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NOTES ON ASTERISM

IN CORUNDUM, ROSE QUARTZ AND ALMANDINE GARNET AND CHATOYANCY IN BERYL

By W. F. EPPLER

1. Causes of Asterism and Chatoyancy

There recently appeared in *The Gemmologist* an article by J. H. Halford-Watkins about the "Reasons for Chatoyancy and Asterism."[1] This article was originally published in the same journal in 1932. The author pointed out that asterism in corundum (star-sapphire and star-ruby) was due to the presence of fibres. This fibrous structure, or silk, follows the prism faces of the corundum crystal and is likewise parallel to the basal plane. The fibres are, the author suggests, most probably minute tubes or cavities which took their origin from the radioactivity in the matrix. Similar fibres, he suggests, may be the cause of chatoyancy in chrysoberyl.

This theory was formerly accepted by many writers. In opposition to it are the results of the careful investigations of Alice Sumner Tait,[2] published in The Journal of Gemmology in 1955.

This author concluded that :

> " The cause of asterism in corundum is due to the symmetrical arrangement of included rutile needles, which lie in the basal plane parallel to the prism faces of the hexagon."

This statement confirms the observations of Tschermak,[3] who as early as 1878 found hair-like rutile needles in ruby. At the same time it confirms and completes the information given by G. F. Herbert Smith,[4] who speaks of " included needles of rutile, tubular cavities, or even colloidal particles " as the cause of asterism in corundum.

In seeking an explanation for the causes of asterism, if we imagine that a polished stone has, for instance, the form of a rectangular prism, then we have on the top plane the conditions shown in the figure (Fig. 1). But if we imagine further that the long edge of the top plane is replaced by a facet, then, with the same direction of the incoming light, the reflected light will be distributed. It is evident that the newly polished facet causes the reflected light to travel along a somewhat different direction. The more the newly applied facet is inclined downwards, the greater this deviation from the original direction of the reflected light becomes.

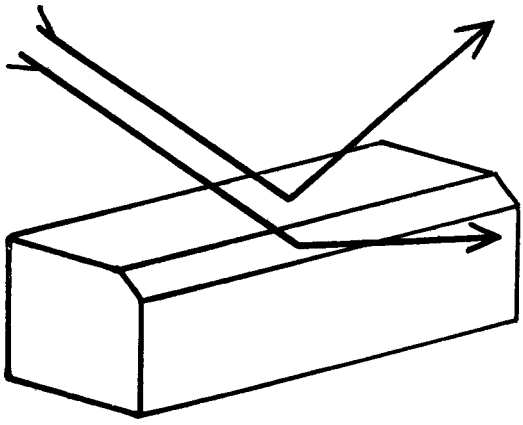

Fig. 1.

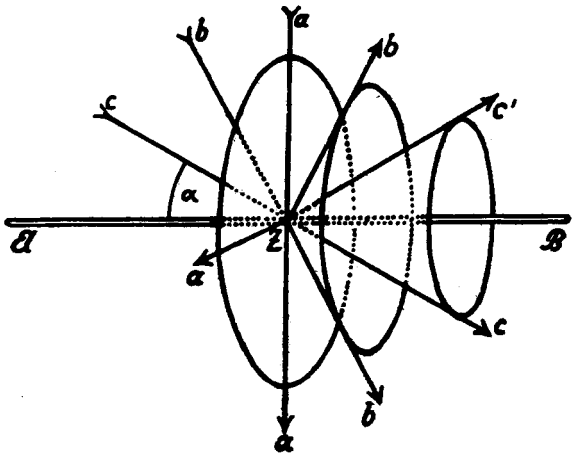

Fig. 2. Rays of light distributed over surface of cone. From "Brillanten und Perlen" by W. Maier, Stuttgart 1949

If there is not only one facet on the prism edge but an endless number of facets covering all the prism edges, then an endless number of reflections will be seen in different directions. In this case, the original prism has changed into a cylinder with the cross-section of a circle.

If this reflecting cylinder is extremely thin, so that it corresponds in size with the rutile needles in corundum, then the rays of reflected light will be distributed over the surface of a cone (Fig. 2). The axis of the cone coincides with the cylinder, and the opening angle of the cone is twice as great as the angle which the incident light forms with the cylinder. The greater this angle, the greater is the opening angle of the cone of reflection. These facts have been recognized and published by Kaemmerer[5] in 1915. This author also found that the effect of diffraction is present as well when a number of rod-like cylinders have the same parallel orientation. But this does not complicate the matter, as the diffraction is masked by the effect of reflection, which therefore remains as the only cause of asterism and chatoyancy.

The needle-like inclusions of rutile in corundum can be compared with very fine and very thin cylinders. Each cylinder, or rutile needle, produces its own cone of reflection, if a ray of light falls upon it. In corundum the included rutile needles form a

pattern which is strictly orientated in accordance with the hexagonal (or trigonal) symmetry of the host crystal. This means that the needles lie in the basal plane and are parallel to the faces of the hexagonal prism of the first order. If we polish the flat basal plane of a corundum crystal, then the rutile needles are situated within this plane and they form at the same time a pattern of intersecting lines at angles of 60°. But even if this basal plane is perfectly polished, asterism cannot be observed in reflected light. The only effect is a sheen or a schiller, seen six times during one full rotation. The reason for this effect is that the multitude of parallel rutile needles produces a multitude of parallel cones of reflection. On a flat surface such as the polished basal plane of a corundum crystal mentioned above, we best observe the reflection if the source of light, the length of the rutile needles, and our own eye are in one plane. This happens with the hexagonal arrangement of the needles six times during one revolution. As the flatness of the polished surface allows the incident light to be reflected on all needles of the same orientation simultaneously, we can only observe a very small part of each conical reflection. The cone of reflection in full cannot come into operation in this case.

The effect is different if the flat basal plane is replaced by a convex surface. If we regard the curved surface as having the form of a half-cylinder, so that the long axis of this half-cylinder coincides with the length of one bundle of the included needles, and a beam of light falls upon the cylindrical surface, we again observe the reflection best when the source of light, the length of the needles, and our eye are in one plane. This time the conical reflection causes a regularly distributed schiller over the entire surface of the curvature, on its top as well as on the sides.

If we now cut away and polish both upper ends of the half-cylinder so that the cylindrical surface is gradually replaced by a spherical one, then the formerly widespread reflection diminishes until it is limited to a fine, circle-like reflective zone. At the same time the half-cylinder has changed into a hemisphere, and the circle-like reflection runs over the spherical surface of the stone in the direction perpendicular to the length of the included rutile needles.

Thus, the conical reflection of light on very thin included rutile needles, which are orientated to each other, causes a reflection also on a curved or spherical surface. It produces not only a

reflection on the top of the curvature, but, so to say, also "sideways"—that is, on the flanks of the curvature. Secondly, the spherical surface of a stone selects for the eye under the proper conditions only a circle-like reflection. This particular line of reflection runs, as is quite obvious, perpendicular to the length of the included needles.

In the case of corundum the needles lie in three directions which include angles of 60°. The needles of each direction produce a circle-like zone of reflection, if the stone is properly cut. As these three reflecting zones intersect each other on the apex of the convex surface of the stone, we receive the impression of a six-rayed star.

An impressive demonstration of asterism can be given by a ball of suitable material, such as rose-quartz or synthetic star-corundum. If such a ball is viewed in reflected parallel light, we observe round the ball three complete circles, which intersect each other at two opposite points. If we look at one of these points, we receive the impression of a six-rayed star. The two opposite points of intersection mark the spots where the main- or c-axis leaves the stone.

Chatoyancy therefore is clearly due to the conical reflection of light on very fine and very thin and elongated inclusions which are orientated parallel to each other and which follow only one direction. If cut in a convex form or as a cabochon, the conical reflection produces a single line of reflection which runs perpendicular to the length of the elongated inclusions.

Only such stones exhibit asterism, or a star effect, as contain elongated inclusions of a symmetrical orientation. The inclusions must be thin enough to produce the conical reflection of light in a similar way to its manner of production on very thin cylinders.

The cat's-eye effect, or chatoyancy, is caused by such inclusions, which are orientated in only one direction.

As the symmetrical orientation of the inclusions is due to the symmetry of the host crystal, stones must be cut according to this symmetry to show asterism or chatoyancy respectively.

A star-effect can be artificially produced, if cylinder-like grooves are scratched on the back of a transparent stone. The scratches act in the same way as cylinders and produce a conical reflection of light. From this particular reflection the spherical cabochon selects for the observing eye the circles of reflection which form the star (Fig. 3).

2. Origin of the Inclusions which produce Asterism or Chatoyancy

Corundum. In corundum the regularly included needles of rutile cause the asterism of star-sapphire and star-ruby. A relatively dense accumulation of acicular crystals is necessary to generate the star-effect. Less dense patches of rutile needles, commonly known as " silk," cannot produce a perfect star.

An indication of the origin of the rutile needles in natural star-corundum is given by synthetic star-stones. According to the process used by the Linde Company in Chicago, which is disclosed in U.S. Patent 2,488,507 of 15th November, 1949, the synthetic star-stones are manufactured by the exsolution of titanium dioxide within the crystal of synthetic corundum. The powder used for making blue or red synthetic star-corundum does not contain more than 0·3 per cent of titanium dioxide. The resulting boules are transparent and look the same as ordinary boules of the same colour. This indicates that the titanium dioxide forms with the corundum a synthetic " mixed-crystal." During subsequent heat-treatment the dissolved titanium dioxide slowly crystallizes in the form of rutile needles, a process which is generally known as " exsolution." These newly formed rutile crystals occupy

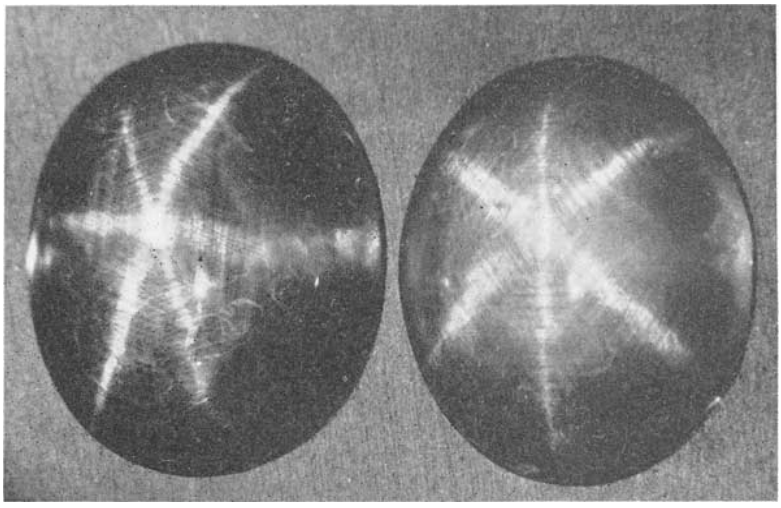

Fig. 3. Star-effect produced by scratching cylinder-like grooves on back of synthetic spinel.

preferred spaces within the lattice of the synthetic corundum crystal and consequently they are arranged in the same symmetrical order as in natural corundum. The heat-treatment is accomplished at temperatures within the range of 1,100 to 1,500°C which are maintained for a period of over 72 hours.

It is very unlikely that the natural star-corundum crystals have been treated in the same way. Most probably, the temperature was not so extremely high, but the pressure, which in the earth's crust can reach considerable amounts, acted in a favourable sense. It seems, therefore, that in natural star-corundums also the rutile needles originated from exsolution.

Fig. 4 shows the well known pattern of rutile in a star-sapphire from Ceylon. On one side of the picture they are enriched by zones parallel to the first order prism $(10\bar{1}0)$.

A very rare star-stone is the twelve-rayed star sapphire. The star is apparently composed of two six-rayed stars, the second of which is turned against the first one at an angle of approximately 30°. This results in a similar arrangement of the two systems of rutile needles. While the first system is orientated in the usual manner, the second system of needles follows the hexagonal bipyramid of the second order $(22\bar{4}3)$. It is most probable that this explanation is correct. Another explanation could be that the second system of needles follows the second order prism (1120) ; but in that case the points of intersection of both systems must be in coincidence, which they are not.

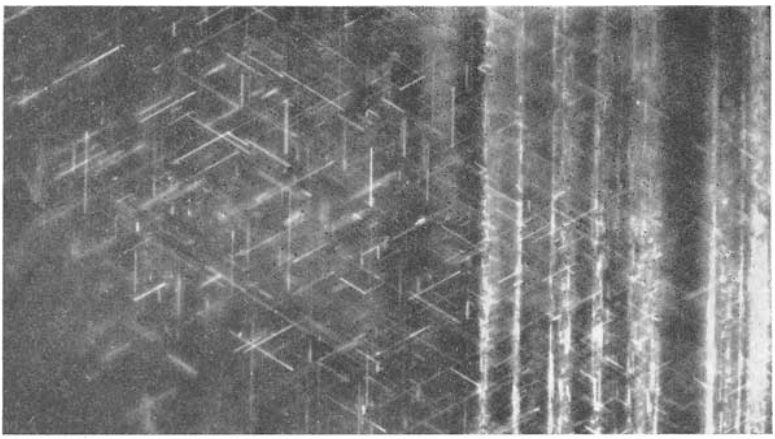

Fig. 4. Rutile pattern in Ceylon star-sapphire.

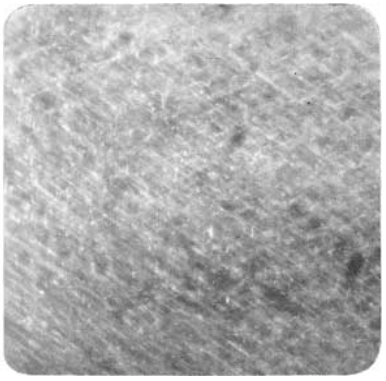

Fig. 5 (left). Long and relatively thin rutile needles in a Linde star-sapphire.

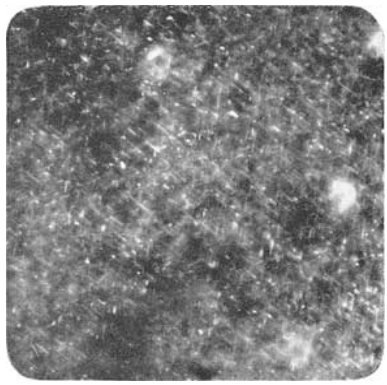

Fig. 6. (right) Short and relatively thick rutile needles in a German star-sapphire.

Differences between the American and the German synthetic star-corundums are seen in figures 5, 6 and 7. The Linde boules for star-stones are manufactured with a high growing speed. Large boules are produced, from which several stones can be cut. The German boules are slowly grown, and rather reminiscent in shape of the " shoe-button " reconstructed rubies of which descriptions were published some years ago.

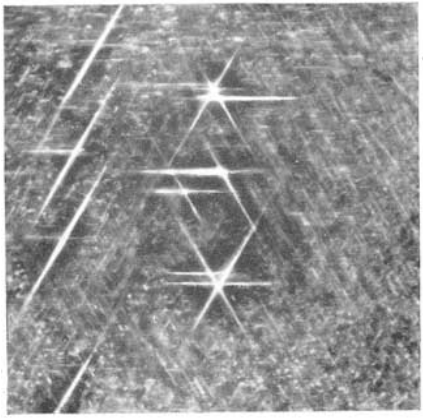

Fig. 7. Short and relatively thick needles of rutile in a synthetic star-sapphire (German) ; also areas of highly concentrated rutile needles which follow plane of first order prism ($10\bar{1}0$).

The difference in the rate of growth influences the shape of the rutile needles. In a synthetic star-sapphire from Linde, the needles are long and relatively thin, whereas in the German blue stone short and relatively thick needles can be observed. Similar differences exist between the two kinds of synthetic star-rubies. The needles of the Linde stones are long and those of German production are short. Besides this the German star-stones of red colour exhibit areas of highly concentrated rutile needles, which areas follow the planes of the first order prism $(10\bar{1}0)$.

The difference in shape of the needles influences the star-effect. The long and thin needles of the Linde stones are responsible for a striking, narrowly developed star. The short and thicker needles of the German stone produce on the other hand a wider star, similar to that in the natural star-corundums.

Besides the difference in the rate of growth the two kinds of synthetics differ in that the Americans do not appear to have made use of so-called crystallizers, which, on the other hand, are added by the German manufacturers. This is shown by the different shapes of the included gas bubbles. Fig. 8 shows, at high magnification, the round bubbles in a Linde stone ; Fig. 9 demonstrates the non-spherical bubbles in the German product. The bubbles in the Linde star are spherical and the German star contains non-spherical bubbles of a more triangular shape.

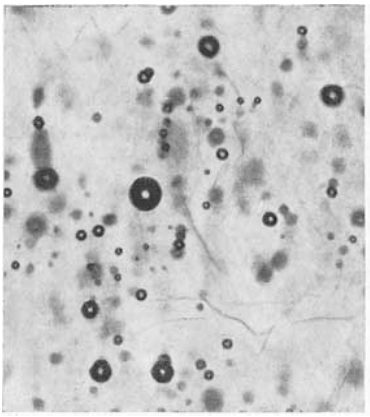

Fig. 8.

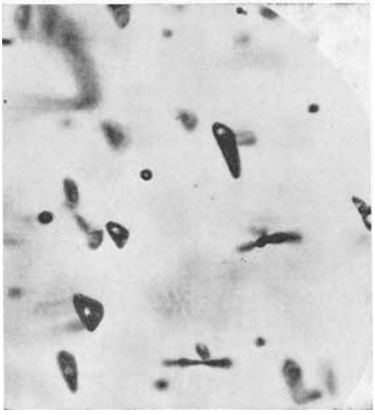

Fig. 9.

These pictures are taken parallel to the c-axis. In observing in other directions, for example perpendicularly to a plane of the rhombohedron, the so-called " bubbles " in the German synthetic star-corundum are seen as two-phase inclusions or as negative crystals in the form of a rhombohedron (Figs. 10 and 11).

A last and very characteristic difference between the two kinds of synthetics is shown by the so-called " Sandmeier-Plato striation." Fig. 12 shows the quickly grown and " empty " Linde stone and Fig. 13 exhibits this particular pattern in the slowly produced German stone.

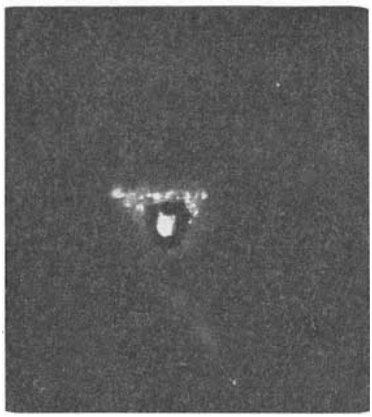

Fig. 10. So-called " bubble " in a German synthetic star-stone seen as a two-phase inclusion.

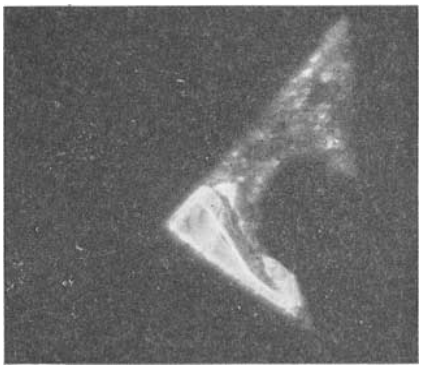

Fig. 11. A similar inclusion seen as a negative crystal in the form of a rhombohedron (greatly enlarged).

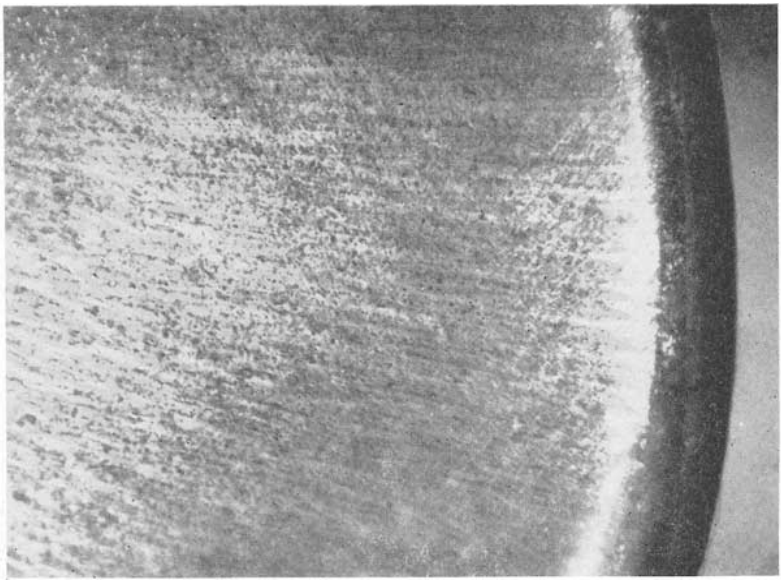

Fig. 12. Sandmeier-Plato striation (American synthetic star-stone).

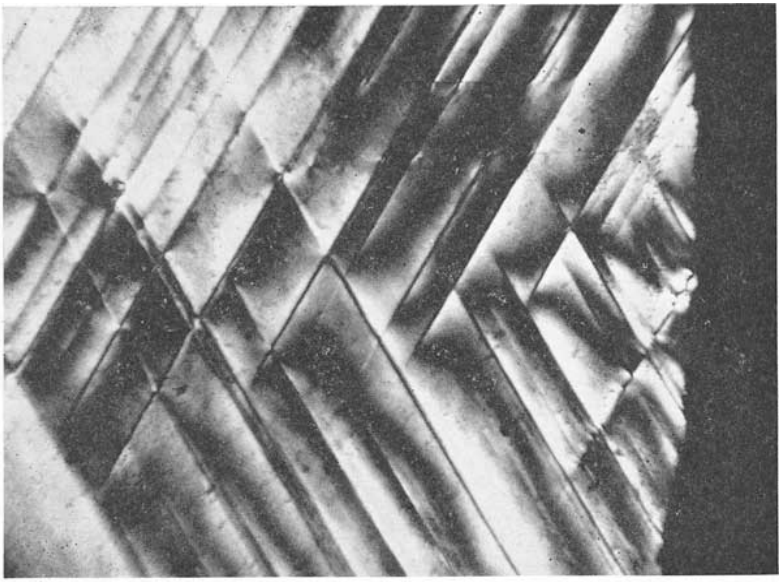

Fig. 13. Sandmeier-Plato striation (German synthetic star-stone).

Rose quartz. Asterism is commonly present in rose quartz, and the imitation of star-sapphire by a doublet of rose quartz with a backing of blue material has been described by B. W. Anderson.[6] But the origin of the asterism in this stone has long been unknown.

It was recently found by J. von Vultée that asterism in rose quartz is caused by rutile needles. He crushed a rose quartz showing asterism and treated the powder with fluoric acid to remove the quartz particles. The residue proved to be pure titanium dioxide. Fig. 14 shows, under the electron microscope, long needles with a rectangular cross-section, which consequently are crystals of rutile, and von Vultée easily found the rutile needles under the ordinary microscope.

Of great interest are two new discoveries, made by him. He found that there exist no less than thirteen different ways in which the rutile is orientated within the rose quartz crystal. According to him, the needles are not only parallel to the main axis and to the lateral axes, but they are also parallel to the intermediate axes and parallel to the edges of several rhombohedrons. This multitude of possibilities gives the explanation for some additional effects of reflected light on a ball of rose quartz. The effects consist of some circular lines weaker than the three main lines of reflection and in so-called " light knots." Both effects can easily be seen under suitable illumination.

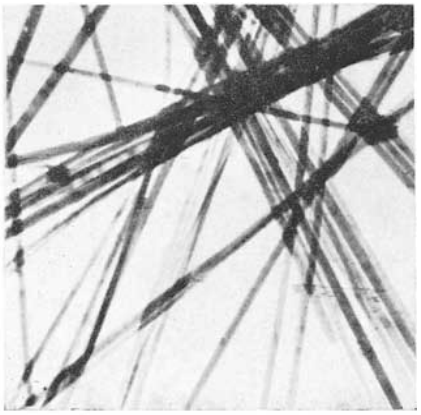

Fig. 14. Residue of titanium oxide (rutile) after crushing rose-quartz.

From J. von Vultée's " Uber orientierte Verwachsungen von Rutil in Quarz," Neues Jahrb. f. Mineral.

The second result found by this author is the discovery of two new twinning laws of rutile, which must be added to the two already known. In some gemstones with needle-like inclusions of rutile, such as corundum, those needles seem to be inclined at one end or even appear to bend. The inclination caused by bending has 169° as a mean value. The continued bending of the needles, which is so difficult to explain in this and other gem material, is regarded by him as a consequence of the simultaneous growth of quartz and rutile. He writes (in translation) :

> " Either these bent needles follow a curvature which is constant over the whole length of the needles, or they are perfectly straight and only bend at one end. I assume that in this case the seed of the rutile originally was attached to the quartz in an orientated manner and that, by some mechanical or other means, the growing seed was bent and diverted from the originally prescribed direction of growth. This seems to be possible because of the elasticity of the extremely thin needles. In the bent and diverted position they have been imbedded in the growing quartz crystal."

From this it may be concluded that in the case of rose quartz the rutile needles are not secondary, but primary, or perhaps syngenetic, inclusions. The thickness of the rutile needles in rose-quartz has been measured from 0·01 to 0·2 micron and in very clear and intensively coloured pieces from 0·05 to 0·07 micron.

Almandine garnet. The asterism of almandine has been described by R. Brauns[8] in 1907. Brauns presumes that the asterism in almandine is caused by the reflection of light on needles of an asbestos-like augite, and he states that the needles are orientated parallel to the edges of the dodecahedron. They cause a four-rayed star on a cabochon or fourteen points of intersection on a ball. E. J. Gübelin[9] determined the nature of the needles as hornblende. As the almandines have been weathered out mostly from hornblende schists this determination seems to be correct. Fig. 15 shows the orientated hornblende needles and reveals other tubular inclusions, the nature of which is not yet known.

It seems to be obvious that the hornblende needles originated from a process of exsolution, details of which cannot even be guessed. Only a hint may exist in the fact that garnets like almandine

belong to the " old " crystals ; that is, they mostly occur in old crystalline schists which have been situated under great pressure during long geological periods. It may be that the pressure to which these garnets were formerly subjected is one of the main reasons for the exsolution of the hornblende.

Beryl. E. H. Rutland[10] reported about a brown beryl with asterism in 1956. The colour of this particular stone was not

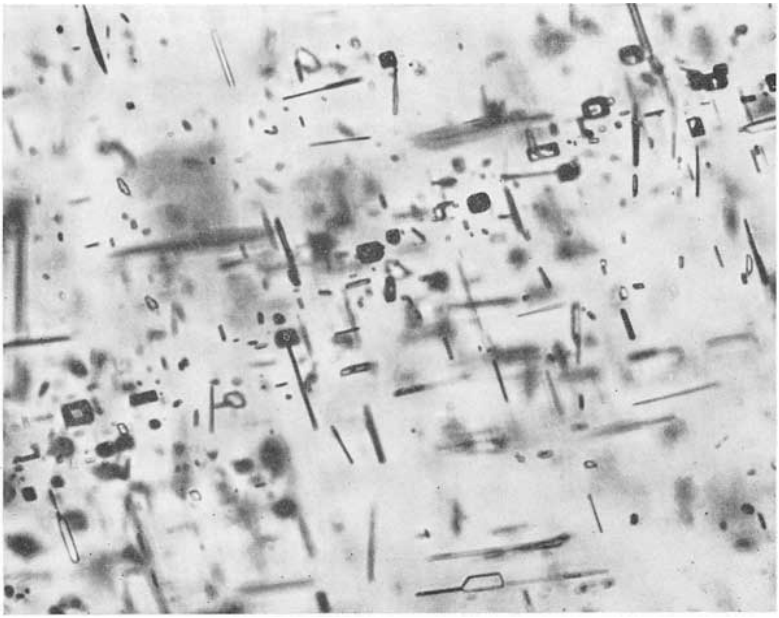

Fig. 15. Hornblende needles in almandine garnet.

attractive and the star very poor. According to Rutland the stone came from Minas Gerais (Gov. Valadares), Brazil ; its dark brown colour was due to rutile needles, and coarser agglomerates presumably also consisted of titanium dioxide ; flat and black inclusions, parallel to the basal plane, might perhaps be muscovite.

By chemical and spectrographical analysis, made at Munich University, it was found that the characteristic inclusions of this particular beryl displaying asterism were not rutile, but ilmenite ($FeTiO_3$ trigonal). Microscopic examination of the stone revealed

very interesting features. A photomicrograph (taken perpendicularly to the c-axis) showed a multitude of straight lines, which run parallel to the basal plane. When the stone was turned at about 45° a marked dichroism was seen. In Fig. 16 some straight lines are to be seen, which are strictly parallel to the c-axis, while others show a small deviation from this direction. With higher magnification (Fig. 17), thread-like inclusions of solid material can be observed, the nature of which is still unknown. In Fig. 18, taken at even higher magnification (420 ×), the straight lines parallel to the basal plane reveal flake-like patches which are seen sideways. Perpendicular to them crosses a thread with various branches.

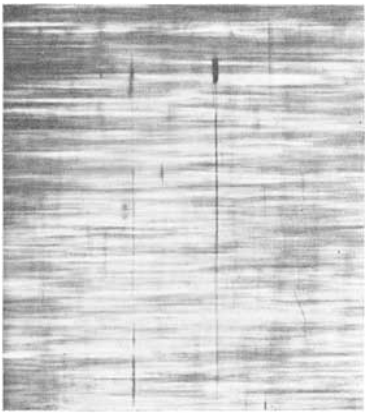

Fig. 16. Multitude of straight lines in beryl showing asterism, parallel to c-axis.

Fig. 17. Thread-like inclusions of solid material, the nature of which is still unknown.

In making observations parallel to the c-axis the patches were recognized as very fine crystallizations of ilmenite. They could be called " skeletons " of ilmenite, which, as shown in Figs. 19 and 20 are orientated according to the hexagonal symmetry of the host crystal. In reflected light (Fig. 21), a coarser and finer network of ilmenite is shown which must be regarded as the cause of asterism. These shapes do not represent the ideal form for a perfect conical reflection. Therefore it follows that the asterism of this beryl is very weak and poorly developed. The patches or separations of ilmenite are very thin and from their shape and distribution it is safe to conclude that they originated from a process of exsolution.

Asterism in spinel and chatoyancy in various gem minerals will be discussed in a subsequent paper.

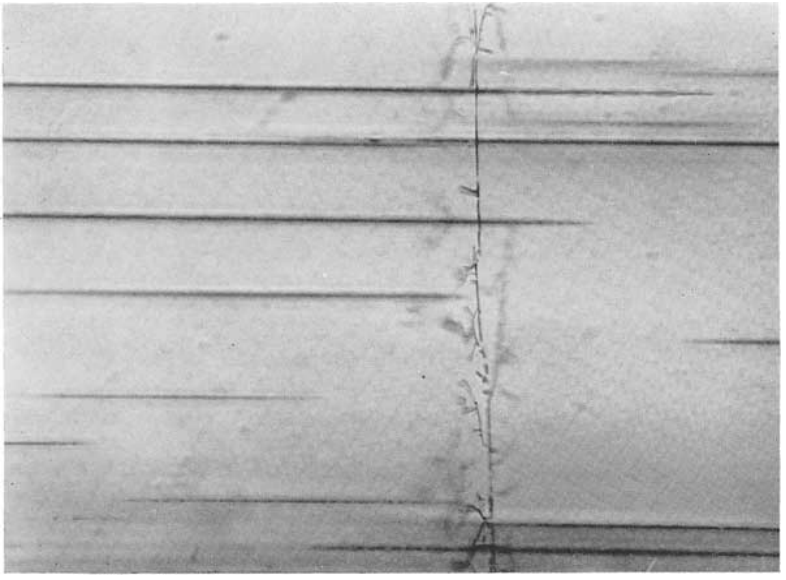

Fig. 18. Straight lines parallel to basal plane are seen, under high magnification, to reveal flake-like patches. Perpendicular to them crosses a thread with various branches.

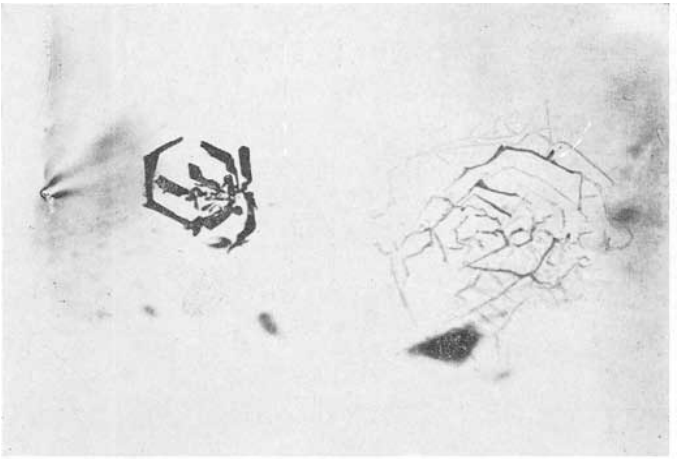

Fig. 19. Skeleton of ilmenite, orientated according to hexagonal symmetry of host crystal.

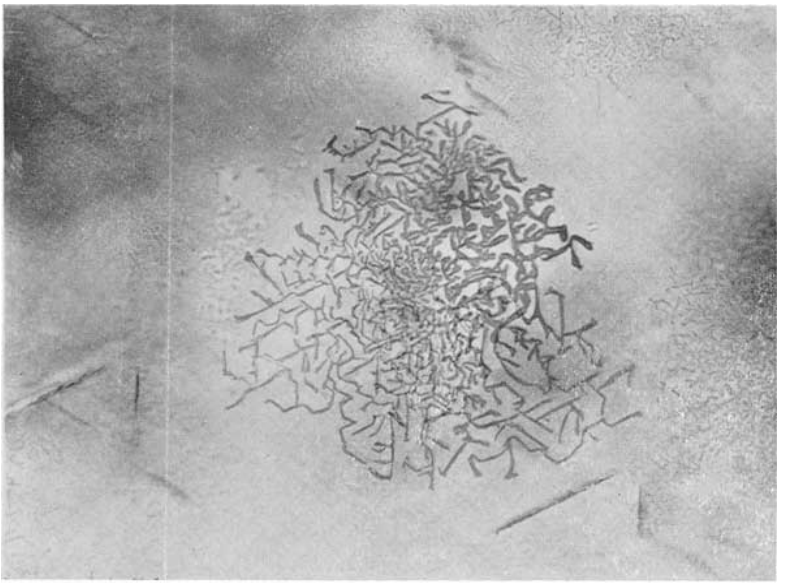

Fig. 20. Skeleton of ilmenite, orientated according to hexagonal symmetry of host crytal.

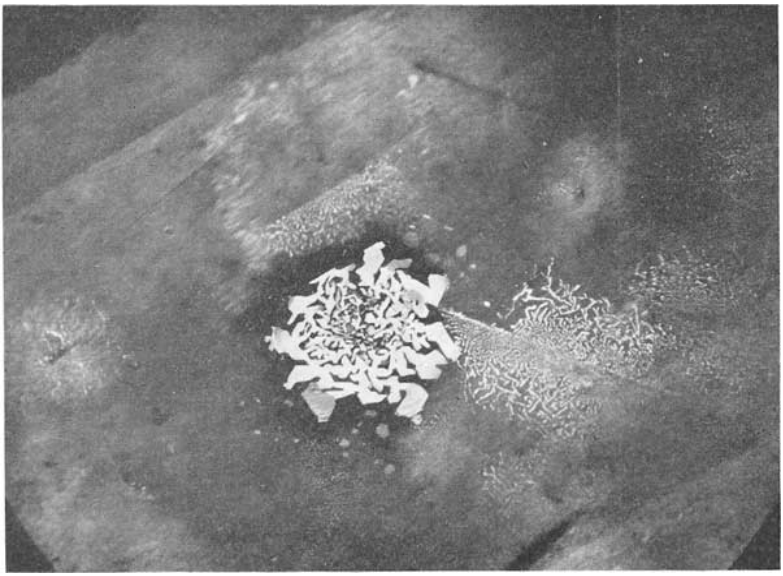

Fig. 21. A coarser and finer network of ilmenite, which is regarded as the cause of asterism, seen in reflected light.

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SYNTHETIC MOONSTONE - COLOURED SPINEL

By ALDERT J. BREEBAART, F.G.A. C.G.

A FEW months ago the first samples of a moonstone-imitation in synthetic spinel came into my hands. These stones, which were cabochon cut, had a colour which ranged from nearly colourless to bluish, and their transparency varied from nearly transparent to translucent, all stones possessing a kind of sheen upon rotation, comparable with that of genuine moonstone.

The refractive index appeared to be the same as for the common synthetic spinel at 1·728. The specific gravity was slightly higher, however, six stones giving 3·639, 3·653, 3·641, 3·665, 3·658 and 3·660. These variations in values are probably an indication of a partial conversion to corundum, caused by the crystallization of excess aluminina. Under short-wave ultra-violet light the stones show a strong greenish fluorescence, the same as seen in the other synthetic spinels ; spectroscopic examination did not reveal any typical bands.

Besides the bluish or silvery sheen, most of the stones possess a weakly developed irregular star by reflected light and some stones have distinct chatoyancy.

To find the cause of these optical effects, the stones were examined under the microscope. Air bubbles were found in several stones in the same irregular forms and patterns as seen in the other synthetic spinels. One tiny circular cloud of irregular air bubbles, all in one plane, with directly above it a " feather " of two-phase inclusions, as described in one of the earlier issues of this journal by I. P. Zwaan, was noted.

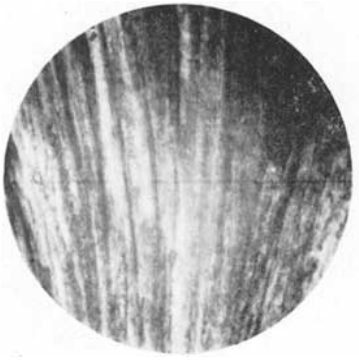
Some stones contained bigger, separate bubbles with definite hexagonal habit or termination and clearly visible surface striations, either parallel or six-sided hexagonal. Strain knots also were present in some stones.

The patchy appearance of synthetic spinel between crossed nicols is quite interesting in these stones. It is completely different, showing colours in yellow, blue and green, and the typical brushes of

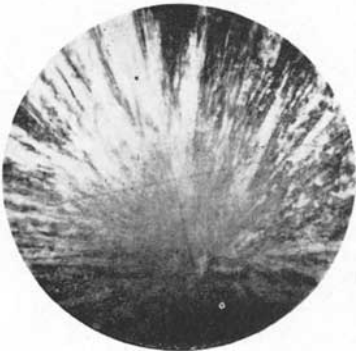
anomalous double refraction are absent upon rotation. The colours seen are probably caused by interference of microscopically small fractures which run through the stone. Its appearance makes one think of a fibrous structure, the fibres sometimes running almost parallel and sometimes radiating out from different centres in the stone. The presence of these microscopic fractures may also be the explanation of the effect that the stone remains comparatively bright upon rotation between crossed nicols. The moonstone star and cat's-eye effects of these stones must also derive their origin from the reflection of light from these fractures.

The manufacturer of these stones informed me that the ordinary spinel boules underwent a heat-treatment in order to produce the moonstone-effect, but further information was not given

1. J. W. Brinck and P. C. Zwaan, *Notes on the Occurrence of Two-phase Inclusions in Synthetic Spinel*, Journ. Gemmology, 1955, **5**, 131-4.



Synthetic moonstone-coloured spinel possessing weak asterism 32x. Structure picture between crossed nicols.



Synthetic moonstone-coloured spinel possessing chatoyancy. 32x. Structure picture between crossed nicols.

Gemmological Abstracts

WEBSTER (R.). *Emerald.* Meldinger f. Norges Gemologiske Selskap. Vol. 1, No. 5, 1957, pp. 3-17.

The second part of an article on emerald, reprinted, with illustrations, from the *Journ. Gemmology.*

P.B.

ANDERTON (R.). *Diamond possibilities in Colombia.* Gems and Gemology, Vol. IX, No. 2, p. 63. Summer, 1957.

Old records of Bogota tell of diamonds given to Philip of Spain and that they were found at a secret mine past Tequandama Falls some twenty miles outside Bogota. It may be that " pipes " exist below the " Llanos " behind the town of Bogota. A large diamond was said to have been found in blue sands on the " Llanos " side of the Andes. The district is thought to be a difficult one for the purposes of prospecting for possible " pipes."

R.W.

—— *Emerald outlook in Colombia.* Gems and Gemology, Vol. IX, No. 2, pp. 60-61. Summer, 1957.

The author refers to the regulations on emerald mining and marketing proposed by the Colombian Ministry of Mines. It is suggested that *moralla*, the low grade emerald crystals, can only be cut on a business-like basis by shipping to India, where cutting costs are low. The Chivor mine, operating under a receivership for creditors, has installed its first automatic compressor. Emerald of fine quality has been found at Buena Vista opposite Chivor and may be mined commercially. The Muzo mine has been plagued, owing to the wet season, with landslides, but the crystals mined are of increasing size and quality. Cosquez is still not operative, while the Gachala mines are under heavy guard against illicit mining by *contrabandistas*, although fine rough from an undisclosed source is currently being cut at Bogota. Prices for fine-quality cut stones are still high. Eleven applications for new emerald locations are on the file of the Mining Ministry.

R.W.

LIDDICOAT (R. T.). *Are present diamond rulings adequate ?* Gems and Gemology, Vol. IX, No. 2, pp. 38-42. Summer, 1957.

A general discussion on the Federal Trade Commission and the American Gem Society rulings on diamond grading. The question " What is a blemish ? " is discussed as well as the factors depending on the " make " of the stone. Colour is said to be more difficult to assess. The value of the American colorimeter is mentioned as being useful in this connexion. There is an excellent photograph of a " natural " seen on the girdle of a diamond.
2 illus. R.W.

BENSON (L. B.). *Diamond substitutes.* Gems and Gemology, Vol. IX, No. 2, pp. 56-59 and 62. Summer, 1957.

Adapted from a lecture given to the American Gem Society Conclave the article fully discusses the stones which can simulate diamond. Strontium titanate is said to have a hardness of 5 to 5½ rather than the published value of 6 to 6½. The names " Starilian," " Fabulite " and " Ultamite " have been used for this material. Some twenty " fancy " names have been used in the marketing of synthetic rutile. The doubling of the rear facets of synthetic rutile, the dispersion and other factors are mentioned as indications of these fakes of diamond. Synthetic sapphire and spinel are considered and mention is made that trap cut diamonds do not show their " fire " to the full, hence the lack of " fire " in the trap cut spinels is not so evident. Colourless zircon, glass, and composite stones are discussed and the article is completed with a table of the diamond substitutes with their characters.

R.W.

CROWNINGSHIELD (G. R.). *An introduction to spectroscopy in gem-testing.* Gems and Gemology, Vol. IX, No. 2, pp. 46-55 and 62. Summer, 1957.

A general survey of the absorbtion spectra of gemstones and the instruments and methods to use for making satisfactory observations. Some historical notes are given and 27 drawings of spectra are incorporated in the text. A line at 5960Å seen in yellow diamonds may be an indication that they have had their colour altered by bombardment with atomic particles.

R.W.

ELLISON (J.). *Formulas for the weight estimation of colored faceted stones.* Gems and Gemology, Vol. IX, No. 2, pp. 43-45. Summer, 1957.

A series of formulae devised to cover the various shapes of coloured faceted stones of various species by taking into account the dimensions of the stone and its density with a multiplying factor. A page of illustrations is appended as a guide to the percentage to add or subtract from the calculated weight when the stones have thick girdles or flat or lumpy crowns or pavilions.

R.W.

CROWNINGSHIELD (G. R.). *New or unusual gem materials encountered in the Institute's Gem Trade Laboratories.* Gems and Gemology, Vol. IX, No. 2, pp. 35-37 and 61-62. Summer, 1957.

The article tells of some of the unusual minerals which have been examined during routine work at the laboratories of the Gemological Institute of America. Specimens mentioned are sodalite from Canada—it is remarked that sodalite can at times contain pyrites like lapis lazuli—and some tumbled stones which were found to consist of an intermixture of green nephrite, pink thulite and greyish-brown zoisite. Some "jade" beads were a combination of white albite feldspar and green actinolite, while another necklet consisted of approximately equal numbers of albite and matching white prehnite beads and was offered as "Japanese jade." Another "jade" was found to be a breccia of true jadeite in kaolin. Ruby in green zoisite from the Kenya-Tanganyika border produced attractive cabochons. Faintly chatoyant sillimanite from Idaho is challenged as not being a gem material despite the publicity to that effect. "Television stone" (ulexite) had on examination a hardness greater than 2 and a density near 2·00, which are values greater than published. Synthetic sintered spinel imitating lapis lazuli and a schillerized synthetic spinel imitating moonstone are mentioned, as are some specimens of synthetic red spinel. Three dark green stones with refractive index of 1·805 and a density of 4·44 are mentioned as being gahnospinels (? gahnite). Heat-crackled synthetic ruby and similarly treated green glass are mentioned as being troublesome to the jeweller. Tests for the recently produced dyed jadeite and the jadeite triplet are mentioned. Highly refractive glasses as paste imitation gemstones are discussed. Criticism of the emerald colour

filter as a test for emerald is made but its value in the testing of synthetic blue spinels is noted. Some pale beryls painted with a coloured plastic coating and some soudé-type emeralds (emerald triplets) show red through the colour filter.

R.W.

LEECHMAN (G. F.). *True story of White Cliffs.* Mineralogist, Vol. 25, No. 10, pp. 339-343. Oct., 1957.

The story of the discovery of the opal deposits of White Cliffs and of the activities of the early miners. In 1897 there was a population of some 3,500 and to-day about forty. The two illustrations show the opal fields of Coober Pedy, South Australia, and of Lightning Ridge, New South Wales.

2 illus. R.W.

DAKE (H. C.). *More on dyed jade.* Mineralogist, Vol. 25, No. 10, pp. 349-352. Oct., 1957.

Light grey translucent jadeite is dyed lettuce-green, apple-green or emerald-green. The cabochons are first shaped leaving the back rough. Minute holes are drilled from the back and the cabochons are then boiled in a dyestuff derived from vegetation, one report stating that the dye comes from Japan. When the colour has sufficiently penetrated into the material the back is ground off to remove the holes and to round the base slightly. The treated material is highly polished. The dyed jadeite fades on exposure to strong sunlight. The dyeing techniques are said to have been originally developed in Pekin but now may be carried out elsewhere and even in the United States. Some of the material has been sold under the name "Korean jade," which suggests that it may have been smuggled from Red China to the United States zone of Korea. The vegetable dye used can be removed by soaking in chemicals. It is suggested that if jadeite is so porous as to take stain it should be possible to use more stable coloration by the use of nickel, chromium or copper compounds, and it is hinted that such colouring agents may have already been used.

R.W.

ANDERSON (B. W.). *Stained jade : a warning.* Gemmologist. Vol. XXVI, No. 314, pp. 155-157. Sept., 1957.

Examination of specimens of jadeite, received from the Far East, which had been artificially stained to an excellent green

colour. That jadeite was susceptible to dye was not previously suspected. The dye is concentrated along cracks in the stone and in some cases is quite evident. The stained jadeite shows pink through the Chelsea colour-filter, but the spectroscope is the best test as the absorption spectrum shows a rather broad woolly band near 6500Å with a weaker band near 6000Å. The narrow 4370Å line of jadeite could, in one specimen, be seen in the gloom of the blue-violet. Another and more convincing-looking faked green jade cabochon is filled with a closely fitting inner cabochon of similar material, the base being finished off with a third piece of jadeite. The dyestuff, a blue dye and a yellow dye mixed together, fills the interspace between the hollow cabochon and the " plug " and the baseplate, the three pieces being held together with resin. The triplet also shows pink through the colour-filter and the absorption spectrum is similar to the above mentioned stained jade except that the bands are at 6300Å and 5800Å respectively. The density of one of these triplets was found to be 3·27.
1 illus. R.W.

LEECHMAN (F.). *The origin of the Roman opal.* Gemmologist, Vol. XXVI, No. 315, pp. 175-177. Oct., 1957.

After an introduction to opal and mention of the more common localities where precious opal is found, notes are given on the eastern European mines from which opal obtained found in Roman times. The workings are near Czerwenitza on the River Pruth. There is little evidence that opal was known, at least in Europe, before Roman times, and the reasons for this assertion are fully given.

R.W.

JANK (R. A.). *A superior method of testing for dichroism.* Gemmologist, Vol. XXVI, No. 315, pp. 185-186. Oct., 1957.

A scheme whereby two pieces of polaroid with opposite optical directions are mounted on an annular cardboard ring cut to fit loosely on the diaphram of a microscope ocular. The advantages of this dichroscopic ocular are enumerated, a particular point being that the specimen is under microscopic magnification and is evenly illuminated with light. The specimen may also be immersed in liquid whilst the dichroism is observed.
1 illus. R.W.

SPENCE (G. H.). *Emerald Mining in Colombia.* Mineralogist, Vol. 25, No. 11, pp. 387-391.

An account of the author's own observations since 1952. Basic methods of mining have changed little since days of Spanish workings. Much of the material mined is fragmentary and opaque. The geology of the emerald-bearing district is briefly mentioned.

S.P.

STEINWEHR (H. E. v.). *Eien neue Türkis-Imitation.* A new turquoise imitation. Zeitschr. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 21, 1957, pp. 3-4.

A new material was found on the German market, looking like turquoise, but specific gravity, refractive index and X-ray powder diagram were different from the natural product. The material was found to consist of Al $(OH)_3$ and a copper phosphate $Cu_3(PO_4)_2.3H_2O$.

E.S.

HAUSMANN (P. A.). *Untersuchungen mit Phosphor-32 an Achaten.* Experiments with Phosphorus 32 on agates. Zeitschr. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 21, 1957, pp. 4-9.

The problem was to colour agate so that the polisher could easily distinguish between " hard, medium and soft parts," Various experiments were made, using phosphorus 32 to enter the agate material. When agate was coloured it used to be assumed that the irregular absorption of colouring matter by the agate was due to the varying porosity of the material ; it is now shown that the construction of the molecular chains is the reason for the varying absorption.

4 illus.

E.S.

MOHAMED (Y. a H.). *Achat und Onyx von Yemen.* Agate and Onyx from the Yemen. Zeitschr. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 21, 1957, pp. 9-14.

Survey of occurrences of agate and onyx in the Yemen, with bibliography.

E.S.

LEHFELDT (W.). *Das Ultraschallverfahren in der Edelsteinindustrie.* The ultrasonic method in the gem-cutting industry. Zeitsch. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 21, 1957, pp. 19-24.

Untrasonic sawing, drilling and cutting of gem stones is being used more and more, in the case of hard materials. The principle

of the method is explained in detail with illustrations. Speeds are given in cub. mm./minutes, and are for instance, for ruby 15, agate and oynx 25-30, spinel 30-35. There is a short bibliography. E.S.

SCHIEBEL (W.). *Ultraschall-Verfahren zur Bearbeitung von Edelsteinen.* Ultrasonic methods for working of gemstones. Zeitschr. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 19, 1957, pp. 7-11.

This method is now in general use for hard stones such as diamonds, especially when holes with small diameter have to be drilled. As the cutting and drilling can be controlled easily, this method is also used for engraving stones on a mass-production basis. It should also be possible to produce cabochons and faceted stones by this method. E.S.

SCHLOSSMACHER (K.). *Echte perlen mit echtem Kern.* Real Pearls with real neuclus. Zeitschr. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 19, 1957, pp. 22-23.

The Institute at Idar-Obserstein was given a broken real pearl, which inside had a neuclus of pearl, which also was real. Although composed like a cultured pearl, tests proved this to be a real pearl. E.S.

—— *Susswasserperlen im Rontgenbild.* River pearls under X-rays. Zeitschr. d. Deutsch. Gesellt. f. Edelsteinkunde, No. 19, 1957, pp. 23-24.

By combining X-rays and X-rays shadowgraphs it is possible to determine river pearls and to differentiate between sea-water pearls as well as cultured pearls. E.S.

BATCHELOR (H. H.). *Very little mining at Lightning Ridge.* Gemmologist, Vol. XXVI, No. 315, pp. 187-188. Oct., 1957.

The author tells something of the present conditions in the mining fields of New South Wales and Queensland. Some sapphire mining is being carried on at Ruby Vale but little work is done at the Lightning Ridge opal fields.

P.B.

WEBSTER (R.). *Cultured pearls.* Gemmologist, Vol. XXVI, Nos. 312, 313, 314, pp. 129-132 : 147-152 : 158-163. Jul./Aug./Sept., 1957.

The coating of objects placed between the shell and the mantle by nacre-producing molluscs has been known from the 13th century. The experiments of Carl Linné in the 18th century are mentioned. K. Mikimoto produced the cultured half-pearl (cultured blister pearl) by cementing a mother-of-pearl bead to the shell of the pearl oyster and then removing it after the animal had coated it with nacre. Mikimoto patented and commercialized the process. The mystery of who discovered the method or methods for the production of whole cultured pearls is discussed. The localities where pearls are cultured and the types of oysters used are mentioned. There is a full description of the cultivation of the oysters and the subsequent operations to produce the cultured pearl by nucleus insertion. Experiments with plastic beads as nuclei showed them to be unsuitable, but " marble " has been used. The cultured pearls recovered are counted, sized and graded. The methods used in drilling the beads are explained. The pearls are strung as graduated necklaces in Japan and are sold by the *momme* (1 momme equals 18·75 carats). The base method of price calculation is not used for cultured pearls. A note is given on non-nucleated cultured pearls. Some notes on the detection by eye of cultured pearls is given and hints on the care of cultured pearls. The dyeing of cultured pearls to a black or a rosée colour is mentioned.

6 illus. P.B.

SCHWARTZ (J.). *Collecting crystals.* Gemmologist, Vol. XXVI, No. 314, pp. 173-174. Sept., 1957.

Hints on the care of crystal specimens during transport and in storing. Methods of cleaning crystals by boiling in acids are given, and the labelling and systematic arrangement of a collection are discussed.

R.W.

SIR JAMES WALTON MEMORIAL LIBRARY

The library, which was established in memory of Sir James Walton, K.C.V.O., F.R.C.S., F.G.A., by the National Association of Goldsmiths and the Gemmological Association, has now been completed, and its main sections are shown in the photographs. In addition to books on jewellery, gemmology, gold and silverware and horology, the library contains gemstones and gem minerals.

The National Association of Goldsmiths has contributed substantially to the formation of the library and various members of that organization also made generous contributions. Donations that have been kindly sent by companies to the Gemmological Association are recorded on page 245.

It is one of the most comprehensive private libraries on the subjects mentioned. There are some gaps, however, and the Council of the Association would be most grateful for any contributions of books, gemstones or gem minerals or donations.

Final section of the library.

First section of library, completed in 1956.

Further aspect of final section of library,
with oil painting of the late Dr. G. F. Herbert Smith, C.B.E.

Nephrite plaque with inscription " In memory of Sir James Walton, K.C.V.O., F.R.C.S., F.G.A." and drawers containing models made by Sir James.

JADE STORY—EUROPEAN

(The sixth part of the Story of Jade in Europe)

By ELSIE RUFF, F.G.A.

IN search of jade we have travelled backwards, from the known to the known, perhaps along the line of effect to cause. Here it seems necessary to generalize, and in doing so we find the mainspring of knowledge established in the Roman Empire during the height of her power, and thence on to her decline. In other words our search for jade, or jasper, in Europe, is now largely a search in the Roman world or a world deeply influenced by Rome. We are roughly half-way between the neolithic use of jade in north-west Italy—referred to in the first article of this series—and our own times.

Because specialization belongs to this age, it is difficult to pin-point usage and authority in earlier days. In any case, authority tapers. Terms are vague and spelling is elastic—almost one might say up to recent times. Dates have therefore a different implication. The whole tempo of life was, of course, slower. There is no moral involved here. It is fact. Legends, too, might be particularly popular at some known period, and the period may date them, but in actual fact the birth of a legend may be ante-dated by hundreds of years. Works by the poet Orpheus have been confused in this way. He has been quoted as a possible authority for the use of the word *nephrite* during the fourth to fifth centuries.[1] Nevertheless he seems to have lived around the period of Homer. He wrote of other gemstones, fortunately, including jasper, and here we are on safer ground :

> " . . . Who'er the polished grass-green Jasper wears
> His parched glebe they'll satiate with rain,
> And send fat showers to soak the thirsty plain."

C. W. King[2] says :

> " . . . hence, Orpheus terms it ' the Jasper ' colour of spring."

A modern author, Lyn Thorndike, who has contributed two extremely interesting volumes on *The History of Magic and Experimental Science* (1923), has something to say about this poet :

" Among poems of some length extant under Orpheus' name and the one of most interest to us is the *Lithica*, where in 770 lines the virtues of some 30 gems are set forth with considerable allusion to magic . . . The date of the poem is now generally fixed in the fourth century of our era. . . .The *crystal* wins favourable answers from the gods to prayers, kindles fire, if held over sticks, yet remains cold ; as a ligature benefits kidney trouble. . . . "

The story of Tristan or Tristram and Iseult is an example of a legend used in many countries. Tristan himself was one of the most famous of mediaeval heroes. He is found in the Arthurian legend. One scholar maintains that the story had its roots in an unknown Anglo-Norman poet. Be that as it may, our interest here is in a ring set with a green jasper, not because it represented great wealth but because it was valuable in a much deeper sense.

" And friend " the story runs, " I have here a ring of green jasper. Take it for love of me, and put it on your finger ; then if someone come saying he is from you, I will not trust him at all till he show me this ring, but once I have seen it, there is no power or royal ban that can prevent me from doing what you bid—wisdom or folly."

There can hardly be a greater example of human loyalty than this or greater motive attributed to a particular stone. And here was the " jasper " of Marco Polo,[3] seen in the mines of Turkestan. It is the " better than gold " of Chaucer a little more than a hundred years later, quoted in the same JOURNAL.

From the evidence examined thus far jade appears to have fraternized with both the ornamental and the medical. Sometimes it was medical only. As late as 1811, John Pinkerton, writing of *Jad*—the *Giada* of the Italians, said :

" . . . the nephritic stone was supposed when worn, to cure diseases of the reins or lumbago, according to others the stone or gravel, in which sense it is used by modern physicians."

If physicians were using jade as a curative at the beginning of the nineteenth century, in this country, the illustration in VOL. V of this JOURNAL[4] suggests that such pendants must have been approved " medicine " in the medical world. Almost a hundred years later, there is still evidence of its association, medically. Thomas Wilson, in what is now regarded as a famous paper on jade (liberally quoted in these articles) writes of a call he made at the French National Library in Paris during 1900, and of being corrected for enquiring for certain books on jade in the mineral department when he should have consulted the medical section.

This twentieth century custom of filing information on jade in the medical section must have gone on for hundreds of years, in France at least. A work was published in Paris during 1694, written by Monsieur Pomet, Chief Druggist to the French King, and entitled *A Compleat History of Drugs.* It is doubly interesting to us because the translation was dedicated to a famous Englishman who passes in and out of these pages. We read :

" Done into English from the Original. London, 1712. Dedicated to the Truly Ingenious and Learned Dr. Sloane, Physician extraordinary to Her Most Sacred Majesty, Secretary to the Royal Society, and Fellow of the College of Physicians, London."

" P. 405. 9 :

" Of the Jafper. There being various sorts of Jafpers, fuch as the Green, the Purple, Cérulean, Aurora, or Crystal like. I shall speak only of that which is sold in the shops, which is the Green Jafper ; and if it had not been of some small use in Medicine, I should not have spoken of it.

" *Jaspis*, the jafper, is a fine, hard, smooth resplendent, precious Stone, which differs little from the Agate, only that it is not so hard and pure . . . "

" 10. Of the Jade Stone :

" The jade is a greenish Stone, inclinable to grey, extremely hard and very rare. This Stone is little used in Physick, it being difficult to cut . . . The Oriental is the finest Jade. Jade is a very hard Stone, of a greenish grey Colour ; the finest comes from the East Indies . . . Some pretend that applied to the Region of the Kidnies, they are proper to bring away Stone and Gravel, but I can give no credit to such remedies."

" 11. Of the Nephritick Stone :

" The Nephritick Stone is a greyish Stone, with a little Mixture of Blue in it, so that it is usually of a bluish colour, being fat and oily like Venetian Talck. This stone is much valued by certain Perfons for the Cure of Gravel, which makes it so scarce ; and so much enquired after, because of its Virtues, which it performs by hanging about the Thigh of those who are troubled by the Stone or Gravel in the Kidnies, from whence it is called *Nephritick Stone* . . . The true *Nephritick Stone* comes from *New Spain* ; and whoever would know further of it may read Mr. Worms, who has writ a large Description of it, too long to be inserted here . . . It is found in New-Spain, sometimes with Jafper, and sometimes alone. Some reckon it among the kinds of Jafpers, making no great Difference, but only that it is harder . . . they are likewise gathered in Bohemia, and several Parts of Spain, but these are not so much esteemed as what comes from America.

" This Stone has the Property to ease the Stone Colick, to break the Stone in the Reins, and expell Gravel by Urine, being hung about the Neck Thigh and Arm. Some prescribe it to be taken inwardly from four to fifteen grains. Of the latter years there is brought into Use for the same Diseases,

a brown, smooth, shining Stone, which they call from its great Virtues, the *Divine Stone* ; this breaks the Stone in the Kidnies, and forces it away by Urine ; they tye it in their Cloaths about the Back."

Thanks to our earlier reading, this book on drugs makes sense. Running over the above list it is possible to feel that the author might be writing of one material only, and that material nephrite ; though his jasper that " differs a little from agate," and the various colours, quoted in the first sentence, are not clear. Here, too, is a prescription for internal treatment, mentioned a little later by Lange (1704) and a little earlier by Emanuel the Elder,[5] in 1686. A further point here is the term Oriental jade as opposed to the jade of New Spain.

An earlier link in connexion with cures displaces an oft-quoted authority for the coining of the word *nephrite* itself. Always this not-so-clever title (being a simple matter to adapt from *nephriticus*) has gone to the credit of A. G. Werner of Freiberg,[6] in 1789 (though two other writers have been cited, one in 1762 and the other 1760). The honour probably belongs to Cleandro Arnobio in his *Tesoro delle Gioie*, published in Venice in 1602—over a hundred and eighty years earlier than Werner. Arnobio writes, page 109 :

" The stone of the flanks (or hips)—kidney stone—named Nephite, the finest specimens included in emeralds. Its shades incline to the green, with a milk-white undertone. It is worn in various forms coming from the use the Red Indians carried it for, according to the part of the body it was intended to cure for flank trouble or stomach pains."

Quoting Monardes he writes that the gem was called NEFRITE and named for the flank—kidney stone. On page 110 he says again it is useful for stomach trouble and quotes two experiments. Further, that the Spaniards called it Stone of the *Iada* and the Greek NEPHITE.

" It is found in many shades, mostly a white-green—and also where the white dominates. It is never transparent."

Later in the volume he writes of various stones " carried in Italy on account of their medical appropriateness, notably the Gioia NEPHITE."

The Italian use of what is quoted as the Spanish term *iada* corroborates the Italian/English dictionary *Worlde of Words*[7] printed in 1598, just twenty-nine years after Monardes. The 1611 edition of this publication, greatly enlarged and improved, makes

little distinction between the two terms that concern us here. *Iada* or *Jada* is a " kinde of pretious ftone like an emeraud," while *Iaspe* or *Jaspe* is " a pretious Stone called a iasper ftone." Certainly the word *iada* would not have appeared in a dictionary of 1598 had it not been already established.

Arnobio is valuable evidence, not only because we find our word Nephrite (though spelt *nephite* and *nefrite*) in earlier use than heretofore believed but because the writer was familiar with Monardes, who had written *piedra de ijada* in 1569, and also because even as early as 1602 people were in the habit of carrying nephrites in Italy on account of their belief in the medical efficacy of the stones. He knew too that the custom of the Red Indians was similar.

In *The Magic of Jewels and Charms* (1915) G. F. Kunz quotes Arnobio as having received a specimen of American jadeite prior to 1602 and having shown this to one Signor Michele Mercate[8] " a man well versed in medicine and in the knowledge of minerals and herbs " and that he immediately recognized and called the specimen *nephrite* from its virtues, saying that he had found it useful in aiding parturition. Later the specimen was shown to a pharmaceutist who declared that he had used the stone but did not know its name. A much earlier writer (1098-1179) invests the jasper with the same virtue, i.e. as an aid to child-birth.

Unless communications were much more rapid than we have reason to suppose, it must be obvious that before 1600 nephrite was known in Italy, not only by name but for the cures it was supposed to effect. Had this not been so, the material, as well as the custom, must have been adopted in less than thirty years. Even the fact that a specimen of American jade had come to hand does not detract from its common use among the Italian people.

An even greater interest for us here is suggested by a further excerpt from Dr. Kunz's book. He writes :

> " Proceeding to dilate upon the many virtues of this stone, Cleandro quotes Aldobrando, ' a physician, physicist, and philosopher of Bologna ' who described it as having usually a purple shade, almost like porphyry, with various figures of herbs, flowers, knots, and Arabic characters in yellow colour. There were, however, according to the same authority, some of the darker hue, with protuberances and bands of yellow, and also black spots, as though the stone were a section of the spleen. In another variety in the midst of the purple colour might be seen a yellow stain with pittings and hollows : this was thought to figure a section of the liver. spattered with bile, and such stones were employed with good effect to cure those suffering

with bilious disorders. To discharge the bile a dose of four grains was administered, the powdered stone being thoroughly dissolved in wine. Still another kind of a reddish hue like coagulated blood, full of pittings and veinings, was thought to be more especially as a remedy for disorders of the blood and for checking hemorrhages."

Many stones may perhaps be confused in this quotation but almost certainly jade was among them, and the " physician, physicist, and philosopher of Bologna " was most likely Ulissi Aldrovandi of Bologna who used the term *lapis nephriticus* in his own writings[9] around this period. Aldrovandi was no mean scientist either, as the earlier reference substantiates. It would seem therefore that both the term *lapis nephriticus* and *nephrite* originated in Italy.

A further point of interest is that Arnobio gives a dose of 4 grains as a cure for bile while Monsieur Pomet, about a hundred years later, safeguards himself with a suggested 4-15 grains ; albeit for a slightly different disorder. Here too may be an answer to an oft-repeated question : Why were certain stones considered suitable as cures for certain diseases ? Either the *appearance* of the stone suggested a part of the body in need of aid or suggested the aspect of the disease in the body.

Gemstones were sometimes used as charms for purposes other than medical or moral. In Elizabethan times, for instance, there was a charm to find stolen goods :[10]

" *To know where a thinge is that is stolen.*

Take virgine waxe and write upon yt ' Jasper + Melchior + Balthasar ' and put yt under his head to whome the good partayneth, and he shall knowe in his sleape wher the thinge is become."

There is really more than meets the eye in this belief. It is linked, psychologically, with " sleeping on a problem " when answers present themselves on waking, as many know from their own experience.

Although the terminology of Gesner (1516-1565) was not very helpful, from our point of view, he was undoubtedly a very great authority in his day. In the Proceedings of the Free Museum of Science and Art, University of Pennsylvania (May, 1897-1900) is an article by Professor P. Brown. He writes :

" Thus we find in Gesner that amulets of green ' jasper ' mottled with white were reputed to have extraordinary powers in protecting the wearer from death by poisoning, and he states that this use was universal thoughout the East. Even in the time of Pliny this use seems to have been common."

It could be that Gesner was not going to be bothered with any newfangled title such as *Piedra de Ijada.* He was, after all, a contemporary of Monardes and as such was entitled to some degree of scorn. Certainly he stuck to the old term *jasper.* Kunz, in the above volume wrote :

> " Gesner states that he saw in the possession of a writer of Lausanne a green jasper, bearing the image of a dragon with rays, similar to the gem described by Galen."

A name well known in the gem world is that of John Trevisa, a mediaeval writer frequently quoted. As a native of Cornwall he brings a rather more local flavour to the jade problem. John Trevisa, or John of Trevisa, was born around A.D. 1322. His literary work consisted mostly of translations from Latin into English and although it is claimed that he produced very little original work, his value as a translator, particularly into the language of this country at that time, has earned for him the title of " Father of English Prose." Caxton printed some of his work and, later, Wynkyn de Worde. Besides being a scholar, John Trevisa was also a traveller. One of his most important translations was *De Proprietatibus Rerum,* written by Bartholomaeus Anglicus (de Glanville) another Englishman. Bartholomaeus, who joined the Fransciscan order in France, produced an encyclopaedia around A.D. 1250, which became famous largely because it mirrored the life of the day. Shakespeare is said to have been familiar with this work. Doubtless it was one of the books to be consulted for that period, and around the thirteenth and fourteenth centuries books were being hired in Paris. (Was this the forerunner of our lending libraries ?) Trevisa's translation appeared in 1398 (or 1387, for controversy exists here also). In Chapter 53 is a heading : *De Lapidibus Preciosis,* with something to say about jasper :

> " Jasper is a precious stone and is greene like to *smaragdus ;* but it is more dim of colour. And there be 17 kinds thereof as Isidora saith. *Jaspis* when greene is called *Gemma Prassiua* (*Prassius*) and though the chief colour be greene, yet it hath many colours . . . *Jaspis* is more beauteous in Silver than in gold . . . and men say it is a stone of wonder virtue . . . And best *Jaspis* is found in the mountains of Licia."

Many Virtues are attributed to this stone and it is suggested that it is helpful also if taken in powdered form dissolved in milk.

Isidore, Archbishop of Seville, quoted above, was another of the early encyclopaedists, and a name to appear in print for hun-

dreds of years. A translation of his work *An Encyclopedist of the Dark Ages*[11] was made as recently as 1912, in New York. In Book XVI of this work is a section *On Stones and Metals* and the stones are classified according to colour. On green gems :

> " Certain believe that the jasper gives both attractiveness and safety to its wearers, but to believe this is a sign not of faith but of superstition."

Isidore's period was A.D. *c.* 570-636 and a footnote to this volume states that Pliny's *Natural History* was the chief source of writers of these times and that an epitome or an epitome of an epitome was made by Solinus in the third century and that Isidore is supposed to have used both the epitome and the original as well as an unknown work. The authority of the Roman Pliny was the chief source for writers on gemstones for hundreds of years. The tragedy is that so little of Pliny's own authorities is extant.

Julius Solinus was a Roman of the third century A.D. A translation of his work appeared in London in 1587. Here we find the " native soil of the Emerald " " . . . the land of the Arymafpes" (Scythians) and a statement that the emeralds of Scythia are better than those of Egypt, Chalcedon or Media, and " maketh it to be liked above all others." Later we read, in an interesting paragraph easily linked with Pliny :

> " . . . for in the inner parts of Germanie is found a stone called *Callais*, which men prefer before the precious stones of Arabia : for it passeth them in beauty. The Arabians say it is not found anywhere but in the nests of birds which they call MELANCORYPHES which no man believeth forasmuch as they are found in the regions of Germanie among stones, although very rarely. In respect of the estimation and value of the Emerawd, it is of colour a faint greene. . . . "

There are frequent early references to green stones emanating from " Germanie," which is not surprising since gem cutting was an industry in that part of the world in Roman times.

Numerous references to jasper exist, both ornamental and medical. The word is frequently found in Roman writings. The difficulty is to determine whether the word *jasper* referred to jade or to other substances, that might too include jade, or even to the jasper of to-day. It could hardly be that jade was not in the picture at all when so many descriptions of jasper clearly describe jade. Virgil wrote of " yellowish jasper." These stones were set into a sword " all sparkling like stars " suggesting that the stones were

neither jade nor jasper, for though our own jasper takes a good polish it can hardly be said to sparkle. Such references abound. C. W. King[12] wrote that :

> " no stone held so high rank in the alexipharmaca of both ancient and mediaeval physicians as the Jasper."

He said also :

> " Fine specimens of jasper continued to be prized under the Empire, in spite of the then comparative abundance of the true emerald. Thus Juvenal excuses the host's watchfulness over the ' sharp nails ' of this needy guest when he handles his jewelled cup, on this plea : ' *Da veniam : praeclara illic laudatur iaspis.*' " (Freely translated : Pardon me : the praised (valued/ prized) jasper is there.) E.R.

King adds :

> " Similarly, Martial, after making his exquisite look over and bargain for all the most expensive articles in the Septa, or Grand Bazaar—slave boys, ivory ear-rings, antique bronzes, old plate, crystal and murrhine vases—ends with ' Sardonychas veros mensa quaesivit in omni, Et pretium magnis fecit iaspibibus.' Freely translated : He looked for real precious stones at every table and declared them worth great jaspers. (Supposing that jasper was as good as money.) E.R. This verdant colour furnished the idea to King Polemo for the pretty epigram (X750) ' If you saw on the land these cows and this jasper, you would declare that the first were breathing creatures, the last a field of growing grass'. "

Germanicus, the Roman commander, is reputed to have been highly superstitious (along with his contemporaries) and always to have slept with a talisman beneath his pillow. The talisman was of green jasper engraved with a figure of the Goddess Hecate, who presided over magic arts and spells. After a life fraught almost daily with danger, Germanicus came to a tragic end. It was then discovered that his talisman had disappeared.

It seems incredible that a part of the world could ever have revered what we now term jasper. In *Quartz Family Minerals*[13] (p. 145) we have an informative description of jasper :

> " Jasper includes, in a general way, nearly all varieties of impure, opaque, coloured, amorphous quartz. Under the microscope it is essentially a very fibrous quartz—a characteristic in which it differs from all other varieties . . . In colour, jasper may be red, yellow, brown, green, bluish or black. These different colours are due to the inclusion of different impurities, such as clay, iron in varying stages of oxidation, or organic matter, and possibly admixtures of other minerals in minute quantities. From time immemorial, the jaspers have enjoyed wide popularity as gem stones. They take a splendid, glossy polish, wear well, are attractive in appearance . . . jasper is not translucent, unless cut into very thin sections."

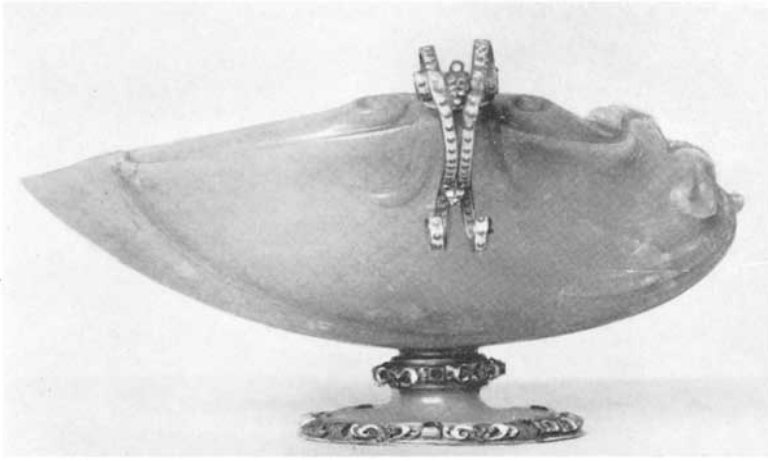
In other words, jasper covers a range of colour not unassociated with jade itself and certainly not at variance with some of the old lists, yet by no stretch of the imagination could its polish, which everyone agrees is glossy, be mistaken for the greasy wax-like finish of jade. In 1865 C. W. King[14] was writing :

> " The modern jasper, distinguished from the modern agate as being quite opaque, and containing more iron, was certainly the stone known to the ancients as the Achates."

Undoubtedly a small piece of jasper, here and there, might be generally acclaimed beautiful and of specimen status, but one does not need to search for beauty in jade, whatever its shade or size. In early days, as now, emerald green was the most admired green. Writing of *Callaina*, Pliny said :

> " The best of them have just the colour of *Smaragdus*, a thing that proves that the most pleasing property in them is one that belongs of right to another stone."

How often we meet this, and not alone in the world of gems. We love something mainly because it is like something else that we love. So the modern taste in jade, said always to be the emerald green, is by no means original. It seems to have been in demand at all periods.



Vessel in nephrite, probably early 17th century, believed to be work from the Imperial Court Workshop of Rudolph II, in Prague.

What we do know is that Rome not only imported the luxuries of the world—for she was in a position to do so, rather as the U.S.A. is to-day—but she was also a clearing house for these luxuries, and gemstones were luxuries as well as talismans, and necessities in the medical sense. Sir Mortimer Wheeler has unearthed numerous instances of a thriving trade between Rome and India, and the frequent arrivals of Indian missions at the court of the Roman Emperor suggests that the exchange was of mutual advantage and desirable. During the fifteenth and sixteenth and even seventeenth centuries Europe found another continent eminently to her interest, but in the Roman day there was a vast country to fascinate Europe and that country was India. Pliny makes frequent mention of it.

A writer of the third century A.D. (though the date is contested) was Dionysius, the Geographer. It is believed that this author of blank verse (translated from the Greek in 1789 in London) was an Alexandrian. He writes of Eastern India, ancient and modern :

> " The Indians, dwelling near the western Sun,
> These are distinguished by their tawny skins
> . . . .
>
> Of these some search with Care the hidden Gold,
> Digging the Sand with Spades for that Intent :
> . . . .
>
> Some trace adjoining to the Torrent's Streams,
> Or the blue Berrill, or the Adamant
> Transparent, or the Jasper green to Sight,
> Or the bright Topaz of a clearer Blue
> Fair flowing Indus, whence the Land takes Name,
> The Indian Realms the Ganges cuts in two."

Yet another around this period was Epiphanius, who wrote of gems. Epiphanius was bishop of Salamis (called Constantia after A.D. 395) in Cyprus. He was born in Palestine of Christian parents around A.D. 315 and died in 403. In 367 he became bishop of Salamis. One of his few works was on the *Twelve Stones*, and he attributed the jasper to Peter the Apostle. On page 113 of this volume is the heading : " The Gem Jasper " (*Iaspini*) :

> " The jasper is a green gem whose appearance is similar to that of the emerald. It is found in the immediate neighbourhood of the river T'ermagondos and near Iamant'isa—not that which is in Cyprus, for in the nature there are many places which they call Amat'usion."
>
> (Footnote : T'ermagondos = Thermondontis. Iamant'isa = Amathunta.)
>
> " Its appearance is green in colour, like the emerald but to a slight

extent like that of the bnobi (a reference to obscurity) and from within it emits a green colour like that of copper rust."

C. W. King translates the last paragraph as follows :

". . . the Emerald, like which it is green, but duller and more obscure, and having its substance green inside resembling verdigris."

Epiphanius continues :

" Those make much use of it who adorn their person, as is stated in the fables. . . . "

On p. 136 he writes :

" The sixth gem is the jasper (*Iaspini*) on which is inscribed the name of Naphtali (Nep't'alem) who was next in birth . . . Many are the kinds of this gem, nor is it found in one place, but in many quarters . . . jasper . . . is in appearance like to the hue of the emerald, and secondly its colour resembles that of the sea . . . As I have said before about this stone, it is a revelation, as it were, which comes in a dream. It is found in the regions of Phrygia, as it were, in a nest like a trough of clay."

One of the most quoted writers of the Middle Ages (and later) was Galen, sometimes spelt Gallen, or given the Latin renderings, Claudus Galeni or Claudius Galenus. Galen was a Greek Physician who lived around A.D. 130-200. He wrote a great deal on medical matters and as a medical authority was second in importance only to Hippocrates. One of his works *Natural Faculties* was translated into English in 1586 and printed in London. In search of knowledge Galen is said to have roamed through Greece, Cilicia,* Phoenicia, Palestine, Crete, Cyprus and finally Alexandria where he visited the famous medical school. Eventually he settled in Rome and on one occasion when he left the city for Pergamum was recalled by the emperor Marcus Aurelius. We are told that Latin translations of his works were studied in European medical schools until the beginning of the nineteenth century. According to Gesner, Galen is reported to have worn a jasper on his finger and to have asserted that hanging from the neck jasper influenced the stomach. C. W. King quotes the " sober Galen " as follows :

" The green jasper benefits the chest and the mouth of the stomach if tied upon it. Some set it in a ring and engrave upon it a serpent with a radiated head, just as King Nechepsos prescribes in his thirteenth book. Of this gem I have had ample experience having made a necklace of such stones, and hung it round the neck, descending so low that the stones might touch the mouth of the stomach, and they proved to be of no less service than if they had been engraved in the manner prescribed by King Nechepsos."

*Then a Roman province in Asia Minor.

Thomas Wilson does not share King's opinion that by jasper Galen meant Plasma.[15] Wilson believed that Galen, writing of green jasper, referred to jade. He said, " Galen, who speaks of green jasper (subsequently identified as jade) as having certain medicinal qualities," and he quotes Galen's words, " Jaspis virens, nempe, stomachum adhalaesu (or adhaesu) ventrisque es colores mitigat." Freely translated, the first part of the sentence runs, " The green jasper indeed calms the stomach by its clinging (power) . . . " The rest of the sentence is not clear. Wilson continues

> " The name *jaspis*, and the phrase " jaspis virens, viridis ' seem to have been continued with the inclusion of jade from the time of Galen and Actius through Orpheus, Argonautica (Hymni et Libellus de lapidibus), (A.D. 500-600), Albertus Magnus (A.D. 1205-1280), Marco Polo (A.D. 1271-1323) and others too . . . "

In Revelations of St. John the Divine, written in A.D. 96, just 17 years after the death of Pliny, there are references to jasper. It seems fitting to record them here :

Chapter 4, v. 3 :

> " And he that sat was to look upon like a Jasper and a sardine stone : and there was a rainbow round about the throne, in sight like unto an emerald".

Chapter 21, v. 11 :

> " Having the glory of God : and her light was like unto a stone most precious, even like a jasper stone, clear as crystal."

Chapter 21, v. 18-20 :

> " And the building of the wall of it was of jasper and the city was pure gold, like unto clear glass. And the foundations of the wall of the city were garnished with all manner of precious stones. The first foundation was jasper ; the second, sapphire ; the third, a chalcedony ; the fourth, an emerald ; the fifth, sardonyx ; the sixth, sardius ; the seventh, chrysolyte ; the eighth, beryl ; the ninth, a topaz ; the tenth, a chrysopraseus ; the eleventh, a jacinth ; the twelth, an amethyst."

Contemporary with Pliny was Dioscorides of Anazarba in Cilicia. He too has been frequently quoted. Lange mentions him as giving the synonym *Gemma Calsnee*. Gesner wrote of his medical knowledge. His great work, compiled in the first century A.D., was later illustrated by a Byzantine in A.D. 512 and Englished in 1655 by John Goodyer, though not then printed. This book had to wait for our own age for the privilege of print; in 1933 it was

edited by Robert T. Gunther. It seems better to quote him here, before Pliny, because just as *ijada* stems from Monardes, jasper must halt with Pliny. In Book V, No. 160, p. 655, we read :

> " *Iaspis.* Lithos. Jasper. *Lapis Iaspis,* some of it like ye Emerald, and some like Christall resembling phlegm, some like ye air and some (is called) Capnia, as we should say, besmoked, and some also having white middling partitions, and glittering, called Assyrius. And some is called Terebinthizusa being in colour like *Calais.* But all are said to be Amulets being hanged about one, and to speed deliverance, being tied to ye thigh."

Pliny the Elder was born in A.D. 23 and died in the eruption of Vesuvius in 79. It has been claimed that his work was more read than any other during the Middle Ages, with the single exception of the Bible. Perhaps at this time his authority has never been higher, for, with the discovery of the Dead Sea Scrolls and the subsequent ruins of the monastery connected with the scrolls, scholars have turned to Pliny for a description of this organization and its location.

Since the word jade (or nephrite), in any of its forms, was not then born, and since, despite its Latin, the term *lapis nephriticus* can be traced no earlier than the end of the sixteenth century A.D., it remains to discover what this famous Roman called jade. Pliny has several references to *Jaspis.* He also has a chapter on *Beryls : Eight Varieties of them.* Not only has jade been likened to the emerald in modern times, it has been a favourite description by almost everyone writing on the subject. And it is an apt description, since it is possible for a fine piece of green jade to be mistaken, on sight, for an emerald. Even Captain Cook likened the Maori jade to the emerald, as did Florio in his dictionary some 200 years earlier than Cook.

Pliny[16] writes :

> " Beryls, it is thought, are of the same nature as the *smaragdus,* or at least closely analogous. India produces them, and they are rarely to be found elsewhere. The lapidaries cut all beryls of an hexagonal form ; because the colour, which is deadened by a dull uniformity of surface, is heightened by the reflection resulting from the angles."

Two interesting points emerge here. First, the term beryl is a species in itself and includes the emerald, and Pliny was familiar with this. Secondly, the emerald occurs naturally in hexagonal crystals, so it is possible that Pliny thought this the work of man rather than of nature.

" The most esteemed beryls," he goes on, " are those which in colour resemble the pure green of the sea ; the chrysoberyl being next in value, a stone of a somewhat paler colour, but approaching a golden tint." After describing various other varieties he says : "The people of India are marvellously fond of beryls of an elongated form, and say that these are the only precious stones they prefer wearing without the addition of gold . . . They prefer too, cutting the beryls in a cylindrical form, instead of setting them as precious stones . . . " (Gesner mentions this also.)

Our next reference to *Iaspis* (Chapter 37) is entitled : *Iaspis : Fourteen varieties of it.* (These are the famous fourteen varieties so frequently quoted by later writers.) " *Iaspis* too is green, and often transparent ; a stone which, if surpassed by many others, still retains the renown which it acquired in former times. Many countries produce this stone: that of India is like *smaragdus* in colour; that of Cyprus is hard, and of a full sea-green." (Another rendering of this passage, given by Dr. Ball in his *Roman Book*, page 162, is : " The *jaspis* of Cyprus is very hard and of a greasy grey colour, between white and green.") " That of Persia," Pliny continues, " is sky-blue, whence its name ' aerizusa.' "

If jasper (or jade) could have been confused in certain instances with one of Pliny's beryls, here little doubt remains that one, at least, of his jaspers is our jade. The sky-blue of the Persian stones was undoubtedly our turquoise. The various colours he mentions later, under this same *Iaspis* heading, differ little from those quoted in the French book on Drugs. He also says that there is a *jaspis* that resembles *sarda* in appearance, probably referring to red jasper. Again jasper here seems to be a generic term like jade. " One great defect in them," he goes on, " is a subdued lustre, and a want of refulgence when viewed from a distance. . . . Throughout the East, it is a custom, it is said, to wear *iaspis* by way of amulet. The variety of this stone which resembles *smaragdus* in colour is often found with a white line running transversely through the middle." (The confusion here could be with cat's-eye though a natural white line is not unknown in nephrite. Dioscorides mentions this, above.) " Here, too, I may take the opportunity of exposing the falsehoods of the magicians who pretend that this stone is beneficial for persons when speaking in public." This may be a falsehood in one sense but for another reason it was

common among the Maoris (who were great orators) and the Chinese.

Although it is certain that Pliny's jasper included our jade —for what could be more convincing than the " renown of former times," the " greasy-grey colour, between white and green," the " subdued lustre and want of refulgence," the amuletic properties and the use of it in oratory ?—it is not possible to discover, via Pliny, that " jasper " was a cure specifically for kidney ailments. Moreover, Pliny throws little light on this subject. The nearest is his chapter on : *Precious stones which derive their names from various parts of the human body.* " . . . Adadunephros, adaduphthalmos, and adadudactylos, meaning ' kidney of Adad,' ' eye of Adad ' and ' finger of Adad ' respectively, and Adad was a god of the Syrians." A footnote here explains : " An ancient king of Syria, worshipped by the people of that country and the inhabitants of Phrygia. According to Macrobius,[17] the Assyrians worshipped Jupiter and the Sun under that name."

Despite the fact that these stones were called after various parts of the body, we are not told whether it was so because of the *shape* in which such stones were discovered or sometime discovered or whether it was similarity of colour or markings to the various parts of the body, or, as was the case quoted above, because the stones gave an appearance of a diseased part of the body and were believed to have curative properties on this account. Another authority, Ignatius Donnelly in *Atlantis,* gives some information on the word Adon which is probably related to Adad.

> " Adon was one of the names of the Supreme God of the Phoenicians ; from it was derived the Greek god Ad-onis . . . just as in the Bible we have allusions to the " Sons of Adad ' who were the first metallurgists."

In his *Roman Book* S. H. Ball seems certain that Pliny's *jaspis* in part referred to jade, particularly the variety emanating from India, or more likely by way of India ; though he was doubtful about Adadunephros. He also felt that Pliny's *Ceraunia* may have included some of the jade axes used by neolithic people in north-West Italy.

Perhaps Pliny's most interesting contribution, from our point of view, is his reference to *Callaina:*

> " . . . the stone known as *callaina* and of pale green colour. It is found in the countries that lie at the back of India, among the Phycari, namely, who inhabit Mount Caucasus, the Sacae, and the Dahae . . . it is

only amid frozen and inaccessible rocks that it is found, protruding from the surface . . . not as though it formed an integral part of it . . . People so habituated as they are to riding on horseback, cannot find the energy and dexterity requisite for climbing the rocks to obtain the stones . . . It is with this stone that the people pay their tribute, and this the rich look upon as their most graceful ornament for the neck."

A footnote here says that Isidorus, Archbishop of Seville, see above—B. XVI, ch. 17—claims they wore the ornament in their ears. Pliny goes on : " . . . The best of them have just the colour of *Smaragdus* . . . The finest of them lose their colour in contact with oil, ungents, or undiluted wine even . . . "

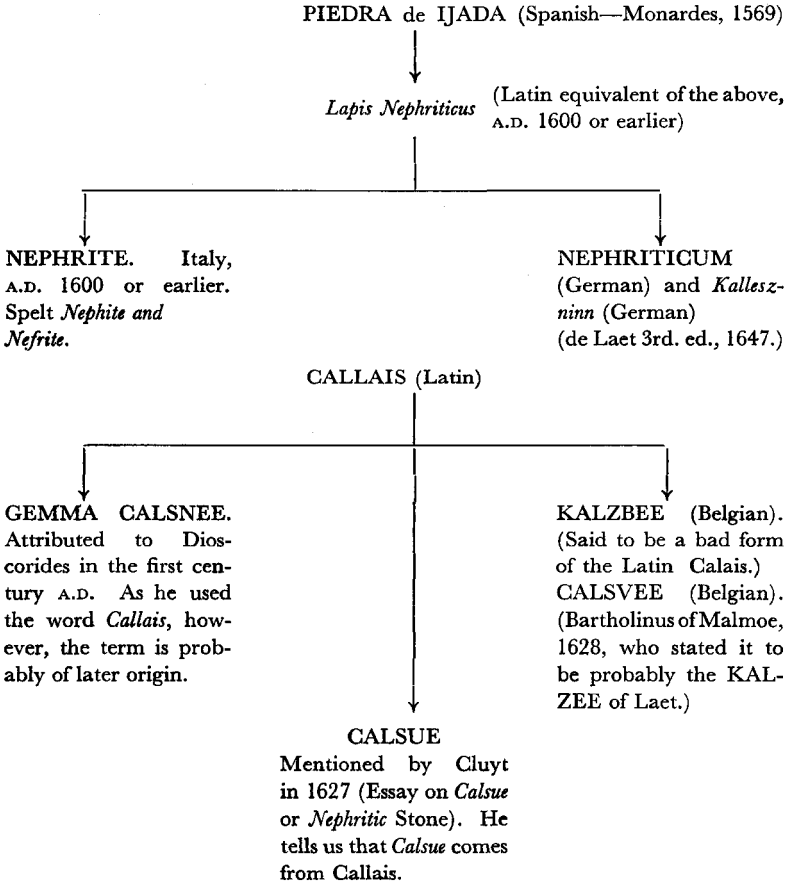
Pliny's *Callaina* possibly covered two species, (1) turquoise, often of a pale green, and (2) jade. It is even possible that this occurrence refers, in part, to the northern slopes of the K'un Lun Mountains in Sinkiang. Certainly jade was used there as tribute. The term Caucasus was a geographical one with extremely elastic frontiers. The *Sacae*, mentioned by Pliny, occupied territory north of Kashmir, which in ancient times was part of the Persian empire. The *Dahae* were rather more to the west. Though turquoise is never a true emerald green, grease and oil and indeed the atmosphere may render it a definite green in time.

The word *Callaina* is yet another term persisting over the years and evidence suggests that it covered jade or turquoise or more likely the two materials. Solinus speaks of the stone *Callais* being found in the inner parts of " Germanie " and tells us that it was precious. Was this the nephrite of Silicia ? It was quite common to lump turquoise and jade under the same heading, as was the case in South America where it was called *chalchihuitl*—perhaps because of the greenness of turquoise after exposure. In the first article of this series C. Daryll Forde, describing the megalithic culture of Brittany, includes Jadeite and *Callais* under a *Greenstone* heading. Joannes de Laet, in his third edition, printed in 1647, wrote : " There is another species, green *Iaspis* . . . The Germans call it *Nephriticum*, *Kallesznin* (Pliny calls it *Callais Callaias*), Belgians one Kalzbee, bad form of the name *Callais* one would say " (yet, of course, very close to the German word) " . . . Still further from the truth are those who compare it with *Prasius*." Cluyt, writing in 1627 said : " The stone *Nephriticus*, by some called Calsue." Cluyt tells us too that the word comes from *Callais*.

No chart is needed to clarify the word *jasper*. It seems always to have been with us, serene and uncomplicated, at least back to Roman times. No deviation of spelling is apparent. Perhaps it was that the word itself is so simple it could hardly be misspelt. An English/Welsh dictionary defines it : Jasper—*maen jaspis*. (*Maen*—stone). Here jade is defined Jâd, also Jaden. The question of the Semitic origin of the word jasper must await a later article. In the list of words[18] covering material we know as jade (at various periods of history) it will be recalled that jasper was included as :

Jaspis and *Jaspis Viridis*—Latin version (or slight variations of this, meaning always green or greenish).

Jasper—Anglicized version. *Jaspe*—French version.



In search of jade, therefore, it seems imperative that we not only accept many of the references under the *jasper* heading as our modern jade but also accept *Callais* which, though sometimes referring to turquoise, also indicated jade.

It would appear that the Germans knew that *Nephriticum* and *Kalleszinn* were one and the same, perhaps the second word being a local form of the first.

The word *Callais* or Callaite is to be found in almost every modern summary of mineral terms and goes back, as we have seen, to Pliny.

REFERENCES

1. Journ. Gemmology, January, 1956, p. 290.
2. C. W. King. Natural History of Precious Stones and Gems, 1865, p. 202.
3. Journ. Gemmology, October, 1956, pp. 418 and 419.
4. Journ. Gemmology, January, 1956, pp. 283.
5. Journ. Gemmology, October, 1956, p. 411.
6. Journ. Gemmology, July, 1955, pp. 148-149.
7. Florio's *Worlde of Words*, Italian/English dictionary, 1598. See Journ. Gemmology, January, 1955, p. 15.
8. Signor Michele Mercate was the author of *De Gli Obeliscgh di Roma*, published in Rome during 1589.
9. Journ. Gemmology, January, 1956, p. 275.
10. George Gordon Coulton. *Social Life in Britain from the Conquest to the Reformation.* 1918, p. 527.
11. By Ernest Brehaut.
12. C. W. King. *Natural History of Precious Stones and Gems.* 1865, p. 209.
13. Dake, Fleener and Wilson. *Quartz Family Minerals.* N.Y., 1938.
14. C. W. King. *Natural History of Precious Stones and Gems.* 1865, p. 206.
15. Certainly our modern Prase and Plasma could be confused with our modern Jasper and perhaps often is. To quote *Gemstones*, G. F. Herbert Smith (5th edition) p. 240 : " Prase, or mother-of-emerald, which was at one time supposed to be the mother-rock of emerald, is a quartz coloured leek-green by actinolite fibres in the interior." And on p. 247 : " It is a dull leek-green in hue, . . . the name comes from πράσον a leek. Plasma, which may have the same derivation, is a bright leek-green." *Quartz Family Minerals* classifies Plasma as a much coarser variety of Quartz than Prase " approaching jasper in texture and appearance . . . The name Plasma means *image* and refers to the use of the stone in olden times for seals and signets . . . "
16. The Natural History of Pliny. Bostock & Riley, London, 1857.
17. Macrobius. Roman grammarian and philosopher, flourished during 395-423.
18. Journ. Gemmology, October, 1956, pp. 402-403.

GEMMOLOGICAL NOTES

Capt. John Sinkankas reports the finding of hambergite crystals in the dumps of the Little Three Mine at Ramona, San Diego County, California. Apparently hambergite occurred in the pegmatite of this mine as an isolated cluster upon the floor of a pocket associated with quartz and clevelandite. The material looks like shards of microcline and orthoclase feldspar and this no doubt accounts for its being overlooked by collectors who have visited the dumps in search of tourmaline, quartz and topaz. These splinters form during late stages of hydrothermal activity and appear to represent the failure of pocket walls under considerable pressure developed inside the openings. Quartz and feldspar are therefore often found as broken pieces, recrystallized upon all surfaces. Superficially, the hambergites appear like some of these shreds and bits. Capt. Sinkankas has kindly sent some samples of the new find to the Association.

ASSOCIATION NOTICES

GIFTS TO THE ASSOCIATION

The Council of the Association has recorded with gratitude donations from the Worshipful Company of Goldsmiths, the Diamond Trading Co. Ltd., the Mond Nickel Company and various members towards the cost of providing the final section of the Sir James Walton Library. This library was jointly established by the National Association of Goldsmiths and the Gemmological Association in memory of Sir James who was President and Chairman of both organizations respectively at the time of his death. (See page 223.)

The Council has also recorded with gratitude the following gifts :

Four rose-quartz, showing asterism, from Starstones, Limited, London.

Samples of hambergite found at the Little Three Mine, Ramona, San Diego Co., U.S.A., from Capt. John Sinkankas, U.S.N., C.G., Arlington, U.S.A.

A fine specimen of corundum (ruby) from a recently discovered locality in Southern Norway, from Hans Myhre, F.G.A., of Oslo.

A sample of realgar glass, from D. S. M. Field, F.G.A., Toronto.

A book on diamonds and their occurrence in the U.S.S.R., published in Moscow, 1957, kindly presented by D. Seneviratne, F.G.A.

Three models in quartz of famous diamonds, from T. Stern, London.

TALKS BY MEMBERS

KENT, D. G. " Gemstones," Deptford Round Table, 9th October, 1957.

KENNEDY, N. " Illumination in relation to gemstones," Illuminating Engineering Society (Liverpool Centre), 19th November, 1957.

WEBB, MALCOLM H. " Gemstones," Tovil Community Club, Maidstone, 12th December, 1957.

JONES, THORLD G. " Gemstones," Institute of Metals, Oxford, 3rd December, 1957.

MELROSE, R. A. " Diamonds and their history," Hexham Inner Wheel, 29th October, and Newcastle Business and Professional Women's Club, 14th November, 1957.

NEW AUSTRALIAN SECRETARY

Mr. F. Leechman, F.G.A., has recently taken up his duties as Federal Secretary of the Gemmological Association of Australia. In the 1930's he took up lapidary work in Cornwall, and studied geology, mineralogy and gemmology. He obtained his Diploma in 1937, and was awarded the Association's Research Diploma in 1953, for his study into the cause of colour in precious opals. He became a member of the Australian Association in 1949, and with his appointment as Federal Secretary has also become the New South Wales State Secretary.

MIDLANDS BRANCH

At the annual general meeting of the Midlands Branch of the Association, held at the Auctioneers' and Estate Agents' Institute, Birmingham, on 21st October, 1957, Mr. Trevor Solomon was re-elected as Chairman for the sixth year. Mr. A. E. Shipton was re-elected as Honorary Secretary and the following were elected to serve on the Committee : Miss J. Rice and Messrs. B. Leng, W. Bowen, B. Clay and J. Harper.

The second annual dinner of the Branch was held at the Imperial Hotel, Birmingham, on Friday, 1st November. Mr. Trevor Solomon presided and principal guests included Mr. F. H. Knowles-Brown, Chairman of the Association, the Secretary and the Librarian, and Mr. David Wright, President of the British Jewellers' Association.

On 29th November, 1957, Mr. W. Bowen gave a talk to the Midlands Branch members of the Association on the " First 5,000 years of personal adornment."

The Midlands Branch are to be congratulated on a fine year's work maintaining enthusiasm for gemmological study in their area.

PRESENTATION OF AWARDS

The 1957 presentation of awards took place at Goldsmiths' Hall, London, on 10th October. Diploma winners from Norway and Cape Town were among those who attended. The diplomas were presented by Dr. G. F. Claringbull, Keeper of Minerals at the Natural History Museum and one of the examiners. Mr. F. H. Knowles-Brown was in the chair. He said that it was almost exactly 50 years ago that the idea of the Gemmological Association was born, largely the conception of the late Samuel Barnett. He felt that Mr. Barnett would have been proud to see the growth of the Association : his son was present that evening.

Mr. Knowles-Brown then welcomed the friends and relations of the successful candidates who had come to see them get the rewards for their achievements : it was an achievement, for if the examinations weren't difficult, the diploma wouldn't be worth getting. Once it was desirable to obtain the Fellowship of the Association, now it was almost essential. He was proud of the high regard in which the Association and its examinations were held overseas, and to pass was to enter a world-wide fellowship. So much was happening in the world of to-day that there was an essential need to keep abreast of new developments in manufacture and synthesis, and for this reason he was particularly pleased that Dr. Claringbull had agreed to present the awards.

Dr. Claringbull made some illuminating remarks about how to pass—and fail—the gemmological examinations. The examiners made things hard for the candidate : they intended to. This year, 40 per cent of candidates passed, but that was a good figure compared with passes in other professional examinations, and was certainly reasonable when one considered that the Gemmological Association set no educational standard ; university candidates, for example, were weeded out year by year, so that the finalists numbered fewer failures among them since the less studious had fallen by the wayside.

Dr. Claringbull said he felt the Association were right not to restrict entry to the examinations ; he was not so sure about the fact that one could sit for the

examination without attending any course. Certainly, all candidates needed a good working knowledge of the practical side of gemmology, the recognition of stones and the use of instruments, for failure to pass the practical examination, which accounted for about a third of the failures, meant failure altogether. It was as well, too, for candidates to have some contact with instructors and other students—the same question could appear in both the preliminary and the diploma papers, but as an examiner he would expect very different answers from the candidates.

Looking back on 20 summers of examination-correcting, Dr. Claringbull said that he divided failures into two kinds—honest failures, who just didn't know and let it go at that, and dishonest failures, who seemed to think the examiner so naïve that he would accept their writing around a subject without ever answering a question. He said he could not understand how jewellers could possibly sit for an examination without thinking about time, and dividing up the number of questions (and marks) sensibly over the period allowed. It was no use doing one question brilliantly and no other, if there were four questions to be answered.

Dr. Claringbull ended by saying how much he appreciated the good fellowship of members of the Gemmological Association. Gemmology was a very small part of mineralogy, but gemmologists had made some very definite contributions to the parent science. He couldn't help being interested in gemstones, and he was sometimes gratified to see, especially in little jeweller's shops, displays of gemstones all labelled. Too often, fine and even rare stones were shown in jewellers' windows without a label of any sort.

Mr. B. W. Anderson, who is a co-examiner in gemmology with Dr. Claringbull, thanked him for his talk, which was straight to the point and would be of great help to prospective candidates. He said that we often tended to forget that gemmology was a part of mineralogy, and, even if the gemmologist did sometimes help the mineralogist, the gemmologist had a debt he should not forget to the research workers in minerals. On behalf of all gemmologists, he was proud that in the Department of Mineralogy they had someone interested in their subject who was so willing to help and encourage them.

The Chairman expressed the thanks of the Association to the Worshipful Company of Goldsmiths for so kindly making the Livery Hall available for the presentation.

FORTHCOMING MEETINGS

Annual General Meeting, 13th March, 1958, at Saint Dunstan's House, Carey Lane, London, E.C.2, at 6.15 p.m.

The Herbert Smith Memorial Lecture will be given by Professor S. Tolansky, F.R.S. at the Science Museum Lecture Theatre on Wednesday, 2nd April, 1958, at 7 p.m.

Vol. VI
No. 5
January, 1958

CONTENTS

Notes on Asterism in Corundum, Rose Quartz and Almandine Garnet and Chatoyancy in Beryl ... ... *W. F. Eppler* **p. 195**

Synthetic Moonstone-coloured Spinel *Aldert J. Breebaart, F.G.A., C.G.* **p. 213**

Gemmological Abstracts ... ... **p. 215**

Sir James Walton Memorial Library ... ... **p. 223**

Jade Story—European ... *Elsie Ruff, F.G.A.* **p. 226**

ASSOCIATION NOTICES

Gifts to the Association ... ... **p. 245**

Talks by Members ... ... **p. 245**

New Australian Secretary ... ... **p. 245**

Midlands Branch ... ... **p. 246**

Presentation of Awards ... ... **p. 246**

Forthcoming Meetings ... ... **p. 247**