on their formation. M.O'D.

**[Opal and magnesite veins in weathered serpentinites from the western Rhodope Mts.]** (Russian with English abstracts.)

V. Kurchatov and P. Petrov. *Annual of the Mine and Geology University Sofia: Part 1: Geology*, **39**, 1993, pp 45-8.

Weathering of serpentinized ultrabasic bodies during the Pontian produced opal veins in the upper part of the weathering crust and magnesite veins in its lower part. The two minerals have been studied by optical and electron microscopy, spectral analysis, DTA and IR spectroscopy. Besides amorphous opal, the crystallization of silica gels has produced cristobalite and finally cristobalite-tridymite opals. I.V.

**Abstraction and jade exchange in Precolumbian southern Mesoamerica and lower central America: Costa Rican considerations.**

F.W. Lange and R.L. Bishop. *Bull. Friends of Jade*, **8**, 1994, pp 105-24, 2 maps.

The paper examines the use of jade as a pre-currency trade medium with particular reference to central America and Costa Rica. There is an extensive bibliography. M.O'D.

**Single-crystal spectra of garnets from diamondiferous high-pressure metamorphic rocks from Kazakhstan: indications for $OH^-$, $H_2$ and FeTi charge transfer.**

K. Langer, E. Robarick, N.V. Sobolev, V.S. Shatsky and W. Wang. *European Journal of Mineralogy*, **5** (6). 1993, pp 1091-1100.

Garnet crystals from the high-*P* metamorphic rocks of the Kokchetav Massif, Kazakhstan, were studied by EPMA and single-crystal spectrometry in the UV, visible and IR range. The crystals are $Gro_{48}Py_{33}Alm_{16}Sp_2$ (yellow) from garnet-pyroxene-carbonate rock and $Gro_{21}Py_{24}Alm_{49}Sp_5$ (deep red) from garnet-biotite gneiss. Their colour is produced by the position of the UV absorption edge and a broad $Fe^{2+[8]}$ $Ti^{4+[6]}$ charge-transfer band centred at 21 500 $cm^{-1}$. A high-*P* garnet, $Py_{70}Alm_{17}Uv_{13}$, from Liaoning-50 kimberlite, NE China, was included for comparison. All crystals studied contained defect OH-groups, corresponding with those in synthetic OH-bearing pyropes, giving a single absorption band in the range 3560-3610 $cm^{-1}$, the exact position depending on the type and site fractions of ions in the OH-coordinating metal sites, $A^{[8]}$ and $B^{[6]}$. This hydroxyl 'water' is not uniformly distributed in the garnet crystals; it amounts to 0.02-0.25 wt.%. In addition to $\upsilon_{OH}$ the IR spectra show a broad band at 3400$cm^{-1}$, characteristic of $(H_2O)_n$ clusters. R.A.H.

**Lightning Ridge. Die Heimat des Schwarzopals.**

W. Lieber. *Mineralientage München, Messethemenheft*, 1994, pp 46-51, 11 photos in colour.

Description of the Lightning Ridge opal mining area in New South Wales, Australia, with notes on mining practice and illustrations of some notable specimens of opal recovered.

M.O'D.

**The Dal'Negorsk boron deposit: a unique mineralogical object.**

A.E. Lisitsyn and S.V. Malinko. *World of Stones*, 4/94, 1994, pp 30-40, 20 photos (19 in colour), 1 map, 1 fig.

Fine crystals of danburite are among the minerals found at the Dal'Negorsk boron deposit in the Primor'ye region in the Russian far east. The mineralogy and geology of the deposit are described at length together with the minerals to which a classified list is also devoted. M.O'D.

**Nanometre scale textures in agate and Beltane opal.**

T. Lu, X. Zhang, I. Sunagawa and G.W. Groves. *Mineralogical Magazine*, **59**(1), 1995, pp 103-9.

Optically observable individual fibres in concentrically banded agates of geode origin are composed of much finer fibres, in which quartz crystallites 8-100 nm long are stacked together ‖ <11$\bar{2}$0> or <10$\bar{1}$0>. Brazil twin lamellae structures are frequently seen in grains > 30 nm long. Uniformly spaced systematic striations consist of a cyclic alternation in quartz grain sizes, the smallest size being 6nm. Coarse quartz or amethyst represent the final stage of agate (lining type) formation. In opal from Beltane, California, the fine fibrous textures observed are composed of cristobalite crystallites with sizes of 8-20nm stacked together. They appear as the rims surrounding quartz crystals, and grow into regions with free space. TEM results suggest that embryonic particles agglutinated to form fibres, possibly driven by electrophoresis. R.A.H.

**Luminescence and exited state $^2E_g$ decay kinetics of $Cr^{3+}$ in grossular $Ca_3Al_2(SiO_4)_3$.**

Z. MAZURAK. *Optical materials,* 3 (2), 1994, pp 89-93, 6 figs.

Spectroscopic and luminescence measurements were carried out on a pale green grossular garnet in which a relatively large splitting of the $^2E_g$ state of $Cr^{3+}$ was observed. M.O'D.

**Gemstone mineralization in southern Kerala, India.**

R.D. MENON, M. SANTOSH AND M. YOSHIDA. *Journal of the Geological Society of India,* **44** (3), 1994, pp 241-52, 2 maps.

Within the gem field extending over an area of 70 x 35km in S Kerala and the adjacent region of Tamil Nadu, a variety of gemstones occur, including chrysoberyl (cat's-eye and alexandrite varieties), ruby, sapphire, emerald, topaz, zircon and amethyst. The primary mineralization is in zoned, complex pegmatites of Pan-African age, emplaced in granulite-facies metapelites (khondalites) and variably weathered and laterized, secondary gemstone deposits are found in stream gravels and placers. Thermal decrepitation of fluid inclusions indicate the presence of variable amounts of $CO_2$ in quartz (72.7ppm), garnet (141.2 ppm) and chrysoberyl (51.6 ppm). The $\delta^{13}C$ value of $CO_2$ in quartz is -8‰. Gem recovery in Kerala has vast untapped potential, but is at present carried on by illegal means. A map of gem occurrences is given, together with photographs and brief details of chrysoberyl, sapphire, ruby, topaz and zircon. R.A.H.

**Genesis of banded, fibrous and twisted quartz by 'catalysis', unstable crystallization fronts and substitution: self-organization in agates.[1]**

E. MERINO, Y. WANG AND E. DELOULE. *Mineralogical Magazine,* **58A**, 1994, pp 597-8

Agates formed in basalts show bands of chalcedony fibres which contain low amounts of trace elements and which repeatedly alternate with bands consisting of twisted, very fine fibres with high trace element content. This is shown to be an example of self-organization, in which a system generates its characteristic features through its own dynamic. M.O'D.

**A new discovery of early Cretaceous (Wealden) amber from the Isle of Wight.**

C.J. NICHOLAS, A.E. HENWOOD AND M. SIMPSON. *Geological Magazine,* **130**(6), 1993, pp 847-50, 1 map.

The early Cretaceous amber nodules can be found within two thin, black lignite horizons which form a channel-lag deposit exposed in the cliffs of Chilton Chine. Examination of plant material above and below this site by other workers, combined with IR spectra of the amber in this study, implies a coniferous (possibly taxodiaceous) origin for this resin. Palaeoenvironmental interpretation of the Chilton Chine sites suggests the amber was exuded locally, and in some cases the globules have been partly replaced by iron pyrite. C.H.D.

**Ein spektakulärer Fund von Rauchquarz und Morion aus der Wiesbachrinne im Habachtal, Land Salzburg, Österreich.**

G. NIEDERMAYR AND A. STEINER. *Mineralien Welt,* **5** (4), 1994, pp 46-55, 4 illus. in black-and-white, 4 in colour, 1 fig.

Crystals of quartz (smoky quartz and morion) are reported to reach considerable size and excellent form at the Wiesbachrinne, Habachtal, Salzburg, Austria. Some specimens reach up to 13cm in length. M.O'D.

**Formation of the Muzo hydrothermal emerald deposit in Colombia.**

T.L. OTTAWAY, F.J. WICKS, L.T. BRYNDZIA, T.K. KYSER AND E.T.C. SPOONER. *Nature,* **369**(6481), 1994, pp 552-4.

Emerald-bearing veins are related to highly altered zones (cenicero) in host shales; the emeralds occur in distal parts of calcite-albite-pyrite veins radiating from cenicero zones. Analyses are presented of fluid inclusions in the emeralds and indicate that mineralizing solutions were residual brines from basinal fluids that interacted with evaporites. Hydrothermal brines transported evaporitic sulphate to structurally favourable sites where it was thermochemically reduced. S thus generated reacted with organic matter in the shales to release trapped Cr, V and Be enabling emerald formation. R.K.H.

**Comparative study of beryl from various Indian occurrences: beryl from Rajasthan.**

J. Panjikar. *Indian Gemmologist,* **4**(3/4), 1994, pp 5-10, 4 photos in colour, 5 figs.

Emerald is found in the area Kala Guman (Kaliguman) approximately 90 miles NNE of Udaipur. The country rock is a peridotite, partly talcose, tremolite-actinolite schist, biotite-schist and hornblende-schist invaded by veins of quartz pegmatites. Emeralds occur in the biotite schists which also contain alteration products, including chlorite. Crystals show prismatic habit with some examples of twinning. Colour is dark to watery green. Refractive index is found to be lower than previously quoted by Webster and others, values being 1.581 and 1.574 for the ordinary and extraordinary rays, with a birefringence of 0.007. SG is 2.7542. Biotite and phlogopite inclusions have been detected by EDS and quantitative microprobe analysis. Chlorapatite and beryl inclusions are also found with some talc and albite. Primary and secondary fluid inclusions were observed but very few three-phase inclusions. Growth tubes of large dimensions were seen and are classified as syngenetic.
M.O'D.

**A study of gem varieties of corundum from parts of Tumkur and Mysore districts, Karnataka.**

J. Panjikar, H. Chandrashekhar, M. Muniswamaiah and N. Ahmed. *Journal of the Geological Society of India,* **43**(3), 1994, pp 311-15.

The mineralogical and gemmological properties of rubies from three localities in Tumkur district and three localities in Mysore district of Karnataka are briefly summarized. Most of the rubies occur as detrital material or at the contacts between granitic pegmatite and schists or gneisses. They are translucent rather than transparent, due to inclusions of rutile ± mica and apatite. The deposit 1.5km NW of Chilkunda (12°20´45″N, 76°10´30″E), Hunsur Taluk, Mysore district, seems the most promising prospect for gem-quality rubies. R.A.H.

**Remarkable finds of minerals of beryllium: from the Kola Peninsula to Primorie.**

I.V. Pekov. *World of Stones,* **4**/94, 1994, pp 10-26, 14 photos (13 in colour), 1 map.

Beryllium-bearing minerals found in the territories of the former USSR are described with notes on their geology, mineralogy and on the history of their discovery. M.O'D.

**La microspectrométric Raman des grenats XYZ O II. La série alumineuse naturelle pyrope-almandin-spessartite.** [French with English abstract.]

M. Pinet and D.C. Smith. *Schweizerische Mineralogische und Petrographische Mitteilungen,* **74**, 1994, pp 161-79, 9 figs.

Raman spectra of 52 natural aluminian garnets in the pyrope-almandine and almandine-spessartine series are examined. The spectra are compared with each other and with the spectrum of grossular which is at once aluminian and calcic. M.O'D.

**Notes on history of topaz and aeschynite finds in the Ilmeny mountains.**

V.O. Polyakov. *World of Stones,* **2**/93, 1993, pp 31-4, 2 photos in colour, 1 fig. in colour.

Topaz crystals occurring in the amazonite pegmatites of the Ilmeny mountains are described. Fine topaz specimens from Ilmeny locations were first noted in 1832. M.O'D.

**La pegmatite Urubu, Araçuai, Minas Gerais (Brésil), example de pegmatite complexe à pétalite: zonalité minéralogique et géochimie des micas et tourmalines.** [French with abridged English version.]

J. Quéméneur, M. Lagache and J.M. Correia Neves. *Comptes Rendus de l'Académie des Sciences, Série II,* **317** (11), 1993, pp 1425-31.

The Urubu pegmatite of Cambrian age, situated in the Eastern pegmatitic province of Minas Gerais, is a Li, Cs, B and Sn pegmatitie which exhibits a complex mineralogical zonation with lepidolite, petalite and pollucite at the centre. The pegmatite is surrounded by a contact metamorphic aureole containing zinnwaldite rich in Fe, Mg, Rb and Cs and Fe-Mg-rich tourmaline. Micas and tourmalines in the pegmatite are richer in Fe and Mg at the rim and in Li, Cs and F at the centre following the classical model of fractional crystallization. The contact aureole is considered to have been formed during the intrusion of the magma. M.L.

**Isomorphic replacement of Al and Si in tetrahedral Be and Si sites of beryl from Torrington, NSW, Australia.**

K. SCHMETZER AND H.-J. BERNHARDT. *Neues Jahrbuch für Mineralogie, Monatshefte,* **1994** (3), pp 121-29.

Chemical analysis of a crystal of emerald from Torrington (averages of results from EPMA + ICP determinations) gave $SiO_2$ 67.23, $Al_2O_3$ 18.99, $Cr_2O_3$ 0.13, $V_2O_3$ 0.02, FeO* 0.20, BeO 13.80, MnO 0.00, MgO 0.02, $Li_2O$ 0.06, $Na_2O$ 0.05, $K_2O$ 0.03, $H_2O$ 0.53 = 101.07. It has ε1.5654, ω1.5700; a 9.2127, c 9.1980 Å. The data from 353 point analyses by EPMA reveal a distinct chemical zoning and a negative correlation of Si with Σ(Al+Mg+V+Cr+Fe) in the formula unit. These results indicate a partial replacement of $Be^{2+}$ by $Al^{3+}$ and/or $Si^{4+}$ and, in other zones of the crystal, a partial replacement of $Si^{4+}$ by $Al^{3+}$ according to heterovalent substitution schemes for both tetrahedral $Be^{2+}$ and tetrahedral $Si^{4+}$ sites. R.A.H.

**Martin Leo Ehrmann, 1904-1972.**

B. SMITH AND C. SMITH. *Mineralogical Record,* **25** (5), 1994, pp 347-70, 20 photos (12 in colour).

Martin Ehrmann, who began his life in the United States as a poor immigrant from Russia, eventually became one of the best-known mineral and gemstone dealers of this century. His rise to this position is given in detail with particular reference to his travels, trading at gemstone locations and his help in the formation of some of the world's greatest gemstone collections, including those at the Natural Museum of Natural History, Smithsonian Institution, Washington, DC, and the Los Angeles County Museum of Natural History. A fascinating sidelight into the ways of gemstone dealing is given along the way and many examples of specimens handled by Ehrmann are described, some being illustrated. M.O'D.

**Earl Perovsky (1792-1856) and his beryl collection in the Mining Museum.**

E.S. SVIRINA. *World of Stones,* **3**/94, 1994, pp 35-8, 7 photos in colour.

Beryl crystals from the Perovsky collection in the St. Petersburg Mining Museum include specimens of emerald and rose beryl. Notes on the formation of the collection are given. M.O'D.

**Chemical composition and structural formula of manganoan sugilite from the Wessels Mine, Republic of South Africa.**

J.E. TAGGART, E.E. FOORD AND J.E. SHIGLEY. *Mineralogical Magazine,* **58**(4), 1994, pp 679-81.

A structural formula for manganoan sugilite from the Wessels mine, South Africa, based on 30 oxygen atoms in the Si O portion of the formula, is given as

$^{(C)}K_{1.0}\ ^{(B)}(Na_{2.1},H_2O_{0.25})_{\varepsilon 2.1}\ ^{(A)}(Fe^{3+}_{1.46}, Mn^{3+}_{0.28}, Fe^{3+}_{0.11}, Al_{0.08})_{\varepsilon 1.3}\ ^{(T2)}Li_{3.05}\ ^{(T1)}Si_{12.0}O_{30}$ M.O'D.

**Cristalli di fluorite rosa dal Poncione di Maniò, Val Bedretto, (TI).**

A. TORINO AND E. OFFERMANN. *Schweizer Strahler,* **10(4)**, 1994, pp 140-52, [Italian and German versions], 4 photos in colour, 6 figs.

Large pink fluorite crystals of gem quality, found at Poncione di Maniò, Canton of Ticino, Switzerland, show an unusual combination of forms for Alpine-type fluorite. A characteristic example is the formation of rhombdodecahedra at all points of an octahedron. Diagrams show how this phenomenon developed. M.O'D.

**Ammolite, an organic gemstone from Alberta.**

R. VANDERVELDE. *Canadian Gemmologist,* **14**(2), 1993, pp 53-7, 1 photo.

Ammolite, the nacreous layer of the ammonite shell, has been used ornamentally with interference colours providing an attractive material provided that adequate backing is used. Recovery is from the Bearpaw Formation in Alberta, Canada. M.O'D.

**Chemical characterization of fossil resins ('amber') - a critical review of methods, problems and possibilities: determination of mineral species, botanical sources and geographical attribution.**

N. VAVRA. *Abhandlungen der Geologischen Bundesanstalt,* **49**, 1993, pp 147-57.

Fossil resins were studied for two reasons: determination of the botanical origin and geographical attribution to a special area. Among chemical methods discussed, possibilities and applications for IR spectroscopy and MS are given. In addition advantages of different varieties of gas liquid chromatography are discussed in greater detail. Computer-aided combined gas-liquid chromatography/MS is shown to be the most promising method for the characterization of fossil resins at the moment. An exact distinction of single material species of fossil resins is still uncertain in some cases. H.E.

**Der wilde Weg zu den Aquamarinen.**

P. VOILLOT. *Lapis*, **19**(11), 1994, pp 38-45, 10 photos in colour.

Describes the aquamarine deposits in the Northern Areas of Pakistan with particular reference to mines at altitudes preventing working for six months of the year. Attention is paid to the geography of the area and to access difficulties for the miners. M.O'D.

**A discernment of ruby by ESR.**

O. WAKISHIMA. *Indian Gemmologist*, **4**(3/4), 1994, pp 21-9, 16 figs.

Electron spin resonance was used to distinguish Burma from Thai ruby, the former showing the $Cr^{3+}$ absorption line (resonance field 7500e) and the latter the $Fe^{3+}$ absorption line (resonance field 8500e). The figure for the $Fe^{3+}$ absorption line varied in heat-treated ruby. M.O'D.

**Essence and nomenclature of jade: a problem revisited.**

CHUNYUN WANG. *Bull. Friends of Jade*, **8**, 1994, pp 55-66.

Short study of the significance of the Chinese word *yu* and its application to the jade minerals. While the word is sometimes used to denote any precious minerals, such features as a hard and compact texture have been inseparable from the concept of the word as far as Chinese use is concerned. M.O'D.

**Krieg und Steine: Ein aktueller Situationsbericht und Neufunde aus Pakistan und Afghanistan.**

A. WEERTH. *Lapis*, **19** (10), 1994, pp 27-30, 7 photos in colour.

Despite the hazards of war, crystals of ruby, aquamarine, purple apatite and peridot have been found by the author at locations in Pakistan and Afghanistan. M.O'D.

**Lapis-Lazuli, die unendliche Geschichte.**

A. WEERTH. *Lapis*, **19**(11), 1994, pp 20-7, 10 photos in colour.

Despite wars and economic conditions mining and sale of lapis lazuli continues in Afghanistan. Methods of mining or at least lapis recovery are described and there are notes on paragenesis and on present-day conditions in the traditional centre of Sar-e-Sang. Notes on lapis deposits in other countries are briefly mentioned. M.O'D.

**Synthetische Amethyststufen und bestrahlter 'Rauchquarz'.**

C. WEISE. *Lapis*, **19** (9), 1994, pp 33-4, 6 photos, (4 in colour).

Specimens of quartz irradiated to give amethyst colour and offered as crystal groups are reported from mineral fairs in Europe. The origin is believed to be Russia. M.O'D.

**The fossil hydrocarbon jet.**

M. WELLER AND CH. WERT. *Die Geowissenschaften*, **11**(9), 1993, pp 319-25.

Jet (Gagat) is a fossil hydrocarbon, with a composition close to that of bituminous coals, but free of mineral inclusions. It does not weather in a moist atmosphere and, because it carves well and takes a high polish, it has been used for jewellery at least as long as amber. Old carvings have been found in England and Scotland, largely made from jet found in Yorkshire. Samples from the Liassic Posidonia shale from Holzmaden (Germany), from the Yorkshire mines and from the deserts of the SW USA were studied especially for their mechanical loss spectra. K.v.G.

**Chinese neolithic jade: a preliminary study of archaeological geology.**

WEN GUANG, JING ZHICHUM, *Bull. Friends of Jade*, **8**, 1994, pp 125-47, 7 photos, 4 figs.

Analysis of jade artefacts from the neolithic period in China shows that nephrite was used extensively in the period. There is a review of jade mineralogy and an extensive list of references. M.O'D.

**Der Sonnengott der Azteken. Die Opale der Neuen Welt: ein Überblick.**

J.S. WHITE. *Mineralientage München, Messethemenheft*, 1994, pp 52-8, 11 photos in colour.

Brief review of opal with particular reference to specimens found on the American continent. M.O'D.

**Check-list for rare gemstones: carletonite.**

W. WIGHT. *Canadian Gemmologist*, **14**(1), 1993, pp 14-17, 1 fig.

Light blue transparent carletonite from Mont Saint-Hilaire, Rouville County, Quebec, Canada, has occasionally been faceted. Between 1982 and 1987 crystals recovered from the Poudrette Quarry reached 5cm in length. Notes on occurrence and properties are given. M.O'D.

**Check-list for rare gemstones: villiaumite.**

W. WIGHT. *Canadian Gemmologist*, **13**(4), 1992, pp 110-13, 1 photo.

Note on the properties and ornamental possibilities of the sodium fluoride villiaumite. Most gem-quality material comes from Mont Saint-Hilaire, Rouville County, Quebec, Canada.
M.O'D.

**Check-list for rare gemstones: shortite.**

W. WIGHT. *Canadian Gemmologist*, **14**(2), 1993, pp 46-9, 1 fig.

Shortite, in pale yellow transparent crystals has been found at Mont Saint-Hilaire, Rouville County, Quebec, Canada. The largest faceted stone recorded weighs 3.52ct. Occurrence and properties are described. M.O'D.

**Check-list for rare gemstones: sodalite.**

W. WIGHT. *Canadian Gemmologist*, **14**(3), 1993, pp 78-81, 1 fig.

The nepheline syenite quarries at Mont Saint-Hilaire, Rouville County, Quebec, Canada, have provided specimens of transparent hackmanite, a variety of sodalite which show tenebrescence, in this case occurring pink and reverting to colourless or achieving pink coloration after irradiation with UV, during which an orange fluorescence is seen. Some specimens remain magenta. Properties and details of the occurrence are given. M.O'D.

**Check-list for rare gemstones: vlasovite.**

W. WIGHT. *Canadian Gemmologist*, **14**(4), 1993, pp 110-13, 1 fig.

Facetable vlasovite is reported from the Kipawa alkaline complex beside Sheffield Lake, Villedieu Tp., Temiscamingue County, Quebec, Canada. Notes on the occurrence and properties are given. M.O'D.

**Check-list for rare gemstones: eudialyte.**

W. WIGHT. *Canadian Gemmologist*, **15**(1), 1994, pp 14-17, 1 fig.

Red transparent eudialyte from the Kipawa Alkaline Complex, Quebec, Canada, has been faceted. Notes on the occurrence and properties are given. M.O'D.

**Check-list for rare gemstones: dolomite.**

W. WIGHT. *Canadian Gemmologist*, **15**(1), 1994, pp 46-9, 1 fig.

Facetable transparent colourless dolomite is described from the Nanisivik mine, Baffin Island, Northwest Territories, Canada. A few pink stones have been found. M.O'D.

**Check-list for rare gemstones: scheelite.**

W. WIGHT. *Canadian Gemmologist*, **15**(3), 1994, pp 78-81, 1 fig.

Facetable yellow-orange scheelite has been found at Emerald Lake, Yukon Territory, and colourless material from Foley Mountain, Agassiz, New Westminster District, British Columbia, Canada. Properties are given. M.O'D.

**Okanagan opal.**

R.W. YORKE-HARDY. *Canadian Gemmologist*, **15**(1), 1994, pp 43-5, 1 photo.

Gem-quality opal has been found near Vernon, British Columbia, Canada, occurring as fracture and vesicle fillings in various Tertiary volcanic rocks. Stability appears to be good. M.O'D.

**Neue Grossulare aus Dionboko/Mali.**

J. ZANG. *Lapis*, **19** (10), 1994, pp 45-6, 2 photos (in colour), 1 fig.

Crystals of grossular garnet, some of facetable quality, are reported from the vicinity of Dionboko in the Kayes region of Mali. Specific gravity is given as 3.63-3.72 and refractive index as 1.756-1.769. The colour of the faceted stone illustrated is yellowish-green. Both iron and chromium have been identified in specimens recovered. M.O'D.

**Fritz Klein: Smaragde unter dem Urwald.**

ANON. *Lapis*, **19**(11), 1994, pp 28-37, 13 photos (12 in colour).

Fritz Klein wrote *Smaragde unter dem Urwald* in 1941 and his career as an emerald buyer in Brazil and Colombia is described. One of Klein's exploits led to the rediscovery of the Chivor mine. Photographs of current activity in some of the areas visited by Klein are included. M.O'D.

## Instruments and Techniques

**Spectrophotometry in gemmology.**

J. ALLAMAN. *Cornerstone, Journal of the Accredited Gemologists Association*, **Autumn/Winter**, 1994, pp 1,3,4, 3 figs.

In gemmology the sensitivity and speed of spectral analysis afforded by the spectrophotometer is being increasingly used for the identification of gems and synthetics. Combined with computer software it is also used for colour analysis in the colour grading of diamonds, the comparison of diamond master stones and the detection of irradiated diamonds. P.G.R.

**Le 'Pearlscop', un nouvel instrument gemmologique.**

H. ATALAY. *Revue de Gemmologie*, **120**, 1994, pp 15-16, 1 photo, 2 figs.

Monochromatic light from a laser source is used to identify drilled or non-drilled pearls. The method works in a similar way to the endoscope. M.O'D.

**Contouring with diamond wire.**

G.L. BIASCO. *Industrial Diamond Review*, **54**(562), 1994, pp 114-16, 1 table, 4 diagrams, 5 illus. in colour.

Over the years the stone industry has seen many developments in processing techniques, all of which have contributed in ensuring the growth of a major area of diamond tool usage. Not least are the computer-controlled machines employing diamond wire. There are at present about fifty of these machines in use in Europe alone. The main uses are the production of tombstones, curved slabs for cladding and columns in the manufacture of modern and antique style accessories. The technique of producing stone profiles with the help of computer-controlled contouring machines is described. E.S.

**Modelling the growth of natural diamonds.**

S.R. BOYD, F. PINEAU AND M. JAVOY. *Chemical Geology*, **116**(1-2), 1994, pp 29-42.

Using available evidence it has been possible to construct a model for the growth of coated diamonds; using this model C isotope fractionation related directly to diamond formation is considered. In contrast, the comparative lack of knowledge of many aspects of the growth conditions of octahedral diamonds leads to uncertainty regarding the interpretation of the isotopic data. Detailed studies (particularly CL and FT-IR) of the internal zoning in isotopically distinct populations of diamonds may help, possibly revealing marked differences in the conditions of growth. R.E.S.

**Penetrating diamonds with X-rays and a microscope.**

A.R. LANG. *Industrial Diamond Review*, **54**(3), 1994, pp 141-6.

The information yielded by simple crystal assessment methods, such as birefringence microscopy, is much enhanced by the correlation of birefringence observations with cathodoluminescence and X-ray topography. In this article, the volume-imaging capabilities of birefringence microscopic and X-ray topographic techniques are described and illustrated, and are combined to give pictures of the internal strains in diamonds that are both comprehensive and capable of interpretation. Since no lenses are used with X-rays, it is not possible to focus observations on a selected layer in the crystal, as can be done in optical microscopy. However, equivalent results can be achieved by a variant of the projection topograph technique, the 'limited projection topograph'. R.A.H.

**Optical anisotropy in the spinel group: a polishing effect.**

E. LIBOWITZKY. *European Journal of Mineralogy*, **6**(2), 1994, pp 187-94.

Examination of > 100 polished sections of magnetite, chromite, franklinite and jacobsite from ~50 localities used two final polishing procedures. Using a 0.1 µm diamond suspension on 'microcloth' always led to weak optical anisotropy, except for {100} and {111} sections, whereas use of an alkaline silica solution on 'microcloth' gave sections which remained isotropic with the exception of five zoned magnetites. Electron channelling pattern images with SEM showed a strongly damaged surface for samples prepared with the diamond suspension and a perfect undisturbed surface for those prepared using an alkali silica solution. This convincingly indicates that the anomalous optical anisotropy effects in the spinel group are usually caused by mechanical polishing procedures. R.A.H.

**Catodoluminiscencia (CL) y espectros de catodoluminiscencia de diamantes sintéticos experimentales De Beers.**

J. PONAHLO. *Boletín del Instituto Gemológico Español*, **35**, pp 25-38, 2 tables, 21 illus. in colour, 8 figs.

Synthetic gem-quality diamonds manufactured by De Beers show geometrically-patterned colour zoning under cathodoluminescence. Polarization figures induced by stress have been observed as well as large euhedral crystals of unknown composition. Colours induced by cathodoluminescence are a greenish yellow and blue. Growth lines can be seen in different sectors of the stones. M.O'D.

**An experimental optical Brewster-angle refractometer.**

P.G. READ. *Gemmological Assoc. of New Zealand*

*Newsletter*, **Nov.**, 1994, pp 5-7, 4 figs.

The author traces his development work on Brewster-angle refractometers from the first simple optical model in 1979 through two fully electronic versions to a more recent optical model using a miniature visible red (670nm) solid-state polarized laser. This latest experimental unit is housed in a modified Dialdex refractometer case and the drum mechanism is used to drive the laser carriage through the 18 degrees of angular movement necessary to cover the RI range of 1.40 to 3.00. (Author's abstract) P.G.R.

## Synthetics and Simulants

**AGEE synthetic hydrothermal emerald.**

S. FERNANDES, S. SARMA AND V. JOSHI. *Indian Gemmologist*, **4**(3/4), 1994, pp 30-1, 3 photos (in colour), 3 figs.

Emerald manufactured by AG Japan Ltd is grown hydrothermally, probably from low quality emerald feed material. RI is found to be 1.573-1.580 with DR 0.004-0.007, SG 2.67-2.72. A strong red is seen through the Chelsea filter and there is a variable fluorescence, weak red to inert. Promotional literature gives figures for RI as 1.569- 1.573. Stones showed partially spiral fingerprints, growth and angular zoning, parallel cavities, crystal structures and widely spaced colour zoning, indicating hydrothermal origin; the IR spectrum for water was also observed.

M.O'D.

**Synthetic emerald overgrowths on colourless beryl crystals.**

U. HENN AND H. BANK. *Canadian Gemmologist*, **14**(4), 1994, pp 102-3, 2 photos.

Colourless beryl crystals with an overgrowth of emerald have been produced in Russia. The natural seed contains inclusions which may deceive the gemmologist but the boundary between seed and overgrowth can be seen under magnification. M.O'D.

**Microscopic features of synthetic rubies. Part 1: melt products.**

R.C. KAMMERLING AND J.I. KOIVULA. *Canadian Gemmologist*, **15**(3), 1994, pp 82-5, 8 photos.

Details of inclusions likely to be found in melt-grown rubies are given with particular reference to Verneuil, Czochralski and floating-zone products. M.O'D.

**The characteristics of Russian flux-grown synthetic red and blue spinels.**

J.I. KOIVULA AND R.C. KAMMERLING. *South African Gemmologist*, **8**(2/3), 1994, pp 4-15, 8 photos in colour.

The presence of flux residues, air-filled fractures and particles of crucible wall material are the most characteristic features of flux-grown red and blue spinel manufactured in Russia.

M.O'D.

**Gem News.**

J.I. KOIVULA, R.C. KAMMERLING AND E. FRITSCH. *Gems & Gemology*, **30**(2), 1994, pp 122-32, 1 table, 18 illus. in colour.

A new emerald imitation 'Swarogreen' made by Swarowski of Austria had an RI range of 1.608-1.612 and an SG of 2.88-2.94. This glass had a reported dispersion of 0.030 and a Mohs' hardness of approximately 6.5. The higher-than-usual RI is due to the presence of both calcium and aluminium. Minute machine-cut synthetics as small as 1mm diameter were shown at Tucson and included emerald simulants consisting of green synthetic spinel triplets. Faceted synthetic opals by Gilson showed a slightly milky body colour and exhibited a full range of hues with green predominating. Manning International showed several Czochralski-pulled sapphires with a saturated slightly greenish-yellow colour. The main chromophore was nickel. Microscopic examination revealed curved growth lines. A near-colourless Russian synthetic diamond produced using a 'belt' apparatus was examined and the cuboctahedral crystal revealed large metallic inclusions and fluoresced yellow in short-wave ultraviolet radiation only. The crystal adhered to a simple magnet and the metallic inclusions contained iron. R.J.P.

**Relationship between the crystallographic orientation and the 'alexandrite effect' in synthetic alexandrite.**

Y. LIU, J.E. SHIGLEY, E. FRITSCH AND S. HEMPHILL. *Mineralogical Magazine*, **59**(1), 1995, pp 111-14.

The transmittance spectra of a synthetic alexandrite along the three crystallographic axes are in general similar, but the observed colour changes along these directions under different light sources are quite different. Calculated hue-angle changes for colours observed under different pairs of CIE standard illuminants are largest for light travelling || to the *a* axis. Therefore, alexandrite as a gemstone should be cut with the top facet oriented || (100) for it to show the most dramatic change in colour. R.A.H.

**Synthetic forsterite and synthetic peridot.**

K. NASSAU. *Gems & Gemology,* **30**(2), 1994, pp 102-8, 1 table, 6 illus. in colour.

Large crystals of forsterite doped with chromium are manufactured commercially for use as a laser material. Forsterite is an end member of the olivine series being magnesium silicate, whilst fayalite, iron (II) silicate is the other end member. Peridot is a silicate containing both iron and magnesium. It has only been produced in experimental amounts and the data so far are consistent with natural peridot, although inclusions are distinctive. The crystal formation used an image-furnace floating-zone technique with an atmosphere of carbon monoxide and carbon dioxide. Any oxygen leak resulted in a brown peridot.

The synthetic chromium-containing forsterite is usually of a different colour to peridot but a peridot-like colour is possible with some overlap of gemmological properties. However, the chromium compound has a distinctive visible spectrum and lower refractive index and specific gravity values than natural peridot. R.J.P.

**Unusual synthetic.**

K.T. RAMCHANDRAN AND J. PANJIKAR. *Indian Gemmologist,* **4**(3/4), 1994, p. 3, 3 photos in colour.

An apparently natural faceted ruby with solid-appearing inclusions beneath the crown facets showed Plato lines on immersion but no curved growth lines. The inclusions proved to be a concentration of chromium salt with aluminium oxide. M.O'D.

**Synthesis, stability, and properties of $Al_2SiO_4(OH)_2$: a fully hydrated analogue of topaz.**

B. WUNDER, D.C. RUBIE, C.R. ROSS II, O. MEDENBACH, F. SEIFERT AND W. SCHREYER. *American Mineralogist,* **78** (3-4), 1993 pp 285-97.

The OH end-member of the F-OH topaz solid-solution series, with a composition close to $Al_2SiO_4(OH)_2$, has been synthesized at $P$ between 55 and 100 kbar and $T \leq 1000°C$) from gels and crystalline starting materials. The results of single-crystal X-ray diffraction (space group *Pbnm*, *a* 4.724, *b* 8.947, *c* 8.390 Å) are reported. J.A.Z

**Note**

1. These are short abstracts from extended abstracts published in *Mineralogical Magazine* **58A** (two parts), 1994. The volumes contain only the extended abstracts of papers from the V.M. Goldschmidt Conference, Edinburgh 1994.

# Book Reviews

**Versteinertes Holz. Aus Holz wird Stein: die Mineralogie der Holzversteinerung.**

U. DERNBACH, M. GLAS, R. HOCHLEITNER, W. JUNG, M. LANDMESSER, H. MAYR AND A. SELMEIER, 1994. Christian Weise Verlag, Munich. pp 96, illus. in black-and-white and in colour. Price DM29.80. (*extraLapis* 7) ISBN 3 921656 32 X.

This seventh monographic issue of *extraLapis* has the theme of replacement and pseudomorphism with particular reference to the replacement of organic materials by silica. Among the topics discussed are opal and agate structure with notes on collectors and collections, mining and chemistry, and there is a useful bibliography on the formation of agates. Readers will find the coloured photographs both beautiful and informative and some notes on the history of solutions in agate formation will be hard to find elsewhere. M.O'D.

**Brésil, terre de pierres. Mines, cristaux et garimpeiros.**

C. DUFOUR AND J.-P. HÄNNI, 1994. Muséum d'histoire naturelle de Neuchâtel, Neuchâtel. pp 80, illus. in colour. Price SF 28.00. ISBN 2 940041 01 6.

A short but beautifully-produced account of the major gem minerals of Brazil with descriptions of geology, mining methods and geology. The photographs are original and particularly welcome on this account since so many pictures while excellent in themselves go the rounds once too often. Some of the photographs show mining techniques in operation. Gem minerals in the book include diamond, topaz, beryl, tourmaline and quartz, making up, in fact, the bulk of the text. There is a short bibliography. M.O'D.

**Silica: physical behaviour, geochemistry and materials applications.**

P.J. HEANEY, C.T. PREWITT AND G.V. GIBBS (eds), 1994. Mineralogical Society of America, Washington. pp xviii, 606, illus. in black-and-white (*Reviews in mineralogy*, vol. 29). ISBN 0 939950 35 9.

A comprehensive account of silica in all its forms. Gemmologists will find the chapter by Rossman, on coloured varieties of the silica minerals, very useful, though there is much else of interest in the rest of the book. As always in this series, the lists of references are very valuable. The level is undergraduate to post-graduate. M.O'D.

**Visual optics: diamond and gem identification without instruments: the Hodgkinson method.**

A. HODGKINSON, 1995. Gemworld International Inc., Northbrook IL. pp v, 50, illus. in colour. ISBN 0 96417331X. £16.50

While the term 'visual optics' may puzzle physicists and mineralogists, those gemmologists who have used Hodgkinson's method - and members of the general public who have stood amazed by its results - know that it means that anyone can identify a faceted gemstone, within limits, under controlled conditions.

This is, of course, not true and the book does not in any way claim that so simple a method of testing can produce results all the time in any hands. What it does claim is that trained operators can quite often, sometimes with unpromising material, identify an unknown with small risk of error. The book is very attractively produced and reads very well despite a few obscure sentences and unexplained technical terms, which I think would rule it out for universal use. The author's photographs and diagrams are well reproduced and the tests could be followed by any gemmologist or student.

Does the book succeed in its argument? Yes, since it does not over-claim and so far as I can see all the tests would work. I am sure that there will be counter-claims on a specific aspect of a particular test and I am also certain that developments will arise over the years. This is how a diagnostic science should work and this interesting and moderate overview of a way of gem testing should be welcomed in its context. The beautiful view of Arran from the author's laboratory will certainly make many diamonds rise a grade or two in colour! Buy the book to find out why! M.O'D.

**Handbook of crystal growth.**

D.T.J. HURLE, 1993. North-Holland, Amsterdam. Illus. in black-and-white and in colour, hardcover. Approx. 560 Dutch guilders per volume. 3 volumes [in 6]. ISBN [series] 0 444 89933 2.

This is the most important monograph on crystal growth yet to appear in any language and while most gemmologists will probably not have

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access to copies (costing something like £700-800 for the complete set) they will find a very large amount of information on the processes of crystallization and references to monographs and papers on all aspects of crystallization. The first part (in two volumes) deals with fundamentals, divided by volume into thermodynamics and kinetics and transport and stability. The second part, again in two volumes, covers bulk crystal growth, divided again into basic techniques and growth mechanisms and dynamics. The third part covers thin films and epitaxy, divided into basic techniques and growth mechanisms and dynamics.

Gemmologists will find the sections in volume 2 most relevant to their studies as they cover those types of crystal growth most appropriate for gemstones. There is a great deal of relevant material in the rest of the book but some skill is needed to find exactly what is wanted since the text is aimed at crystal growers and at those dealing with characterization rather than crystal applications. This is a book likely to be found only in the largest two or three university libraries but is a monument to the science and well worth looking through if and when encountered. M.O'D.

**Das Diamanten-Imperium. Aufstieg und Macht der Dynastie Oppenheimer.**

S. Kanfer, 1994. Carl Hanser Verlag, Munich. pp 503, hardcover. Price DM45.00. ISBN 3 446 16075 2.

This is a German version of *The last empire: De Beers, diamonds and the world,* first published in 1993. The theme is the fairly well-tried one of the De Beers near-monopoly of diamond recovery and price maintenance with useful history of how the group of companies developed. Sidelights on South African politics are given and there are very useful lists of references for each chapter. M.O'D.

**Manual of mineralogy 21st edition.**

C. Klein and C.S. Hurlbut Jr, 1993. John Wiley & Sons Inc, New York. pp xii, 681, illus. in black-and-white, soft cover. Price £22.95. ISBN 0 471 59955 7.

This is an ideal text to read with that of Putnis, reviewed elsewhere. In the continuing absence of a completed (or better, a revised and completed *System of mineralogy*) the two texts, theoretical and taxonomic, complement each other excellently and in this new edition of the *Manual* chapters on crystal chemistry and mineral chemistry have been revised and a new chapter on mineral stability diagrams included. Such diagrams are now incorporated in the descriptive section where relevant. Crystal chemistry is the underlying theme in this edition, as with its more recent predecessors. Chapter 15 describes gem minerals briefly and many will find both the descriptive section and the tables useful. It is always important for gemmologists to keep up with current thinking in the wider earth science field, however fast or slowly it moves. M.O'D.

**Mineralogical gemmology. The precious minerals through the centuries.** [In Bulgarian.]

R.I. Kostov, 1993. Nauka i Izkustvo Publishing House, Sofia. 213 pp. Price Bulgarian Leva 32.00.

This book reviews the aesthetic attitude of mankind to the precious and decorative minerals and bio-objects used in different epochs and different countries and continents. A lot of mythological stories and ancient texts have been analyzed, as well as some works of well known writers and poets of the past. The first part of the book describes gemmology as a complex science, lists important contributions in the history of gemmology and gives the principles for classification of gemmological minerals. The second part is related to mythological texts, stories and legends about gemstones in primitive societies, in the Ancient and Medieval civilizations around the world. The third part deals with the miracles and reality about gem materials in the spectrum of knowledge, philosophy, astronomy, physics, chemistry, geosciences, medicine, ethnography and semantics. The last part is an attempt to give an art point of view on crystals and gemmological materials. A glossary of gemmological names (natural materials) has been added for the general reader. The book can be defined as a work on mineralogical folklore with a lot of new ideas and information after the pioneer works of G.F. Kunz in the USA and A.E. Fersman in Russia. R.A.H.

**Amethyst: geschichte, eigenschaften, fundorte.**

W. Lieber, 1994. Christian Weise Verlag, Munich. pp 188, illus. in black-and-white and in colour, hardcover. Price DM98.00. ISBN 3 921656 33 8.

In a well-printed and beautifully illustrated book Werner Lieber, who has already written such mineral classics as *Kristalle unter der Lupe* and *Calcit, Baustein des Lebens,* introduces both the mineralogically-inclined and the more general reader to the history, geology, mineralogy and identification of amethyst. The gemmologist, too, will find the text quite sufficiently extending and there is an excellent bibliography.

The book begins with the use of amethyst over the past 5000 years and then goes on to describe the form and structure, physical and optical properties, cause of colour, inclusions and synthesis. The remainder of the text, some 100 pages, is devoted to the main amethyst occurrences of the world and one of the indexes covers locality names. Here and there about the text are pictures of postage stamps and in some ways the main thrust of the book is towards the collector. The photographs are very well chosen and reproduced and the variations in colour are sufficiently distinguished to show how great they can be. Gemmologists will welcome the photographs of inclusions and the diagrams in the text, especially those depicting the forms of crystals and the ways in which twins occur, are especially well-drawn and clear. The price of the book is very reasonable and I strongly recommend readers to obtain a copy. M.O'D.

**The crown jewels.**

K. Mears, 1994. Historic Royal Palaces Agency. pp 51, illus. in black-and-white and in colour, softcover. (Original text by K. Mears revised with additions by Simon Thurley and Clare Murphy.) £3.50.

Guides to the crown jewels have never equalled the importance of their subject either in text, illustration or standard of production. There has always been a sense of let-down over an unscholarly, breathless and hastily-written text or over indifferent photographs set out in an amateurish style. The present book, while one of the best of recent productions, does not go all the way to remedying a rather mysterious tradition. Here the text is harmless and the pictures nearly all good (some are very good, in fact): there is, though, too much white paper showing and the text of the captions is rather small. The cover, while boldly conceived, is too dark to be really successful and some of the other photographs also have too much shadow.

While I see no serious inaccuracies in the text, the dearth of information is sad: so much more could have been supplied and none of the information given would be new even to fairly well-read people, let alone to scholars. The book is, though an improvement on most others, another example of insufficient initiative or skill being brought to bear on a subject of major importance to the historian and gemmologist. Something in the crown jewels seems to stop serious effort either being initiated or, when started, carried on. Timidity has wrecked what have promised to be previous attempts to provide a useful survey. Perhaps the curse of the regalia will lift when a champion of adequate status presents himself. M.O'D.

**Physics and chemistry of earth materials.**

A. Navrotsky, 1994. Cambridge University Press, Cambridge. pp xiii, 417, illus. in black-and-white, softcover. (*Cambridge topics in mineral physics and chemistry. 6*) £22.95. ISBN 0 521 35894 9.

The book is intended for first-year and more senior undergraduates and is aimed to present crystal chemistry away from the rock-forming context and also to give an overview of chemical bonding in minerals. The author relates microscopic structural features to macroscopic thermodynamic behaviour and in doing so shows off the usefulness of modern tools, especially in spectroscopy. High-pressure phase transitions, solid-state reactions and amorphous materials are discussed in conclusion.

While gemmologists will probably find the general standard rather above diploma level, sections on spectroscopy and crystal structure may fill gaps in understanding left by standard gemmological texts: mineralogists will find the book an excellent overview of a topic much in discussion today. The long lists of references appended to each chapter are valuable in themselves.

M.O'D.

**Introduction to mineral sciences.**

A. Putnis, 1992. Cambridge University Press, Cambridge. pp xx, 457, illus. in black-and-white, softcover. Price £22.95. ISBN 0 521 42947 1.

Over the past few years there have been so many developments in techniques in the mineral sciences that the more customary taxonomic type of mineralogy text now needs a companion work in which these are described. Advances in techniques have made it possible for a greater understanding of mineral formation and behaviour to be developed and this aspect of mineralogy is a major theme in this book. While many of the concepts are perhaps a little too advanced and mathematical for the majority of gemmologists they should be aware of some of the current work and ideas in what is still seen as the parent science. M.O'D.

**Dictionary of gemmology.**

P.G. Read, 1994. Butterworth-Heinemann, Oxford. pp 266, illus. in black-and-white, softcover. Second edition. £16.95. ISBN 0 7506 1675 X.

It is pleasing to meet an old friend in a new and cheaper issue, though the covers, like those of our real friends, conceal matter both good and questionable! This may be the time for an evaluation of the enterprise before a third edition appears.

A check of the some 3000 entries shows that approximately 30 per cent are little-used names of ' gem' materials. A sample of these tested against *Hey's mineral index* shows that approximately half are not included and are thus regenerated by the book under review (via some of the mostly British pundits of the 1960s whose uncritical work was unhelpful in this context). Further investigation shows that these entries include some misreadings (e.g. darlingtonite for darlingite [jasper]) and some names first making their appearance in the late eighteenth century.

Someone, sometime, needs to ask the question 'were these names ever in general currency?' I am quite sure that only a very few were used in the trade and that most originate from novels and the more fanciful mineralogical texts of the last century. Unless readers are engaged in serious mineralogical or gemmological taxonomy they perhaps do not need so many names?

This is a vexed question arising from the time when gemmology was little but an amateur and commercial aspect of mineralogy. Now that mineralogy itself is taken in some quarters to be inorganic natural products chemistry (with some geology) it seemed worthwhile to look at some of the chemistry in the *Dictionary*. The description of garnet as an isomorphous series of gem minerals' misses the point that 'garnet' is a group name and the remainder of that entry, somehow dragging in the feldspar group, repeating iron and omitting potassium, only confuses more. The tourmaline entry again omits the group name status (which explains the chemistry and properties much more easily). Uvite is stated to be a dravite-type tourmaline but is, in fact, an individual species within the tourmaline group. Fibrolite is said to be polymorphous with andalusite and kyanite but it would be more accurate to say that the three species are polymorphs of $Al_2SiO_5$. The entry for olivine is inaccurate in that no mention is made of the magnesium content nor of the isomorphous series existing between forsterite and fayalite, knowledge of which is important in gem testing.

On a lighter note, I was interested to encounter the concept of the 'rare collector' and hope that they form a club which I might one day join when sufficiently eminent. It is always good to have an ambition! Non-rare [common?] collectors have to be content with crocoite while their betters can have creedite (inexplicably, with other species, described as 'complex').

From the book itself it is not clear whether the text has been revised but a publisher's note accompanying the review copy calls it a 'revised paperback edition'. One of the adjectives must be incorrect but I do recommend the book even as it stands, as the only text of its kind. It would have been helpful if the publisher had included a short biography of the author who, after all, has made money for them: this type of omission is discourteous and unhelpful to later bibliographical scholarship. M.O'D.

**Jade treasures of the Maori.**

M. RILEY, 1994. Viking Seven Seas Ltd, Paraparaumu, New Zealand. pp 63, illus. in black-and-white and in colour, softcover. Price NZ$6.25. ISBN 85467 090 4.

A really first-class small book covering one part of the jade story that gets less airing in proportion to that given to the Far Eastern scene. The bibliography alone, containing references to MS material in New Zealand and other libraries, is worth the very reasonable price. The book has beautiful photographs, a great deal of folk-lore pertaining to jade in New Zealand and notes on the ritual and other significance of the shapes of jade artefacts used by the Maori people. Maori names for the various colours of nephrite are listed, with notes on their origin. In many cases the names originated in descriptions of native creatures. This is one of the most interesting books I have seen for a long time. M.O'D.

**Humboldt's travels in Siberia (1837-1842): the gemstones. Extracts and commentaries on Gustav Rose's Reise nach dem Ural, 1837-1842.**

G. ROSE [translation and commentary by John Sinkankas. Edited by George M. Sinkankas], 1994. Geoscience Press, Phoenix, AZ. pp 80, illus. in black-and-white, hardcover. Price on application. ISBN 0 945005 17 2.

The expedition mounted by Alexander von Humboldt to the then virtually unknown Siberian part of the Russian realm was intended to explore mineral possibilities. Count Cancrin, Minister of Finance to the Tsar, had a strong interest in minerals (cancrinite was later to be named after him) and was instrumental in establishing the expedition. Gustav Rose, the team's official geologist and later to be the namer of cancrinite, was the recorder and secretary. Rose eventually produced a two-volume description of the expedition's activities under the title

*Mineralogische-geognostische Reise nach dem Ural, dem Altai und dem Kaspischen Meere* - a title usually, as here, shortened to *Reise nach dem Ural*. Considerable attention was paid to the gemstones and the work has very great value on this account alone.

The travels began in Berlin and proceeded to St. Petersburg. Before the travellers had got very far they had their first experience of displayed gem materials (amber) in the mineral collection of the University of Königsberg in the then East Prussia. A good deal of detail about amber in general from the Königsberg area is given and the pattern of 'expedition stops somewhere - gemstone deposits, traders or collectors encountered - Rose writes about them' is maintained as the travellers passed from St. Petersburg to Ekaterinburg to the northern Urals, to the Altai, to Miask, Slatoust, Orenburg and elsewhere. In passing, extended details are given on such topics as the Orlov and Shah diamonds, the habits of topaz crystals from Mursinsk and chrysoberyl from the Uralian emerald mines. The amount of useful and unpublished material is very large and readers will be most grateful to Sinkankas for unearthing the treasures from the larger work. In passing, Sinkankas laments the poor acquaintance of British-American writers with German mineralogical works and after years of working with German and other continental language texts I can support his strictures with experience! The language barrier seems insurmountable to the insular and thus poorly-informed British gemmologist at least - perhaps a closer acquaintance with Europe over the next few years will put this right. M.O'D.

**Crystal identification with the polarizing microscope.**

R.E. Stoiber and S.A. Morse, 1994. Chapman & Hall, New York. pp xiv 358, illus. in black-and-white, softcover. Price £24.95 (paperback), £65.00 (hardback). ISBN 0 412 04831 0.

It is very pleasing to meet a new text on one of the most traditional methods of mineral identification. This is desert-island mineralogy with never a black (or grey) box in sight. The authors set themselves a difficult task when they state their aim is to make the text available and understandable to the widest range of readers from beginner to professional but my feeling is that they are largely successful. The opening chapters cover crystal identification and optical properties, the text then passing to the different types of effects shown by isotropic and anisotropic specimens. Gemmologists will be familiar with a good deal of this material and it is presented in such a way that diagrams and text complement each other satisfactorily. Perhaps many will find the account of the immersion method of obtaining refractive index particularly interesting while others will not be able to wait to get to grips with biaxial crystal optics. Appendix A gives the optical properties of common rock-forming minerals while Appendix B outlines the identification of fibrous asbestos, by now known to everyone as a notorious health hazard. There is an excellent bibliography which refers entries back to the pages on which they occur - a very useful feature.

I strongly recommend gemmologists to buy this book which is very reasonably priced. It will explain many aspects of optical mineralogy which cannot be followed, for space reasons, in specifically gemmology-oriented textbooks.

M.O'D.

**Gem care.**

F. Ward, 1995. Gem Book Publishers, Bethesda, MD. pp 32, illus. in colour, softcover. *(Fred Ward Gem Books.)* Price on application. ISBN 0 9633723 5 1.

Fred told me something I already knew - that there was no comparable book on the market! This short and pleasant-appearing guide tells the jeweller and customer about the way to handle (and not to handle) the major gemstones. Photographs accompany each gem section and the text concludes with Mohs' hardness figures for quite a lot of species. Matters dealt with include hardness, cleavage, cleaning (beware of ultrasonic cleaners for brittle stones, especially tanzanite and emerald), storage conditions and the effect of chemicals, including cosmetics. Each stone is also given a brief description. This is a book for everyone. M.O'D.

**Pearls.**

F. Ward, 1995. Gem Book Publishers, Bethesda, MD. pp 64, illus. in colour, softcover. £9.95. ISBN 0 9633723 3 5.

The literature of pearl is still far less exhaustive than that of inorganic gem materials and while there have been one or two books published in the last few years they have not attracted the eye so much as this short guide which succeeds in covering a difficult subject very well. The book opens with notes on the history and lore of pearl, then describes natural, cultured salt-water, and cultured freshwater pearls. Mother-of-pearl and shell products, imitation pearls and the purchase and care of pearls complete the book.

As with all the *Fred Ward Gem Books*, there are photographs of a kind and quality never before seen and this reviewer, at least, is beginning to learn some of the pearl basics. Readers could turn to any opening to find stimulus but try pages 30-31 first - they show the inside of a cultured pearl. Notes on mother-of-pearl and shell are especially welcome since these have had scarcely any up-to-date treatment in the literature. A must for students and for presents!

M.O'D.

**The art of diamond cutting.**

B. Watermeyer and S.S. Michelsen, 1994. Chapman & Hall, New York. pp xxi 137, soft-cover. £19.99. ISBN 0 412 98411 3.

The difference between the work of the lapidary and that of the diamond polisher is not so great, say the authors, that a good lapidary may not learn how to polish diamonds successfully. The book is a simple manual designed to make just such a transformation and sensibly begins with a glossary which is worth reading before starting on the main text. After a short discussion on diamond formation and structure, the authors describe how rough material is selected for polishing and go on to exhibit the processes of bruting and girdle faceting. As in the remainder of the book, the text is accompanied by clear diagrams. Chapters 4 to 6 tell the reader about the mechanics of diamond polishing so that he may set up his own lap (levelling it is hard to do) and have all the equipment set up before turning to Chapters 7, which shows how to find the four-point grain direction, and 8, which deals with facet placement for the round brilliant-cut.

The repair and re-cutting of old-cut diamonds (sometimes a pity!) is dealt with in Chapter 9 and further discussion of equipment follows. An account of diamonds from various sources and the working of the diamond market in the United States completes the main text. Advice is then given to the aspiring home polisher and an appendix explains the pricing structure for rough diamonds.

I enjoyed reading the book and can certainly recommend it, not only to its intended readership but also to students who want to know the essentials of diamond polishing. The price is competitive by today's standards. M.O'D.

**Australasian mining and metallurgy: the Sir Maurice Mawby memorial volume (second edition: in two volumes).**

J.T. Woodcock and J.K. Hamilton, eds., 1993. Australasian Inst. of Mining & Metallurgy, Parkville, Victoria, *Monograph 19*. pp xxxvi 1587. Price $A 325.00.

This is essentially an upgraded version of *Monograph 10*, published in 1980. Its aim is to reflect the technical, operational and general practices of the mining and metallurgical industry in Australasia after 100 years of activity. It contains 416 articles on current activities in Australia, New Zealand, Papua New Guinea and Fiji, in 20 chapters covering background, general practices, environmental management, research, education and training, statistics of mineral and metal production, iron ore, iron and steel, Pb-Zn-Ag, Cu, Al, Au, Sn-W-Ta, U, Ni-Co, other metals, mineral sands, industrial minerals, diamond and other gems, and coal; there are author and subject indexes. Listed below are the articles most likely to be of interest to gemmologists:

(1) Hard rock diamond mining at Argyle Diamond Mines Pty Limited, Argyle, WA. D. Yates, D. Matthews and S. Deakin, pp 1443-9, 2 maps.
(2) Diamond mining by Poseidon Bow River Diamond Mine Limited, Bow River, WA. M. McCracken and T. Major, pp 1449-52, 1 map. Alluvial gravels yielding 0.28 ct/t. Gem-quality 15-20 per cent, due to presumed concentration from Argyle source.
(3) Opal mining in Australia. I.J. Townsend and J.L. Keeling. pp 1472-6.
(4) Sapphire mining and production in the New England region, NSW. D.C. Lawrence, pp 1477-81.

R.A.H.

# Proceedings of the Gemmological Association and Gem Testing Laboratory of Great Britain and Notices

## OBITUARIES

**David Wilkins** (D.1962), Chairman of the NAG Registered Valuers Committee, gemmologist and jeweller of Yeovil, died on 29 August 1994.

David had struggled bravely with his illness, working, advising, planning and helping the trade right up until a few weeks before his death.

David was a founder member of the Registered Valuers scheme; indeed its inception, fruition and success is something that he could certainly be very proud of; during his career he was able to see so many ideas realized which proved of great benefit to so many people.

David was apprenticed as a watchmaker and became a craft member of the British Horological Association. To study gemmology, he travelled the 34 miles to Bath from Cirencester to attend the study classes run at 1 Royal Crescent and spent his career furthering his knowledge and expertise, all the while sharing it with his colleagues.

He was a Council member of the National Association of Goldsmiths and made a particular contribution to the education activities. An examiner for the Retail Jewellers Diploma for 28 years, he wrote training articles and courses on gemstones, jewellery, silver and antiques. His enthusiasm for gemmology was immense; his collection included much that was unusual and reflected his taste for quality. Many students will remember his insistence on viewing 'asterism in sunshine' and the satisfaction of appreciation!

David's contribution to the trade was unique and his tireless enthusiasm will be irreplaceable. David's widow, Margaret, who was always involved and so supportive of his work, and all of us who enjoyed his friendship and kindness will miss his generous spirit. Michael Norman

**Kenneth Norman Brohier** (FGA 1979, DGA 1980 with Distinction), Kirby, Merseyside, aged 64.

Gordon Brohier died in a road accident in Sri Lanka in September 1994. He was a close personal friend and a popular and enthusiastic member of the North West Branch of the GAGTL. He had in the past few years spent a large part of his time in Sri Lanka where his family owned a hotel in Galle and part of a tea estate. It was while working on plans for the future of a hotel and estate that he was so tragically killed. He is survived by his wife and a son and daughter. J.W. Franks

**Robert Anthony Buhl** (D.1982), West Vancouver, Canada, died on 8 January 1995.

**Thomas Reginald Shipster** (FGA 1950, DGA 1970), Bergvliet, South Africa, died recently.

## GIFTS TO THE ASSOCIATION

The Association is most grateful to the following for their gifts of gems and gem materials for research and teaching purposes:

Marie de Chamerlat, FGA, Paris, France,

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for buttons in shell, bone, horn and imitation materials.

Luella Woods Dykhuis, Tucson, Arizona, for sets of rough and cut sapphires from Montana.

Mrs M. F. M. Eliahoo, London, for two fine blue beryls.

Mrs Vanessa A. Guest, Nottingham, for specimens of rough and cut pectolite (larimar).

Steve Ryle, Dallas, Texas, for 21 cut Kashan synthetic rubies.

## NEWS OF FELLOWS

**Nick Sturman, FGA, DGA,** of the Gem and Pearl Testing Laboratory of Bahrain, gave a talk entitled 'An introduction to the world of gemstones' to the American Women's Association, at the Diplomat Hotel, Bahrain, on 13 February 1995.

## MEMBERS' MEETINGS

### London

On 16 January in the Gem Tutorial Centre at 27 Greville Street, London EC1N 8SU, Stefany Tomalin gave a talk entitled *Miniature treasures and wearable works of art.* Slides and 'hands-on' examples illustrated the most famous collectable types of bead.

On 20 March at the Gem Tutorial Centre Alexandra Rhodes FGA, a Director of Sotheby's and Head of their Jewellery Department in London, gave an illustrated talk entitled *Jewellery at Sotheby's.*

### Midlands Branch

On 24 February at Dr Johnson House, Bull Street, Birmingham, Clive Burch gave an illustrated talk entitled *Inclusions in silica gems.*

On 19 March a Gem Club was held, the subject of which was pearls.

On 31 March at Dr Johnson House Eric C. Emms gave a talk entitled *Diamond and its treatments.*

### North West Branch

On 15 March at Church House, Hanover Street, Liverpool 1, Alan Hodgkinson gave an illustrated talk entitled *A taste of Scottish gemmology.*

## ANNUAL TRADE LUNCHEON

**The 1995 GAGTL Annual Trade Luncheon is to be held on Friday 16 June at the RAC Club, 89 Pall Mall, London SW1.**

The Luncheon is open to all members and their guests and is an ideal opportunity to thank customers or suppliers for their support or to express appreciation to staff for their hard work. The speaker will be Jeremy Richdale, a Director of the Central Selling Organization.

As well as a buffet menu which has been carefully selected to suit all tastes, on this occasion we are also able to offer a Kosher menu at a small additional cost.

The price of the luncheon is £42.00 plus VAT (totalling £49.35) to include wine. Tickets for single and block bookings are now available from

Mary Burland at GAGTL,
27 Greville Street, London EC1N 8SU.
Telephone 0171-404 3334.
Fax 0171-404 8843.

## SCOTTISH BRANCH

The first meeting of the newly formed Scottish Branch is to be held on Friday 19 May 1995 at the Assay Office, Goldsmiths Hall, 39 Manor Place, Edinburgh, when Ana I. Castro will give an illustrated talk entitled 'Gem Testing at the Laboratory'. All members in Scotland and the North of England are welcome to attend.

For further details please contact Joanna Thomson FGA DGA, PO Box 2, Peebles, Tweeddale, EH45 8BW. Telephone 01721 722936.

# FORTHCOMING MEETINGS

## London

| | | |
|---|---|---|
| 12 June* | Annual General Meeting, Members' Reunion, and Bring and Buy Sale | |
| 16 June | Annual Trade Luncheon, the Royal Automobile Club, Pall Mall, London SW1 | |
| 1 October | GAGTL Annual Conference to be held at the Scientific Societies Lecture Theatre, New Burlington Place, London W1. The theme will be *Gemmology in Britain*. | |
| 16 October* | **Recent developments in the diamond industry** | Howard Vaughan |

**Weekly Meetings on Wednesdays**

Regular practical gemmology evenings, held in the Gem Tutorial Centre, 27 Greville Street, London EC1N 8SU, are conducted by Michael O'Donoghue every Wednesday from 6.00 - 8.30 p.m. An opportunity to take part in individual or in group projects, or to pursue new paths in gemmology, the resources of the GAGTL are available and the fees are £25.00 per quarter or £90.00 annually.

* To be held in the GAGTL Gem Tutorial Centre, 2nd floor, 27 Greville Street, London EC1N 8SU (entrance in Saffron Hill). The charge for a member is £3.50. Entry will be by ticket only, obtainable from the GAGTL.

## Midlands Branch

Full details from Mandy MacKinnon on 0121-444 7337.

| | | |
|---|---|---|
| 21 May | Gem Club - **Jade in the contemporary world**. Venue: 3 Denehurst Close, Barnt Green. 2.00 p.m. to 6.00 p.m. | Rosamond Clayton |
| 18 June | Gem Club - subject to be announced | |

## North West Branch

Meetings will be held at Church House, Hanover Street, Liverpool 1. Further details from Joe Azzopardi on 01270 628251.

| | | |
|---|---|---|
| 17 May | **Diamonds in the laboratory** | Eric C. Emms |
| 21 June | **Luminescence as a means of identification** | Geoffrey Simpson |
| 20 September | **Natural history of jewellery** | Dr John Franks |
| 18 October | A gemmology evening - no charge, open to members and friends | |
| 15 November | Annual General Meeting | |

## MEETINGS OF THE COUNCIL OF MANAGEMENT

At a meeting of the Council of Management held on 15 February 1995 at 27 Greville Street, London EC1N 8SU, the business of the meeting included the election of the following:

### Diamond Membership

Bao, Chunhui, Wuhan, China. 1994
Chen, Shulan, Wuhan, China. 1994
Di, Jingru, Wuhan, China. 1994
Fu, Yunlong, Wuhan, China. 1994
Han, Hui, Wuhan, China. 1994
McKearney, Michael Colin, Tring. 1986
Xu, Shirong, Wuhan, China. 1994
Zhou, Min, Wuhan, China. 1994

### Fellowship

Abdeen, Mohammed, London. 1961
Basnayake, Senarath B., Katugastota, Sri Lanka. 1983
Collyer, Rodney Frederick, Rubery, Birmingham. 1953
Goodall, Andrew, London. 1986
Guo, Xiaming, Wuhan, China. 1993
Hai, Hu, Wuhan, China. 1994
He, Wei, Wuhan, China. 1994
Jackson, Mark, Birmingham, 1989
Jin, Yi, Wuhan, China. 1994
Liang, Tao, Wuhan, China. 1994
Lord, Karen, Lutterworth. 1994
Lu, Yi, Wuhan, China. 1994
Mitchell, Terence, Sydney, NSW, Australia. 1969
Pan, Huijin, Wuhan, China. 1994
Perez Munoz, Jorge Antonio, Madrid, Spain. 1994
Shi, Dan, Wuhan, China. 1994
Tao, Duo, Wuhan, China. 1994
Wilby, Christine Ann, Bromsgrove. 1985
Wilding, Peter, Liverpool. 1960
Zhang, Congsen, Wuhan, China. 1993
Zhao, Hechun, Wuhan, China. 1994
Zhou, Jie, Wuhan, China. 1994
Zhu, Wenhui, Wuhan, China. 1994

### Ordinary Membership

Amarasinghe, Diwin, Hayes
Bak, Krystyna, London
Chawla, Harmeet, Los Angeles, CA., USA
Dokken, Aarrynne, D.C., Sutton
Ebata, Reiko, Tokyo, Japan
Endo, Masahiko, Osaka, Japan
Fujimoto, Eiichi, Yokohama City, Japan
Gerrard, Peter William, Sydney, NSW, Australia
Godwin, James George, Brighton
Hino, Toshiaki, Owase City, Japan
Hiroko, Shiomi, Tokyo, Japan
Honda, Takashi, Tokyo, Japan
Inoue, Daisuke, Osaka, Japan
Jo, Yoon-Hee, Twickenham
Kato, Junko, Osaka, Japan
Kawamura, Toshiko, Sakurai City, Japan
Kawarara, Tamami, Osaka, Japan
Kitamura, Yumia, Osaka, Japan
Kobayashi, Yukiko, Osaka, Japan
Kubota, Chiaki, Kobe City, Japan
Kudo, Kazuhiko, Hiroshima City, Japan
Kurahashi, Keiko, Tokyo, Japan
Macnish Porter, Frances Holly, Edinburgh
Maeda, Mariko, Ichikawa City, Japan
Maruyama, Kyoko, Kumagaya City, Japan
Maunga, Ntite Tito, London
Nagaoka, Mikage, Nishinomiya City, Japan
Nakata, Junko, Osaka, Japan
Nicita, D., Milan, Italy
Niroo, Sousan, London
Nishioka, Megumi, Osaka, Japan
Ogura, Yasumi, Osaka, Japan
Ohtsuka, Mayumi, Osaka, Japan
Osman, Naushad Daud, Wembley
Parker, Michael Anthony, Midhurst
Pierce, Jason, London
Purshottam, Vimay, London
Raben, Jonathan D., Boston, Mass., USA
Roultedge, Hylton, Bromsgrove
Sakulbenjayotin, Somchai, Bangkok, Thailand
Seki, Shoko, Osaka, Japan
Shibata, Yukari, Osaka, Japan
Takiguchi, Naomi, Osaka, Japan
Tanaka, Daisuke, Kobe City, Japan
Van Essen, Elma Irene, Ymuiden, The Netherlands
Wakefield, Sharon A., Boise, Idaho, USA

Yamada, Setsuko, Kyoto, Japan
Yoda, Yukino, Tokyo, Japan

**Ordinary Laboratory Membership**
F. Abbas, London EC1
Manhattans, London EC1
S.A. Souri, Kensington, London

At a meeting of the Council of Management held on 15 March 1995 at 27 Greville Street, London EC1N 8SU, the business of the meeting included the election of the following:

**Fellowship**
Alaniva, Orvokki, Pello, Finland. 1994
Daulatani, Shambhu Lal, Dubai, UAE. 1982
Dayasagara, Kalupahana L.D., Colombo, Sri Lanka. 1981
Kaminaras, Merope, Athens, Greece. 1994
Oh, Sook Hoe, Pusan, Korea. 1994
Park, Mi-Kyeong, Pusan, Korea. 1994
Vikamsey, Indira Jayantilal, Bombay, India. 1981

**Ordinary Membership**
Franquet, John Julian, London
McInnes, Catriona, Edinburgh
Peech, Rosalind Mary, Worksop

**GEM DIAMOND EXAMINATIONS**

In January 1995 32 candidates sat the Gem Diamond Examination worldwide, 23 of whom qualified. The names of the successful candidates are listed below:

*Distinction*
Li Yali, Wuhan, China.

*Qualified*
Bedwell, Victoria Lynsee, London.
Chan, Tony Chung Sing, Toronto, Ont., Canada.
Chan, Yik Pun, Hong Kong.
Chen Huilan, Wuhan, China.
Chen Kesheng, Wuhan, China.
Chen Meihua, Wuhan, China,
Chung, Yam Ming (Daly), Hong Kong.
Gedeon, Leila, London.
Kaskara, Tatiana, London.
King Chuen Hui, Hong Kong.
Liu Xu, Wuhan, China.
Liu Zhao, Wuhan, China.
Mei Gewei, Wuhan, China.
Mok, Dominic Wai Kei, Hong Kong.
Nottbusch, Jurgen Uwe, Appel, Germany.
Osmond, Catherine, London.
Qi Wie, Wuhan, China.
Yoshida, Miyuki, Hong Kong.
Xiong Xianzheng, Wuhan, China.
Xue Qinfang, Wuhan, China.
Zhang Jiewen, Wuhan, China.
Zhuang Zhenghua, Wuhan, China.

**EXAMINATIONS IN GEMMOLOGY**

In the Examinations in Gemmology held in January 1995 165 candidates sat for the Preliminary examination of whom 130 passed and 125 for the Diploma examination of whom 50 passed. The names of the successful candidates are as follows:

*Diploma*
Agarwal, Pooja, London.
Ayles, Catherine, Edinburgh.
Bae, Eun Jeung, Seoul, Korea.
Bagai, Deepak, Bombay, India.
Bowman, Helene, Epping.
Cai, Cuihua, Wuhan, China.
Campbell, Robert, Wallington.
Cheung Lai Ha, Losanna, Hong Kong.
Cho, Jin-Ho, Seoul, Korea.
Dalla Libera, Natalie, London.
Dinnis, Simon John, Swadlincote.
Eggleston, Avrina, London.
Fantis, Charoulla, Nicosia, Cyprus.
Feng, Jiansen, Wuhan, China.
Ferrell, Ronald L., Deland, Fla., USA.
Garvik, Beate Kielland, Oslo, Norway.
Gulliani, Narinder, Birmingham.
Kan, Wing Lok, Hong Kong.
Kim, Ki-Jung, Taegu, Korea.
Kim, Chul-Seung, Seoul, Korea.
Lee, Chiu-Hsia, Taipei, Taiwan.
Lee, Min Hi, Seoul, Korea.
Levonis, Helen, Toowoomba, Qld, Australia.
Lundsrud, Berit, Sandvika, Norway.

Macarthur, Iain, London.
Mangun, Colleen Chien, Manila, Philippines.
Mi Sun, Won, Buchon City, Korea.
Newman, Frances, London.
Park, Kinam, Seoul, Korea.
Rush, Laura, Edinburgh.
Ryu, Kyeong Won, Daejon, Korea.
Samson, Ma. Teresita Pelea, Quezon City, Philippines.
Seow, Meng Seh Francis, Hong Kong.
Sherman, Suthita, Makati, Philippines.
Shetty, Vaju Krishna, Bombay, India.
Shu, Xingying, Wuhan, China.
Simpson, David C., Devizes.
Sung, Min Jun, Taegu, Korea.
Tian, Baozhen, Wuhan, China.
Tripaathi, Naagesha, Jaipur, India.
Tsai, Pei-Lun, Taipei, Taiwan.
Tytgadt, Anne, Johannesburg, South Africa.
Tzou, Jyh-Jeng, Kee Lung City, Taiwan.
Vlahos, Nikolaos, Pireas, Greece.
Wei, Zhou, Wuhan, China.
Won, Dae-Kwon, Seoul, Korea.
Wren, Amanda, Edinburgh.
Zhang, Bing, Wuhan, China.
Zhu, Meidi, Wuhan, China.
Zou, Haiqing, Wuhan, China.

*Preliminary*

Abramian, Levon, London.
Agarwal, Pooja, London.
Allberg, Mauritz, London.
Bagai, Deepak, Bombay, India.
Balalis, Evagelos, Athens, Greece.
Battiscombe, Brigid, London.
Bolin, H. Christian, Stockholm, Sweden.
Cadby, Sarah Louise, London.
Can, Cao, Wuhan, China.
Chan, Bo Kwan, Hong Kong.
Chan, Sally Yuk Wa, Kowloon, Hong Kong.
Chan, Wai Chu, Hong Kong.
Chan, Wai Keung, Hong Kong.
Chan, Yau Yin, Hong Kong.
Chan, Yue Kwan Joyce, Kowloon, Hong Kong.
Chan, Yuk Fan, Kowloon, Hong Kong.
Choi, Chan Wai, Hong Kong.
Chen, Jyh-Shyang, Taipei, Taiwan.
Chen, Shing Lin, Hong Kong.
Cheng, Ming Chi, Wanchai, Hong Kong.
Chung, Jae-Hak, Seoul, Korea.
Curtis, Simon James, Torquay.
Dang, Xiaoying, Wuhan, China.
De Groot, Olivier Robbert, Huizen, The Netherlands.
Ding, Weijun, Wuhan, China.
Fan, Wan Wah Andrew, Shaukeiwan, Hong Kong.
Fotsalis, Angelos, Nikea, Greece.
Fotsalis, Panayiotis, Nikea, Greece.
Galiatsatoy, Helen, Athens, Greece.
Gamage, Amitha K.U., Nugegoda, Sri Lanka.
Geerling, S.A., Rotterdam, The Netherlands.
Go, Jung-Hun, Kyungam-do, Korea.
Golad, Tanya, London.
Goransson, Mari E. P., Stockholm, Sweden.
Guo, Hui, Wuhan, China.
Haria, Aarti Vipul, Nairobi, Kenya.
Ho, Hsiung-Chien, Taipei, Taiwan.
Holt, Jr., Roosevelt, Nairobi, Kenya.
Horniblow, Kathryn Clare, Henfield.
Hui, Mu-Cheng, Chung-Li City, Taiwan.
Hunter, Rachel Suzanne, Bath.
Im, So Yun, Chonbuk, Korea.
Iwata, Kaoru, London.
Jackson, Stephen Douglas, Redruth.
Jayathilake, Salpadoru Thupphige Deepika, Colombo, Sri Lanka.
Ji, Ke Ke, Hong Kong.
Jiang, Xinshun, Wuhan, China.
Jo, Byung-Hyun, Kyungbuk-do, Korea.
Jones, Barry, London.
Jones, Maureen, Coventry.
Junaida, Kathoon, London.
Kim, Chul-Seung, Seoul, Korea.
Lam, Chiu-Hung, Kowloon, Hong Kong.
Lau, Chun Kit, Hong Kong.
Lee, Joong-Hyup, Kyunbuk-do, Korea.
Lee, Julia Siu Ying, Hong Kong.
Lee, Jun-Ah, Seoul, Korea.
Lee, Soon Nam, Daejon, Korea.
Li, Anan, Wuhan, China.
Li, Yuan, Wuhan, China.

Lin, Bing, Wuhan, China.
Liu, Jian, Wuhan, China.
Lai, Shan Lo, Kowloon, Hong Kong.
Loughran, Anna, London.
Loungani, Jagdish, Jaipur, India.
Lu, Fude, Wuhan, China.
Luo, Huabao, Wuhan, China.
Luo, Yiguang, Wunan, China.
Ma, Annie Yiu-Chu, Hong Kong.
Ma, Lien Chen, Kowloon, Hong Kong.
Ma, Yugao, Wuhan, China.
McCabe, Marianne C., Guildford.
McInnes, Catriona Orr, Edinburgh.
May, Frank, Edinburgh.
Mi Sun, Won, Buchon City, Korea.
Miller, Sally, Yeovil.
Nakamura, Shukubin, London.
Nam, Chang Soo, Daejon, Korea.
Nathanson, Maria Caroline, Stockholm, Sweden.
Ng, Shuk Hing Jonas, Kowloon, Hong Kong.
Ng, Hoi Yan Cecilia, Hong Kong.
Ng, Siu Pan, Hong Kong.
Park, Kinam, Seoul, Korea.
Park, Sung-Hyun, Taegu, Korea.
Parsons, Michael John, Bath.
Perkins, David James, Ayr.
Ramirez, Soledad A., Skogas, Sweden.
Rosamond, Wun Wu, Hong Kong.
Rungta, Brinda, Jaipur, India.
Sandar, Mya, Yangon, Myanmar.
Schutt, Alan Werner, Bristol.
Seligman, Dominic, London.
Sharma, Rajeev, Jaipur, India.
Sharpe, Erica, Wells, Somerset.
Shetty, Vaju Krishna, Bombay, India.
Silva, Pitipanage Dushyantha, Colombo, Sri Lanka.
Soo, Hoi Leung, Hong Kong.
Sun, Wai Ling, Hong Kong.
Sun, Yanling, Wuhan, China.
Sung, Soo-Kyung, Taegu, Korea.
Tai, Man Tak, Hong Kong.
Tang, Zhen Yi, Hong Kong.
Tapper Hansson, Cecilia K.M., Coteborg, Sweden.
Tong, Ka Po Abel, Hong Kong.
Tsang, Shiu King, Hong Kong.
Tse, Yee Luen Eileen, Hong Kong.
van der Molen, W.N., Heerde, The Netherlands.
Verity, Michael Oliver, Reading.
Wang, Xuqiang, Wuhan, China.
Wen, Li, Wuhan, China.
Willis, Kathryn, London.
Withington, Terry, Aylesbury.
Won, Dae-Kwon, Seoul, Korea.
Won, Kwang-Hee, Kyungbuk-do, Korea.
Wong, Mei Wai, Hong Kong.
Wu, Zhaoyang, Wuhan, China.
Xiang, Sang, Wuhan, China.
Xu, Hainan, Wuhan, China.
Yang, Eun Kyoung, Taejon, Korea.
Yewn, Dickson Dik Sum, Kowloon, Hong Kong.
Yoo, In Sook, Daejon, Korea.
Yu, Woon Tim Christina, Hong Kong.
Yuan, Yan, Wuhan, China.
Zhang, Juan, Wuhan, China.
Zhang, Yongwen, Wuhan, China.
Zheng, Bei, Wuhan, C'hina.
Zhong, Liyi, Wuhan, China.
Zhou, Min, Wuhan, China.
Zhu, Dawei, Wuhan, China.
Zou, Juan, Wuhan, China.

**THE JOURNAL OF GEMMOLOGY**
**Bound volumes**

Bound copies of Volume 23 of *The Journal of Gemmology* are now available.

If you would like your copies bound, please return them to the GAGTL at 27 Greville Street, London EC1N 8SU. The cost of this service is £25.00 plus postage and packaging (£4.00 UK).

**BACK ISSUES**

A member has back issues of *The Journal of Gemmology* for sale from October 1960 to January 1973 (except April 1968) and October 1975 to January 1995. Also, a member has a complete set of *The Journal* from 1957 to date.

Please contact Mary Burland at the GAGTL who will forward enquiries.

# Guide to the preparation of typescripts for publication in *The Journal of Gemmology*

The Editor is glad to consider original articles shedding new light on subjects of gemmological interest for publication in *The Journal*. Articles are not normally accepted which have already been published elsewhere in English, and an article is accepted only on the understanding that (1) full information as to any previous publication (whether in English or another language) has been given, (2) it is not under consideration for publication elsewhere and (3) it will not be published elsewhere without the consent of the Editor.

**Typescripts** Two copies of all papers should be submitted on A4 paper (or USA equivalent) to the Editor. Typescripts should be double spaced with margins of at least 25mm. They should be set out in the manner of recent issues of *The Journal* and in conformity with the information set out below. Papers may be of any length, but long papers of more than 10 000 words (unless capable of division into parts or of exceptional importance) are unlikely to be acceptable, whereas a short paper of 400-500 words may achieve early publication.

The abstract, references, notes, captions and tables should be typed double spaced on separate sheets.

On matters of style and rendering, please consult *The Oxford dictionary for writers and editors* (Oxford University Press, 1981).

**Title page** The title should be as brief as is consistent with clear indication of the content of the paper. It should be followed by the names (with initials) of the authors and by their addresses.

**Abstract** A short abstract of 50-100 words is required.

**Key Words** Up to six key words indicating the subject matter of the article should be supplied.

**Headings** In all headings only the first letter and proper names are capitalized.

A **This is a first level heading**

First level headings are in bold and are flush left on a separate line. The first text line following is flush left.

B *This is a second level heading*

Second level headings are in italics and are flush left on a separate line. The first text line following is flush left.

**Illustrations** Either transparencies or photographs of good quality can be submitted for both coloured and black-and-white illustrations. It is recommended that authors retain copies of all illustrations because of the risk of loss or damage either during the printing process or in transit.

Diagrams must be of a professional quality and prepared in *dense* black ink on a good quality surface. Original illustrations will not be returned unless specifically requested.

All illustrations (maps, diagrams and pictures) are numbered consecutively with Arabic numerals and labelled Figure 1, Figure 2, etc. All illustrations are referred to as 'Figures'.

**Tables** Must be typed double spaced, using few horizontal rules and no vertical rules. They are numbered consecutively with Roman numerals (Table IV, etc.). Titles should be concise, but as independently informative as possible. The approximate position of the Table in the text should be marked in the margin of the typescript.

**Notes and References** Authors may choose one of two systems:

(1) The Harvard system in which authors' names (no initials) and dates (and specific pages, only in the case of quotations) are given in the main body of the text, e.g. (Gübelin and Koivula, 1986, 29). References are listed alphabetically at the end of the paper under the heading References.

(2) The system in which superscript numbers are inserted in the text (e.g. ... to which Gübelin refers.[3]) and referred to in numerical order at the end of the paper under the heading Notes. Informational notes must be restricted to the minimum; usually the material can be incorporated in the text. If absolutely necessary both systems may be used.

References in both systems should be set out as follows, with *double spacing* for all lines.

**Papers** Hurwit, K., 1991. Gem Trade Lab notes. *Gems & Gemology*, **27**, 2, 110-11

**Books** Hughes, R.W., 1990. *Corundum*. Butterworth-Heinemann, London. p. 162

Abbreviations for titles of periodicals are those sanctioned by the *World List of scientific periodicals* 4th edn. The place of publication should always be given when books are referred to.

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# Contents





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