Gems & Gemology

SUMMER 1973

RICHARD T. LIDDICOAT, JR.
Editor
ROBERT A. P. GAAL, Ph.D.
Assoc. Editor

GEMS & GEMOLOGY is the quarterly journal of the Gemological Institute of America, an educational institution originated by jewelers for jewelers. In harmony with its position of maintaining an unbiased and uninfluenced position in the jewelry trade, no advertising is accepted. Any opinions expressed in signed articles are understood to be the views of the authors and not of the publishers. Subscription price $3.50 each four issues.

gems & gemology

VOLUME XIV *NUMBER 6*

SUMMER 1973

IN THIS ISSUE

The Resistance of Diamond and Other Gemstones to Abrasion

BY E. M. WILKS, Clarendon Laboratory, University of Oxford, U.K.

(Ed. note: Reprinted from Industrial Diamond Review, May 1973.)

In this article quantitative information about the differences in the resistance to wear and abrasion between diamond and the so-called gem "diamond substitutes" strontium titanate and YAG, and also spinel and sapphire, is reported. It is shown that the use of the Mohs scale in describing gemstones in relation to diamond can be very misleading.

Another exceptional and well-documented example of the relative scratchability of a gemstone occurs in this issue of our New York Lab Highlights. The abrasion hardness of jade—nephrite versus jadeite—is superbly illustrated with the softer nephrite (H = 6 – 6 1/2) showing considerable abrasion and dullness while the jadeite (H = 6 1/2 – 7) remains shiny and unscratched.

Introduction

In recent years there has been an increasing interest in the use of synthetic materials, such as strontium titanate and yttrium aluminum garnet (YAG) as gem "diamond substitutes." (Not to be confused with synthetic diamond, which has the same properties as natural diamond.) Strontium titanate, a white transparent substance, with a refractive index of 2.41 and a dispersive power of 0.200, has optical properties comparable with diamond, whose refractive index is 2.417 and whose dispersive power is 0.044. (These and subsequent values are taken from *Diamonds,* E. Bruton, 1970.) YAG has a lower refractive index, 1.833, and a dispersive power of 0.028. Diamond, however, is known to be much harder than either strontium titanate or YAG. On the Mohs hardness scale, which runs from 1 to 10 *(Table 1),* strontium titanate and YAG have values of 5

TABLE 1
Minerals on Mohs Hardness Scale

1.	Talc
2.	Gypsum
3.	Calcite
4.	Fluorite
5.	Apatite
6.	Orthoclase
7.	Quartz
8.	Topaz
9.	Corundum
10.	Diamond

1/2 and 8 respectively, whereas diamond has the highest value of 10. The Mohs hardness scale is, however, based on a very specialized form of hardness testing, the scratch hardness method, and is, moreover, a qualitative scale, indicating only that a substance with a given number will scratch those substances with a lower number. The scale gives no information about the relative ease of scratching, nor about quantitative differences between different numbers. Moreover, the scale has not been related to a more important form of hardness, especially of hard materials, that of resistance to wear and abrasion. Thus to say that two crystals have Mohs hardness values of 8 and 9, for example, gives no information about the relative ease of grinding these crystals, nor about any anisotropic effects there may be in the resistance to wear of these crystals. Yet because of the simplicity of the scale and the ease in determining a mineral's position on it, the scale is widely used in describing crystals, especially those of gem quality.

The present work has therefore been undertaken to obtain quantitative information about the differences in resistance to wear and abrasion between diamond and the so-called "diamond substitutes." At the same time, tests were also carried out on two other crystals, spinel and sapphire. Spinel has a low refractive index of 1.727, a dispersive power of 0.020 and a Mohs hardness number of 7-8; sapphire has refractive indices of 1.760 and 1.768 (sapphire is doubly refracting) and a dispersive power of 0.018, and has a relatively high hardness of 9 on the Mohs scale. It was hoped that as a result of these tests, in addition to comparing the wear of these crystals with diamond, some correlation might be effected between quantitative measurements of the resistance to wear and abrasion and the Mohs hardness scale.

DESCRIPTION OF THE SPECIMENS

(a) Strontium titanate

The specimen of strontium titanate was in the form of a boule 1 cm long and 1 cm across, with two end matt faces. These faces were polished on an ordinary diamond polishing scaife, using diamond powder of 0-1 micron size mixed in olive oil. One of the matt surfaces broke away from the boule during this polishing operation, but a satisfactory polished finish was obtained on the other surface on which measurements could be made, although it was of random orientation.

(b) Yttrium aluminum garnet (YAG)

Two types of specimen of this crystal were available; one sample had been grown from a melt, the others from a flux. The melt-drawn sample was in the form of a white slab a few millimeters thick with two matt surfaces of random orientation 1 cm across. These surfaces were polished on the diamond polishing scaife and yielded high quality finishes. The polished slab was transparent, and when viewed between crossed polaroids showed hardly any birefringence effects at all.

The flux-grown crystals possessed

several crystallographic faces of dodecahedron orientation. On one specimen these faces were very rough and needed to be polished; however, on polishing, the surfaces cracked to such an extent that no further tests could be made. The other samples also possessed dodecahedron faces, but these were of a higher quality; there were crystallographic markings on most of them, but on one crystal there were no markings on the surfaces and the abrasion hardness measurements were made on this stone without polishing the surface. These latter, flux-grown crystals were yellow, transparent and almost isotropic when inspected between crossed polaroids. They contained 5% dysprosium, a rare earth ion likely to increase the density of the crystal but not change its lattice dimensions. In addition they contained 0.1% lead (they were grown from a flux containing lead). Subsequently a dodecahedron face of one of these crystals was polished on the scaife and, unlike the first flux-grown sample, the surface did not crack and appeared similar to the polished surface of the melt-drawn specimen.

(c) Synthetic spinel

Two types of spinel were also available, a melt-drawn sample and a flux-grown crystal. The former was a slab a few millimeters thick bounded by two matt surfaces of random orientation, about 1 cm in diameter. These faces were polished satisfactorily on the scaife and the sample was seen to be transparent and almost isotropic in polarized light.

The flux-grown specimen was a large, white, transparent and apparently good quality flattened octahedron crystal. The octahedral faces were all curved as they possessed many vicinal faces, and had therefore to be polished before any abrasion could be made. On polishing, however, large cracks appeared in the surface, and subsequent abrasions, made on those parts of the surface which had not cracked, were so rough that no reproducible measurements could be made. Observation of this crystal in polarized light showed it to be very birefringent. It would therefore appear that large amounts of strain had been incorporated into this specimen while it was growing from the flux, and that the heat generated at the surface either during the polishing operation or during the abrading process was sufficient to anneal out the strain locally and to produce cracking. (Similar effects were observed when diamonds that had been irradiated with 10^{19}-10^{20} fast neutrons were polished or abraded [Wilks 1965].) No significant hardness results could therefore be obtained from this specimen.

(d) Sapphire

Both natural and synthetic samples of sapphire crystals were available for testing. The natural crystals were dark green with fairly well developed matt crystallographic faces which, however, polished satisfactorily. The polishing revealed a darker green band structure within the stone, and on examining the specimen with a

qualitative X-ray fluorescent technique, it was found to contain large amounts of titanium with smaller amounts of iron and chromium.

The synthetic samples were white and transparent and in the form of small cylinders about 4 mm long with polished end faces of random orientation. Subsequently a basal and a prismatic plane were cut and polished on one of these specimens.

Sapphire is naturally doubly refracting in polarized light, but when viewed in polarized light there was no evidence of strain in the synthetic samples although there was strain present in the natural specimen.

The resistance of diamond to abrasion

Before describing how the abrasion hardness of these crystals was compared with that of diamond, it is necessary to describe the particular features associated with the wear and abrasion of diamond. Diamond is generally ground and polished on a rotating wheel or scaife charged with diamond powder. The scaife may be either of cast iron, in which case the abrasive is mixed with a light oil, usually olive oil, or may consist of diamond powder bonded into a metal matrix; for practical details see Bruton (1970). It has always been well known among diamond polishers that diamond is extremely anisotropic in its wear properties, and that the rate of removal of material from the diamond depends very greatly on both the crystallographic orientation of the face being polished and on the direction of abrasion. The first quantitative measurements of the resistance of diamond to abrasion were made by Tolkowsky (1920), himself a diamond polisher, who weighed a diamond before and after polishing in different directions and on different faces. More recently measurements have been made using a so-called micro-abrasion tester, in which a small rotating wheel of either cast iron charged with diamond powder or diamond-bonded material is brought against the surface of the diamond to be tested for about 20 s under a load of about 100 g. A small cut is thus made on the surface of the diamond, about 1/2 mm long, 1/10 mm wide and 1/400 mm deep. Although the cuts are extremely shallow, their depths can be measured to a few parts per cent by optical interference techniques which yield sharp contour fringes within the cuts; for further details of this technique see Wilks and Wilks (1966).

We have shown previously that the amount of material removed on diamond is directly proportional to the speed of the wheel and to the load on the stone (Wilks and Wilks 1959). It has also been shown that because of the shape of the wheel, the projected surface area of the cut increases as the depth of cut increases, and that, therefore, although the volume of material removed increases approximately linearly with time, the depth of cut increases approximately as the square root of the time of abrasion (Wilks and Wilks 1972). Hence, in comparing experimental observations, a ratio of "x" in depth corresponds to a factor "x^2" in the rate of removal of material.

We have also investigated the considerable differences in the rate of removal of material in the different principal directions on cube, dodecahedron and octahedron faces. For example, we have found that a cut made with a bonded wheel on a dodecahedron face in the softest direction, which is also the softest direction on diamond, is some 10 times as deep as a cut made under identical conditions in the hardest directions on a cube face, which are the hardest directions on diamond. As indicated above, these figures correspond to rates of removal of material in flat grinding which differ by a factor of the order of 100.

Experimental conditions

The abrasion hardness measurements were made with a diamond-bonded wheel mounted in the micro-abrasion tester. Cuts were made, under identical running conditions, on the natural dodecahedron surface of the YAG crystal, and on the polished surfaces of the other crystals. Their abrasion hardness was then compared with that of diamond by making similar cuts on a dodecahedron face of a selected high quality white gem diamond, in the soft direction on this face. To check on the running conditions of the abrading wheel, cuts were made on the diamond before the other crystals were abraded, during the tests and, finally, when all the cuts had been completed. These checks showed that no blunting of the wheel occurred during the tests.

Preliminary measurements showed, however, that excessively long cuts were made on most of the crystals when the abrasion tester was operated under the conditions normally used in abrading diamond. However, by reducing the speed of the wheel to 500 rpm, the load to 50 g and the time of abrasion to 15 s, cuts were made of a reasonable length on most of the crystals so that several cuts could be made on a given face and different directions could be tested. At the same time, measurable cuts were made, of the order of $3\lambda/2$ in the soft direction on the dodecahedron plane of the diamond. It was therefore possible to make a direct comparison of the resistance to abrasion of diamond in its softest direction with the other crystals.

A characteristic of the cuts normally made on diamond in "easy" directions of abrasion is the high quality of the abraded surfaces within the cuts, and this was also true of the abrasions made on the diamond under the present running conditions. The majority of the cuts made on the other crystals were, however, so rough that measurements of their depths could not be determined to the same degree of accuracy as is usual with abrasions on diamond. However, on diamond, if the cuts are sufficiently shallow, that is, less than about $6\lambda/2$, then the length of cut is related to the depth by the relation $l = 2(Dd)^{1/2}$ where D is the diameter of the abrading wheel (Wilks and Wilks 1972). Thus d is proportional to l^2 and the same sort of relation was found to hold for the crystals used in the present tests, although their depths were appreciably deeper than those for diamond and

determined with less accuracy. Thus for all the cuts, measurements were made both of their length and their depth, and the hardness comparison with diamond determined as an average of the results from the two sets of measurements.

Experimental results

As we have already discussed, when shallow abrasions are made on diamond, the volume of material removed is approximately proportional to the time of abrasion, and the depth approximately proportional to the square root of the time of abrasion. Similar tests were made on the melt-drawn specimens of YAG and spinel and on the synthetic sapphire sample using wheel speed of 500 rpm and a load of 50 gm. As noted above, measurements of length of cut were considered to be more accurate than those of the depth, and therefore we show in **Figure 1** graphs of the square of the length of the cuts against the square root of the time of abrasion. Comparable data for the diamond used in these tests is also shown in **Figure 1.** The graphs show linear relationships between the square of the length and the square root of the time of abrasion for all the specimens tested, even though the cuts on the spinel sample were appreciably deeper than those on the diamond. The experimental conditions for all these specimens therefore approximated to flat grinding, and we can compare the abrasion hardness of these crystals with diamond either by comparing the square of the length measurements or directly from a measurement of their depths. These results are shown in the first two columns of **Table 2.** However, as discussed above, a difference in abrasion hardness of "x" as determined from a depth measurement, corresponds to a factor "x^2" when considering the rate of removal of material in flat grinding. The last column in **Table 2** therefore shows the average rates of removal of material of the various gem stones in comparison with that of diamond in its softest direction.

Similar measurements could not be made on the specimen of strontium titanate, as the cuts were appreciably bigger than on the other crystals, being about 2 1/2 mm long, and 40-70 microns deep. Thus, the figures given for strontium titanate in **Table 2** can only be taken as an order of magnitude.

As already discussed, there are very

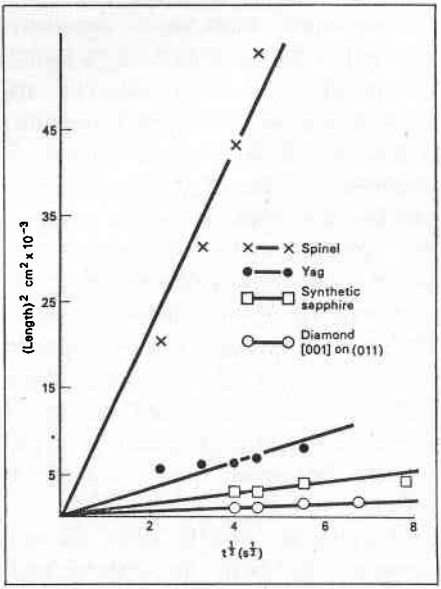


Fig. 1. The (length)^2 of a cut plotted against the square root of the time of abrasion for spinel, yag, synthetic sapphire and diamond

TABLE 2
The abrasion hardness of various crystals compared with diamond

Crystal	*Number on Mohs scale*	*Direction of abrasion*	*(Length)² of cut on crystal / (Length)² of cut on diamond*	*Depth of cut on crystal / Depth of cut on diamond*	*Average rate of removal of material compared with diamond*
Diamond	10	[001] on (011) [softest]	(1)	(1)	(1)
Synthetic Sapphire	9				
Sample (a) – random orientation		hardest	2·0	2·0	4
		softest	3·5	3·0	9
Sample *(b)* – prismatic plane		hardest	3·5	5·0	18
		softest	10·0	15·0	150
– basal plane		average	4·5	6·0	27
Yag	8				
(a) crystal – (011) face		average	4·0	4·5	18
(b) slab – random orientation		average	7·0	7·5	50
Natural Sapphire	9				
– prismatic plane		hardest	6·5	8·0	50
		softest	24·0	34·0	850
– basal plane		average	10·0	15·0	150
Spinel	7–8				
slab – random orientation		average	40	50	2×10^3
Strontium Titanate	5½				
– boule		hardest	45	60	$2{\cdot}5 \times 10^3$
– random orientation		softest	70	105	10^4

large directional variations of abrasion hardness in diamond. To see if there were similar effects in the crystals used in this present test series, cuts were made in different azimuthal directions on the various faces tested. Generally two cuts were made in each direction and the first and last of a series of cuts were made in the same direction. There were no anisotropic effects on either of the two YAG samples, and the results in **Table 2** are the averages for all directions. Similarly on the spinel slab average values for all directions are given in **Table 2**, as the differences between different directions were certainly less than about 20%. As already discussed, no reproducible measurements could be made on the flux-grown spinel octahedron crystal.

Anisotropic effects were shown, however, by both the natural and synthetic sapphire crystals. The first tests on the synthetic sapphire crystal were made on a sample [sample (a)] whose polished face was of random orientation. Further tests were subsequently made on polished prismatic and basal planes respectively that had been cut on another sample [sample (b)]. No anisotropic effects were detected on the basal plane, as was expected from the earlier work of Steijn (1961) and Duwell (1966), but there were considerable differences on the prismatic plane. Similar anisotropic effects were shown by the natural sapphire crystals; no azimuthal variations on the basal plane but appreciable differences on the prismatic plane. On the strontium titanate sample, single cuts only were made as they were so large. Some anisotropy was detected, but as the face tested was of random orientation, the results in **Table 2** showing the hardest and softest directions can only be taken as orders of magnitude.

Discussion

Table 2 shows the comparison be-

tween the rates of removal of material of the various gem stones and a diamond abraded in its softest direction, and show that the resistance to abrasion of diamond in this direction of wear is greater than any other crystal.

The results also show differences between the different samples of the same crystal. Thus the over-all abrasion resistance of natural sapphire is less than that of the two synthetic sapphire samples. This is most probably due to the presence of the various impurities in the natural dark green specimen. The smaller differences between the two synthetic samples may also be due to slight differences in the quality of the two samples. The results also show that the anisotropic effects on the prismatic planes are less than those previously reported by Duwell and Steijn. These authors abraded synthetic sapphire with tungsten carbide and steel respectively, and it is possible that the differences in the results are due to different mechanisms of abrasion when sapphire is abraded with diamond, which is much harder than sapphire, and with materials such as tungsten carbide and steel of similar hardnesses. Similarly the flux-grown crystal of YAG appears to be more abrasion-resistant than the melt-drawn slab, although in this case the more pure specimen is the less resistant specimen.

The results also show that there is no simple relationship between the numbers on the Mohs scale and a hardness expressed as a resistance to wear and abrasion. Moreover, due to the different results for the natural and synthetic sapphire specimens, YAG is seen to be more abrasion-resistant than natural sapphire in any direction, and because of the anisotropy in the sapphire, there are some directions on synthetic sapphire that are more easily abraded than any direction on YAG.

However, as mentioned above, due to the anisotropy in the hardness properties of diamond, material can be removed some 100 times more readily in its softest direction than in its hardest direction. Therefore, when comparing the wear of gem stones with diamond, it is important to specify which direction on the diamond is being considered; the results in **Table 2** in this paper refer to diamond in its softest direction. Thus synthetic sapphire, which in its hardest direction is four times more easily abraded than diamond in its softest direction, will be some 400 times more easily worn than diamond in its hardest direction. Similarly YAG will be worn of the order of 3000 times more readily than diamond in its hardest direction, and strontium titanate some 10^5 to 10^6 times more easily. These results demonstrate, therefore, that the use of the Mohs scale in describing gem stones in relation to diamond, especially those labelled as "diamond substitutes," can be very misleading.

References

BRUTON, E. "Diamonds", London: N.A.G. Press (1970).

DUWELL, E. J. *Wear* (1966), 9, 363.

STEIJN, R. P. *J. Appl. Phys.* (1961), 32, 1951.

TOLKOWSKY, M. D. Sc. Thesis, London University (1920).

WILKS, E. M. *Phil. Mag.* (1965), 11, 433.

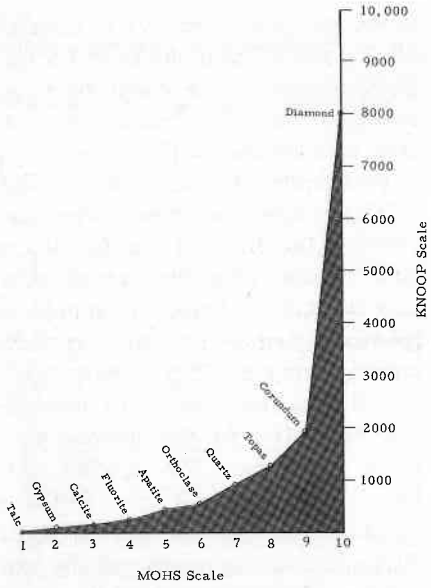
WILKS, E. M. *and WILKS, J. Industr. Diam. Rev.*. (1966), 303, 52; 304, 105.
WILKS, E M., and WILKS, J. *J. Phys. D: Appl. Phys.* (1972), 5, 1902.

•

(Ed. Note: Mineralogical hardness deals with the extent to which a mineral resists abrasion; i.e., the resistance to scratching. Like the other physical properties of minerals, hardness is largely determined by the crystal structure and depends upon the bond strength holding the atoms together. The stronger the binding forces, the harder the mineral. As binding forces may vary in different crystallographic directions, similarly the hardness may change in these directions.

The Mohs scale of hardness lists ten common minerals, all arranged in a sequence-of-hardness numbers from 1 to 10. Each mineral on the list will scratch those with lower hardness numbers and will, in turn, be scratched by minerals with higher values. Consequently, all hardnesses are relative to each other and do not represent actual quantitative steps between mineral hardness. Because the Mohs hardness numbers are not uniform, they are only considered as reference values.

Another more quantitative or scientific scratch test uses the sclerometer, an instrument with a diamond point under load which is drawn across a polished surface to measure scratch hardness. Some other methods use indenting devices such as Vickers, Rockwell, and Knoop indenters. These methods use a diamond point pushed into the mineral under a certain load for about 15 seconds from which the indentation hardness is determined as the ratio of the load applied to the surface area of the indentation produced. A comparison of the Mohs scale with the Knoop scale is shown in the Hardness Comparison Figure which shows the relative differences between minerals and also the superior hardness of diamond over corundum.)



Hardness comparison; Mohs scale vs. Knoop scale.

GIA Receives Important Gifts

For several years GIA has been planning a short class in colored stone grading with some consideration for appraisal. In their efforts in this direction, members of the staff of the Institute, particularly Cap Beesley in New York and Glenn Nord in Los Angeles, have been gathering stones to use for comparison purposes to show the various grades of colored stones. Cap Beesley asked Ralph Esmerian, Jr., to select a number of rubies and sapphires to show the various qualities of those important gemstones. This was over a year ago. Since that time, the approximately 15 one-carat stones selected have been in GIA's possession and, in addition, Mr. Beesley had selected a number of oval colored stones of other species and varieties, with a view to making the course we had in mind possible.

Recently, we received a letter from *Raphael Esmerian,* President of the firm R. Esmerian, Inc., making a gift to GIA of over $15,000 in magnificent rubies and sapphires. They show effectively the various qualities and grades of rubies and blue sapphires. Raphael Esmerian has been a long time benefactor of the Institute. A number of years ago, he gave us a large quantity of rubies, emeralds and sapphires, which have proved to be exceptionally valuable for our test sets in the Gem Identification classes and correspondence courses. Whenever we asked questions with respect to relative values or descriptions of gemstones, he has proved unfailingly helpful. The new collection will be of inestimable value to GIA and to the jewelry industry in helping to make possible a valuable new instruction program.

We also wish to thank *George A. Schuetz, Jr.,* of Larter and Sons, and *Stanley E. Church,* of Church and Company, each of whom gave us magnificent groups of over 3,000 polished stones, including a vast assortment of stones for immediate use in gem testing sets. The Larter assortment included hundreds of hematites of various shapes, of which we were very short, plus some fine jadeites and many carats of attractive sapphires. The Church lot included hundreds of zircons, many turquoises and other stones in short supply previously.

Developments and Highlights at GIA's Lab in New York

By ROBERT CROWNINGSHIELD

Since articles about blue Maxixe-type beryl have appeared in *Gems and Gemology* and in *Lapidary Journal,* we have received several inquiries and some challenging questions. In spite of careful wording to the effect that at no time has either Dr. Nassau and Dr. Wood nor the Institute stated that any dark blue beryl of this type submitted to them definitely owes its color to atomic bombardment (with the exception of three stones in which the unnatural Caesium 134 was detected), we have heard reports that some dealers are stating that GIA has claimed that all such stones are treated. Unfortunately, no readily available type of laboratory examination can establish whether or not a stone has been treated by gamma radiation, the source of radiation the authors used to prove that the Maxixe-type blue and green colors in beryl can be artificially induced. The circumstances surrounding the sudden appearance of these attractive stones, however, throw suspicion on all of them. Furthermore, the admission by dealers in Idar-Oberstein that they are currently producing this color artificially and selling the stones as treated, establishes the source of some of the stones. Whether or not a source of naturally colored Maxixe-type beryl exists is yet to be proven.

Several dealers who had invested heavily in these stones challenged the statements that have been made about their liability to fading. One dealer made an elaborate suite of jewelry slated to sell at retail in the neighborhood of $80,000. The stones have been set for nearly a year and no fading appears to have occurred. The laboratory was questioned about the accuracy of the statements concerning the fading. At that time, we had not actually carried out independent fade tests. One reason was the reluctance of dealers, who may have paid as much as $150 per carat for their stones, to see anything done to decrease their beauty or value. We are indebted to Dr. Gübelin for volunteering to provide us with a stone. Since we had only this one control stone, we covered half the

emerald cut stone with black tape and put it against the glass of an east facing window. The stone was an intense, cobalt blue with the optic axis correctly located at right angles to the table of the stone. In a note on page 132 of Dr. Nassau's article, appearing in the Spring 1973 issue of *Gems and Gemology,* he stated that a large, intensely colored stone may need more than a week in bright sunlight before fading would become noticeable. Since the test was accomplished during the throes of our recent move, we forgot about the stone in the window for two weeks. An unusually sunny and mild autumn in New York allowed the stone to receive more than the usual amount of sunlight. When we were reminded that the stone was in the window, we removed the tape to discover that half the stone was very pale pink and the covered area had faded to less than half the original intensity. *Figure 1* illustrates the appearance of the stone now.

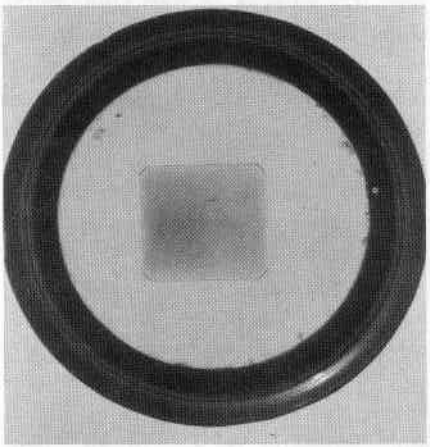


Figure 1

During the course of Dr. Nassau and Dr. Wood's investigation, we supplied them with quite a number of rough pale aquamarines and morganites. Contrary to our expectations only one of the morganite specimens changed color radically after exposure to gamma radiation from Cobalt 60 – it turned an intense red – but proved to be tourmaline! On the other hand, most of the pale aqua rough and the five cut stones changed color to some degree, *Figure 2.*

The most dramatic and significant change from the standpoint of the subject at hand was one quite irregular piece that was originally pale green. Possibly the statement of one dealer traveling in Brazil, that he had seen a large quantity of very "clean" yellow beryls for sale at a cheap price, can now be explained. It would seem that the production of Maxixe-type beryls by gamma radiation depends on structural defects that can be modified by the radiation. Possibly some mines produce such beryl consistently.

Gamma Radiation of Gemstones

The matter of sub-atomic bombardment of gem materials has not been thoroughly explored. We do not know that neutrons from the atomic pile can effect changes in many stones, but resulting contamination may prevent them from being allowed to be sold. X-rays and electron effects from the Van De Graaf generator have been studied but gamma radiation remains to be explored.

We have long suspected that certain dark brown topazes owe their color to gamma radiation. The only laboratory tests that lead one to suspect treat-

Figure 2

Figure 3

ment are the very strong dichroism, yellow-green and red-brown, and the very low indices of refraction for such dark colored topaz. Dr. Pough reported in 1957 (electrons) and 1947 (X-ray irradiation) that pale blue and colorless topaz would change color with irradiation. Our own limited experiments carried out with the good offices of Mr. Irwin Moed nearly 10 years ago, involved a pale brown Mexican topaz placed in the atomic pile. It became very dark red-brown. Although it has not been exposed to light for long periods during the past 10 years, it has not lost color. It has the low refractive indices (1.612-1.620) and strong dichroism associated with known treated topazes. We have seen large, clear pieces of rough topaz of this color and strongly suspect that it has been bombarded – probably by gamma radiation. We are indebted to Dr. Nassau for the report that gamma radiation will indeed color pale topaz, inducing various shades of brown and red-brown. We do not have information yet about the fade resistance of such induced colored topaz.

Last year each delegate to the International Conference of Gemologists at Vitznau was given a parcel of quartz stones that owe their color to gamma radiation. The use of gamma radiation was the subject discussed by Mr. Akira Chikayama of the Gemmological Association of All Japan. He stated that Japan is now independent in the supply of smoky quartz and citrine since they can produce these colors with gamma radiation (brown) and gamma radiation plus heat (yellows). *Figure 3* is a photograph of four treated rock crystals (the center stone is colorless and untreated). Mr. Chikayama mentioned too that inferior colored cultured pearls may be irradiated with gamma rays to produce an acceptable blue to blue gray color. We have no information about the fade resistance of either the quartz or cultured pearls.

One other stone that probably owes its color to gamma radiation, though other sources of bombardment might be used, is the synthetic amethyst which has been produced in Russia and elsewhere. As Dr. Nassau mentioned in his articles, amethyst owes

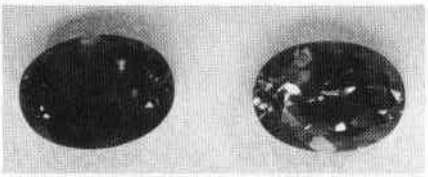


Figure 4

its color to an iron impurity but also to a color center which must be activated by irradiation. The production of synthetic amethyst would seem to be a complicated matter requiring proper orientation of the seed plate, the necessary iron impurity, and subsequent bombardment. *Figure 4* illustrates two handsome synthetic Russian amethysts given to GIA by Dr. Henno Nairis of Stockholm during the American Gem Society Conclave in New Orleans last year.

Gamma radiation will also color spodumene. Among the large number of beryl specimens given to Dr. Nassau for experimentation was a very pale yellow piece of spodumene. Following irradiation, it was an intense nearly emerald green. Just one hour taped to a sunny window, though, was all that was necessary to remove the color. We recently were shown a large lot of peculiar blue-green spodumene which we strongly suspected was artificially colored. The client was too, after he returned and we presented him with a bi-color stone – half pink, half green. We had taped the stone to the sunny window for two hours. Coming to our attention within the same period of time that we have seen the blue beryls, brown topazes, and reported yellow beryls it is more reason to be suspicious that somewhere gem materials are being treated in abundance with gamma rays.

(Editor's Note: Since this was written, Dr. Nassau showed Mr. Crowningshield topaz that had been colored to an attractive blue by irradiation.)

Wearability of Jadeite Versus Nephrite

Figure 5 shows a bracelet of various colors of jade. All except the black stone are jadeite. The black stone is nephrite. The bracelet has been worn constantly for nearly 10 years with the result seen in *Figure 6*. The nephrite has lost nearly all its polish while the jadeites are relatively unworn. The loose black stone is from the original lot of black nephrites and has never been worn. This bracelet would tend to confirm the published data on the hardness differences of the two minerals – 6 – 6½ for nephrite and 6½ – 7 for jadeite. *Figure 7* illustrates the fact that actinolite has a hardness similar to nephrite or perhaps even less. It is an actinolite cat's-eye that has been worn on a man's little finger ring for approximately three months. Although these stones have been coming to the Laboratory's attention for about six months, we really have never seen one with an excellent polish. However, the scratches seen in *Figure 7* are definitely wear marks and not the result of poor original polish.

Gilson Synthetic Opal

We are indebted to Mr. Andrew Heinzmann of H.R. Benedict and Sons for the opportunity to examine several

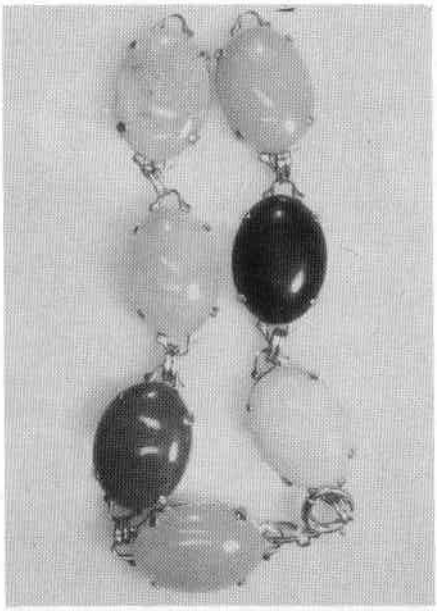


Figure 5

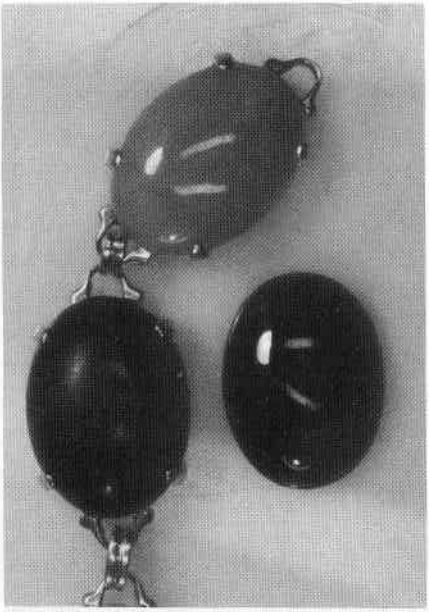


Figure 6

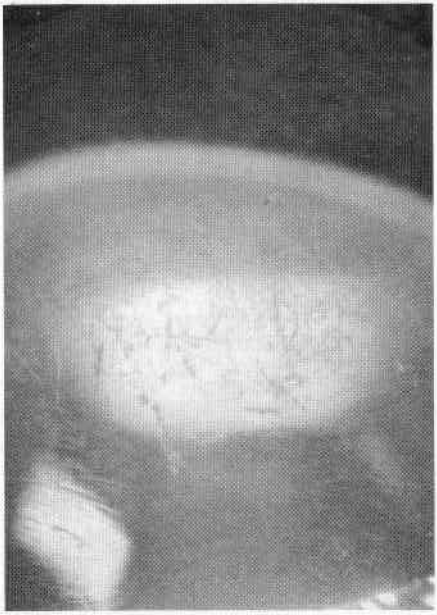


Figure 7

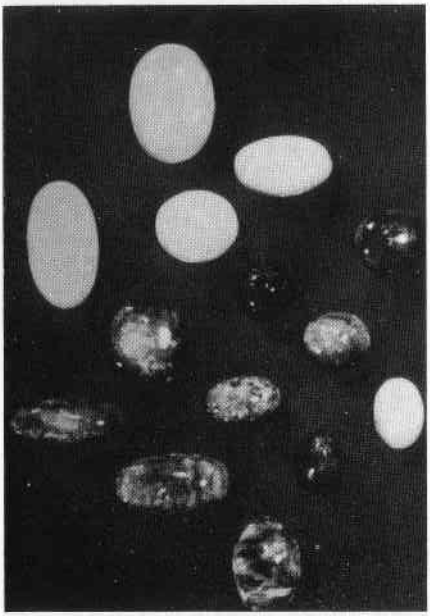


Figure 8

handsome synthetic opals. *Figure 8* (taken from a Gilson transparency) exhibits the range of body colors of the newer stones. We examined the large white stone and the black stone second from the bottom. The color patches are extraordinarily sharp especially in the dark stone. All colors are present in the play of color with the stones tending toward harlequin. We have been informed that the product may soon be ready to market. Certainly, the rough material must now be coming through in sizes large enough to cut regular shapes and quite thick stones. A detailed study and report on synthetic opal will be forthcoming.

Fire Agate

We have seen several parcels of Mexican fire agate recently and have learned to appreciate their muted beauty. Although the over-all impression is of a brown stone, some have such beautiful color play that they are desirable for fine jewelry. In fact, we saw several in manufacturers' lines at the RJA show in July. *Figure 9* illustrates a selection we were happy to examine thanks to the courtesy of Graduate Gemologist Mrs. Lorene Haas, Crown Gems Ltd., Sherman Oaks, California. Whether or not the supply of rough will be sufficient to satisfy a commercial demand remains to be seen. It is certain, however, that for the first time fire agate has become more than the oddity it has been for decades.

Glass

Figure 10 shows earrings containing very jade-like devitrified glass of the type mentioned in the last issue of

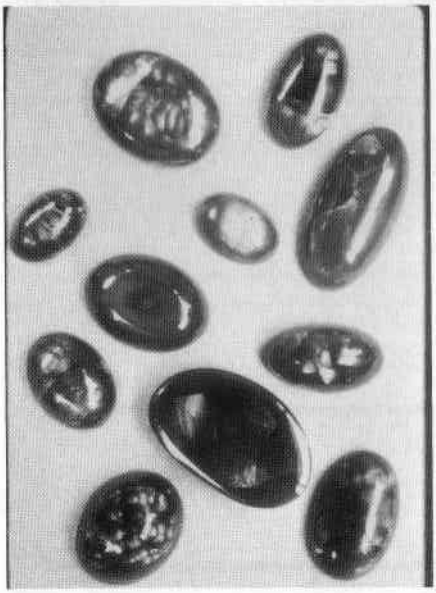


Figure 9

Figure 10

Gems and Gemology. It is interesting that the owner began to suspect their identity when she became aware that they did not feel cool on her skin as her other jade jewelry does. Jewelers to whom she showed them were convinced that they were the real stones, but one humored her and had them tested.

Unusual Serpentine

The beautifully carved elephant shown in *Figure 11* is one of a pair that arrived for testing. The unusual surface imitates the hide of an elephant very well, but prohibited a refractive index reading. Similarly, it is not easy to take a specific gravity of an elephant! The color of the material is a nice yellow-green very much like some californite variety of idocrase that we have. The absorption spectrum, *Figure 12,* also reminded us of that of idocrase and we were at first tempted to call it that. However, the first rule of gem testing – "Get a refractive index if at all possible," came to mind and we polished the bottom of one foot. The 1.57 refractive index and comparison of the absorption spectrum with known yellow-green serpentines gave us the answer.

Diamond Damage

Many jewelers, manufacturers, and repairmen have spent their entire careers without ever experiencing the

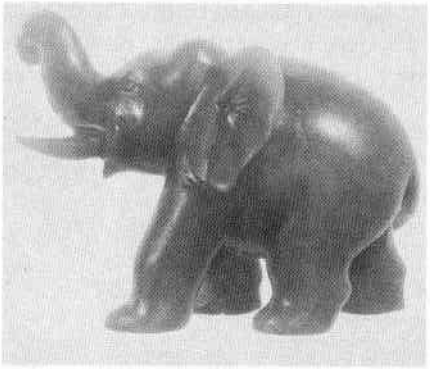


Figure 11

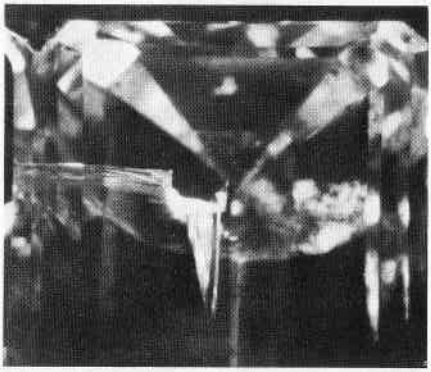


Figure 13

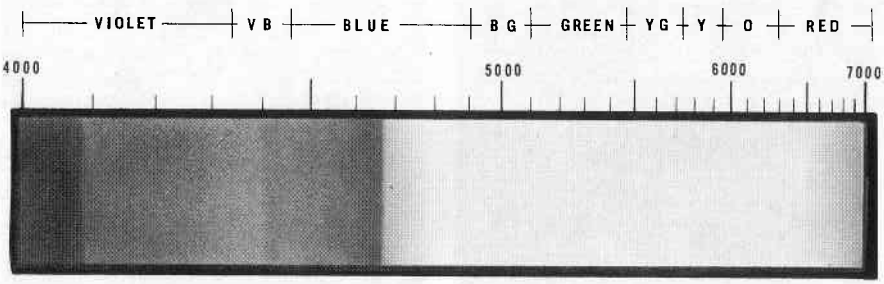


Figure 12. Greenish Yellow Serpentine

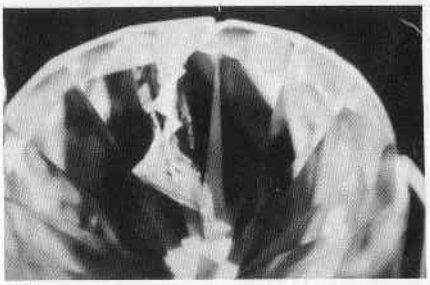


Figure 14

damaging of a major diamond. It was a shock for one jeweler to receive two sizeable diamonds back from repairmen seriously damaged as shown in *Figures 13 and 14.* It would seem that rapid temperature change may have been responsible in both cases. Either the stones or stone was under natural strain or an inclusion with a decidedly different coefficient of expansion was present and the repairman did not realize the possibility of damaging what usually is a very durable stone.

Acknowledgements

We wish to express our sincere thanks for the following gifts to: *Irving Michaels, Jr.,* of Irving Michaels & Co., New Haven, Connecticut, for four emerald cut yellow to brown topazes for student study sets. *Lorene Haas,* Graduate Gemologist, for a nice selection of rough and cut fire agate. Mrs. Haas is with Crown Gems Ltd., Sherman Oaks, California. *Dr. Ed Borgatta,* Ph.D., G.G., of Gempro Distributors, Rupert, Vermont, for a fine selection of jadeite and rose quartz cabochons. *Ed Swoboda* and *Bill Larson* for showing us a beautiful selection of Tanzanian grossularites on a recent trip through New York and sending for our collection a wide selection of rough gem minerals not only from Pala, California, located near their firm at Fallbrook, California, Pala Properties International, Inc., but also from various African localities. *Arthur Reik,* Gem Trade Laboratory member and New York diamond broker for a sawed section of coated diamond rough of the type from which pale blue-green diamonds have been cut. These stones are not of the rare Type IIb occurrence, but owe their color to natural irradiation, evidently. *Melvin Strump,* Graduate Gemologist, of Superior Gem Co., New York, for some uncut very dark aquamarine specimens of great use during our investigation of the Maxixe-type beryls. His gift stones are iron rich and not of the Maxixe type.

Developments and Highlights at GIA's Lab in Los Angeles

By RICHARD T. LIDDICOAT, JR.

In a time of tumult in the jewelry industry, with prices skyrocketing before the recent softening, this has been a period of particularly intense activity at the GIA laboratories. For one period of 60 days, each week – in fact, almost every day – saw new price peaks for diamonds of fine quality and for colored stones as well. The demand in Europe and the Far East strained the U.S. source of supply of large, fine diamonds.

During the time since the last laboratory report from Los Angeles, we have seen quite a number of unusual stones. One day we saw three extremely interesting large diamonds. Two were set in a very unusual fashion. Instead of the usual ring settings or other common setting, the two were set in prongs attached to the top of slender hollow metal rods that curved out to form the shapes pictured in *Figure 1*. The stones were square old-mine cut diamonds of great depth with weights which we estimated at approximately 53 cts. and over 40 cts. In the same lot was another diamond of 18 cts. that had holes drilled at each end to accommodate a string or chain. This is pictured in *Figure 2*.

Figures 3, 4 and 5 show different views of a curious item of inexpensive jewelry that doubles as a ring and a bracelet. *Figure 3* shows it as a ring; *Figure 4* illustrates how the rings are hinged to form the bracelet as shown in *Figure 5*.

Organic Materials

Occasionally, the Laboratory is asked to identify materials that are

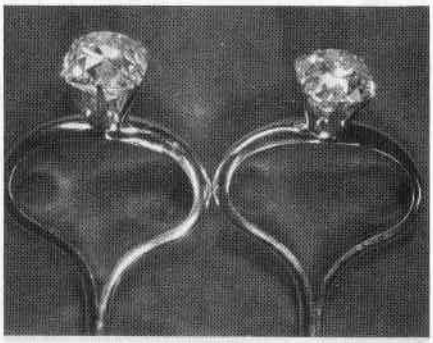


Figure 1

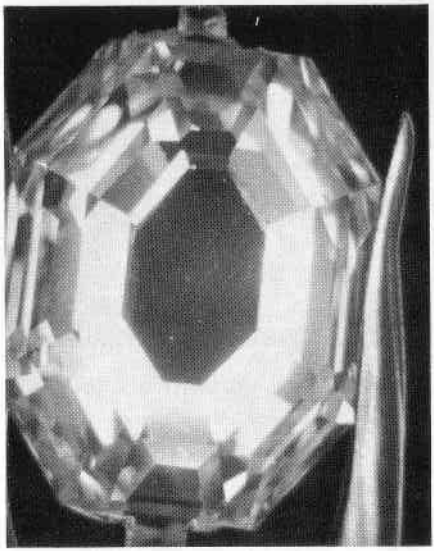


Figure 2

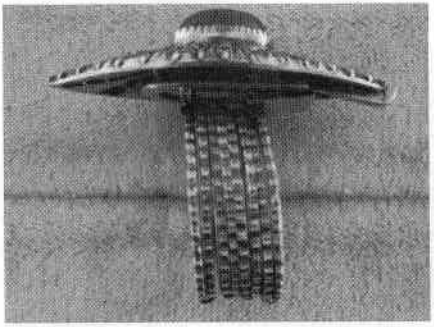


Figure 3

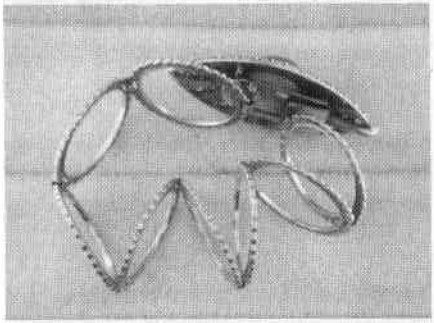


Figure 4

mineral replacements of organic substances. Although our concern is with the nature of the materials as they exist currently, we are often curious as to the nature of the plant or animal life that has been replaced. We usually speculate as to the nature of such a material, without knowing whether we are correct. Perhaps some readers will be familiar with the materials shown in the photographs of the replacements of the organic materials in the next several illustrations. If so, we would be happy to have their comments.

In *Figure 6,* we show a partly silicified coral. On this piece we obtained a refractive index of about 1.54 with very little birefringence noted on the spot reading and the specific gravity was near 2.65. In other words, the properties were those of quartz rather than calcite, yet there was still a certain amount of effervescence to hydrochloric acid, as we might have expected from the calcite of a coral material. Between the two slides, *Figures 6 and 7,* the structure is quite evident; one, *Figure 6,* taken from the top of the cabochon and the other, *Figure 7,* of the base. In this in-

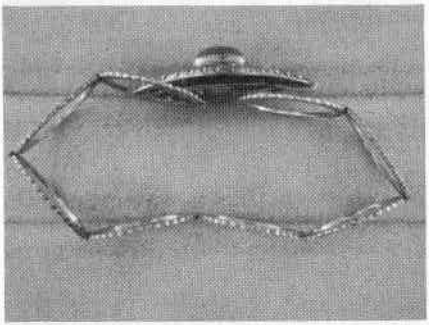


Figure 5

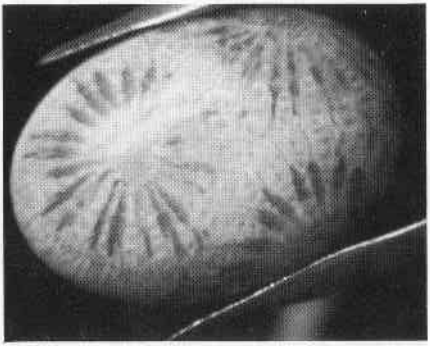


Figure 6

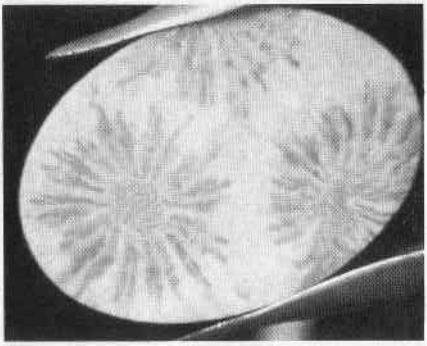


Figure 7

stance, we were quite satisfied that we were dealing with a form of coral.

In *Figure 8,* we see an opal with a very odd pattern we found quite difficult to photograph. Only when the light projected to the top of the stone was directed exactly at the correct angle was it possible to show up this rather odd pattern that appears vaguely in the photograph. We suspected that this might possibly be an opalized replacement of some portion of palm. Whether this was a palm root or part of the palm tree we do not know; as a matter of fact, we are not sure that this is even a replacement of palm, but the pattern is unique in our experience, so we would be happy for any comment from someone to whom this pattern is familiar.

We received another interesting stone that appeared to be a replacement of an organic material. It was a large cabochon of chalcedony sent in by a student who thought it was petrified palm root. This is shown in *Figure 9.* Although easily identifiable as chalcedony, the pattern, though

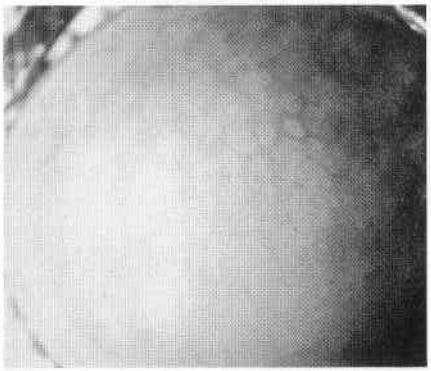


Figure 8

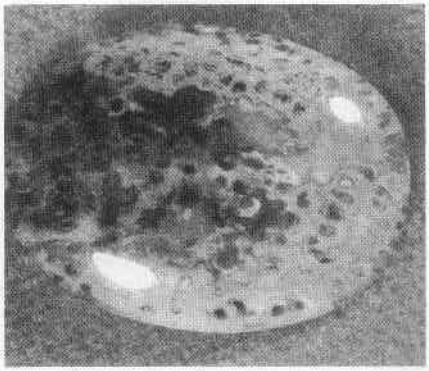


Figure 9

distinctive, is not really familiar to us. Thus, we were not sure whether it was actually petrified palm root as he believed, or the replacement of some other material. The pattern certainly is quite distinctive, so we would like to know whether he is correct in his diagnosis.

Twinned Star

We receive quite a few star diopsides for identification, but it is quite unusual to see one that is twinned in the manner of the one shown in *Figure 10.* In this case, the rays of the star were distinctively displaced by the twinning plane, which is seen in *Figure 10* just to the left of the position where the two rays cross.

It can be seen that the left-hand portion of the east-west ray is displaced to the north. A portion of a ray is seen below the twin plane to the south at about 6 o'clock. Another view, shown in *Figure 11,* gives two north rays and cuts off the south ray just below the position where the rays cross. We find such twinning in star diopside very unusual.

Figure 10

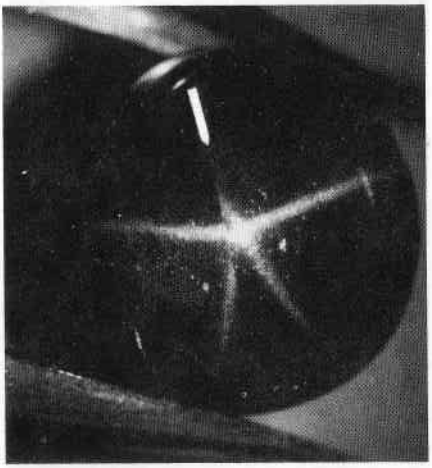


Figure 11

Magnificent Gemmy Barite Crystals

A GIA student, Allen B. Smith of Grand Junction, Colorado, asked his instructor, Jim Taylor, whether GIA would be interested in having some gemmy barite crystals from a nearby locality in Colorado. Since we had no such specimens, we were very happy to receive them. In *Figure 12* the two crystals are shown in the magnificent 4 inch long specimen. Each of the crystals could be used to cut a large, almost flawless specimen of excellent colorless barite. This is indeed a very attractive addition to the GIA gem and mineral collection.

An Unusual Opal

We received an opal for identification, particularly with question as to whether there was any alteration in

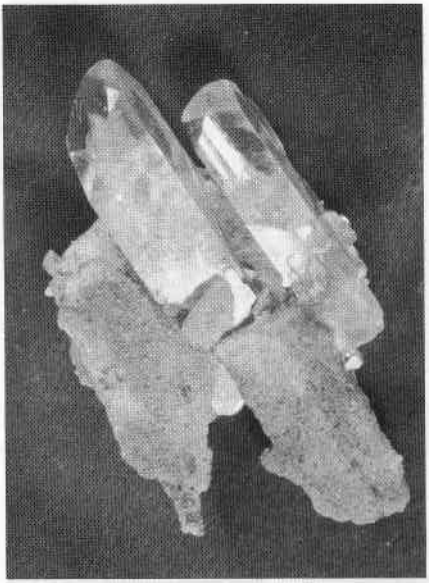


Figure 12

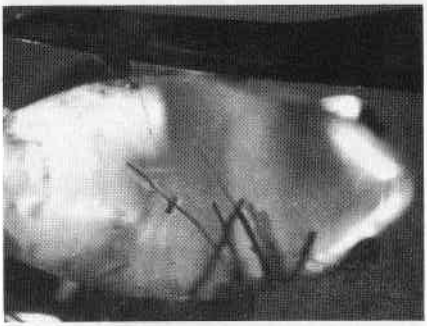


Figure 13

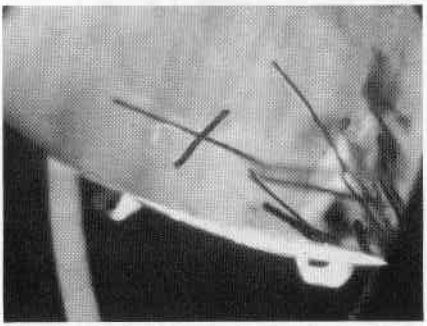


Figure 14

the material. In examining the opal by transmitted light, we saw some rather odd inclusions which are shown in *Figure 13.* In *Figure 14,* further magnification of a portion of that opal showed this peculiar cross pattern and the various tubelike inclusions that were present in the stone. The nature of the inclusions could not be readily determined without microprobe analysis.

One of the Great Rarities

A GIA collector-student brought in to us recently a 1.51 ct. elongated emerald-cut stone of a pale blue color resembling aquamarine. The stone is shown in *Figure 15.* As is obvious from the photograph, it was rather difficult to photograph because of the nature of the cutting, but it proved to be a very interesting stone to test. We learned later that the material came from the Salem Granite north of Swakop, Southwest Africa. For many years, the only known source was Siberia.

The properties we obtained in testing the stone were refractive indices of

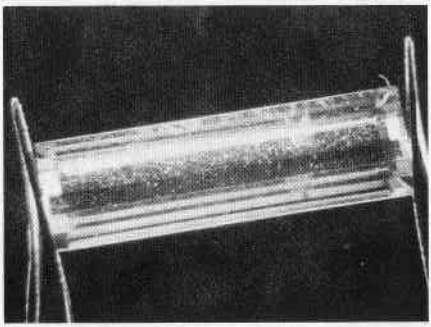


Figure 15

approximately 1.639-1.648; we determined it was uniaxial with a negative sign but it also gave indications of being biaxial with a very small 2V angle. The specific gravity was very close to 3.30. The more we studied the stone, the more we became convinced it was one of the rarest minerals known, called jeremejevite. We have long thought of jeremejevite as one of the rarest of minerals. When later we discussed the matter with the Smithsonian staff, we found that they only had five sugar-grain sized tiny crystals in their collection. To be confronted with a 1.51 ct. transparent faceted stone seemed totally unbelievable.

With the very kind permission of the owner, Edward R. Swoboda of Los Angeles, from whom the collector had obtained the stone, we were given permission to scrape a small portion of a hundredth of a carat from one end of the emerald cut – a portion so minute that its departure could only be detected by a slight roughness at one end of the girdle plane, under high magnification. Charles Fryer, our Laboratory Supervisor, was able to get enough powder to confirm our identification by X-ray diffraction. When we contacted the Smithsonian staff, they were kind enough to send us one of their five grains which could also be used for an X-ray diffraction analysis to confirm the identification. It was a highly satisfying identification because of the extreme rarity of jeremejevite.

An Interesting Imitation

One of our students brought in a quite interesting imitation similar to floating opal, but containing emerald fragments instead. This was a glass, liquid-filled, sealed bead containing many fragments of emerald in an oil. A sealed fragment is shown in *Figure 16.* A broken, similar glass ball with the oil removed and the emerald fragments around the ball, is shown in *Figure 17.*

Figure 16

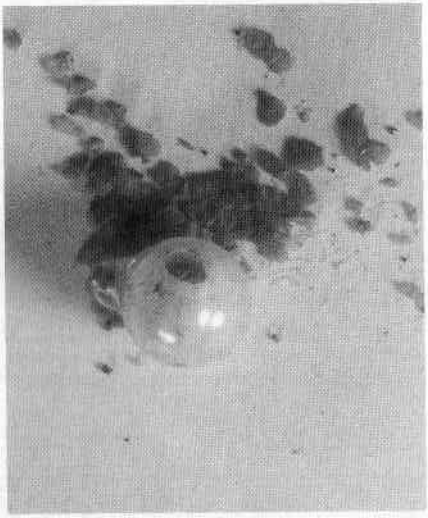


Figure 17

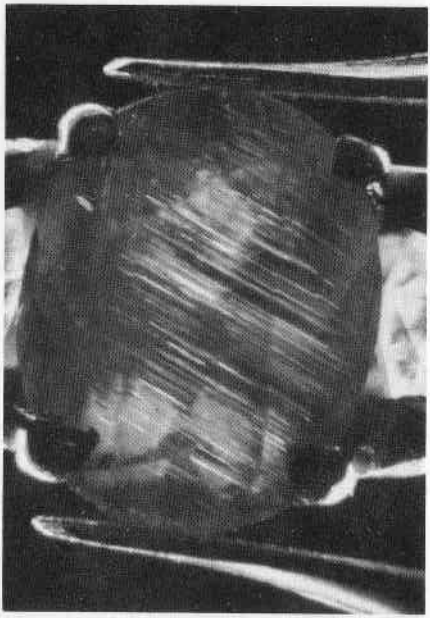


Figure 18

Figure 19

Many fragments of bright green emerald were placed in the oil and sealed into the glass container. The whole effect was that of a bright emerald green color. This was new to us.

An Unusual Emerald

While in the process of a routine identification, the first glance under magnification showed a large number of parallel tubes in what appeared to be a natural emerald. During the process of identification it was obvious that it was indeed, a natural emerald and that the parallel tubes were partially liquid-filled. The emerald, as it appeared under low magnification, is shown in *Figure 18* and, under slightly higher magnification, in *Figure 19.* The apparent displacement in the tubes as they traverse the stone from left to right is occasioned by the optical effect of the facet edges.

Crackled Synthetic Ruby

An unusually effective effort to conceal the true nature of a synthetic ruby is shown in *Figure 20.* In this case, after heating, apparently, the ruby had been immersed in a liquid that would crystallize as it dried. As a result, the many fractures in the synthetic ruby were filled with crystallites that added to the impression of a natural appearance. This is shown under rather high magnification in *Figure 20.* Under careful examination, bubbles and curved striae could be resolved.

Diamonds and Diamond Inclusions

Figure 21 shows a diamond cut in an unusual style. It might be described

as a bead covered by large octagonal and smaller square facets, which is not described by any known cut.

Figure 22 shows a not really rare type of inclusion of a smaller diamond octahedron within a diamond. However, it is not too often that they are seen in a cut stone this clearly.

In *Figure 23,* we see a very unusual inclusion in a diamond. A pattern of this shape and this complexity is unique in our experience. We found it particularly interesting. Below the gletz, just at the table surface at the top of the photograph, the geometrical pattern of white lines were at an acute angle to the surface.

Surface Alteration

Figures 24 and 25 are pictures of a carved object with almost no polish on the surface, which was basically light gray, but which had green and black surface material which appear as dark areas in *Figure 24.* The properties of the material did not agree with the X-ray diffraction findings. We concluded that the material was an ortho-

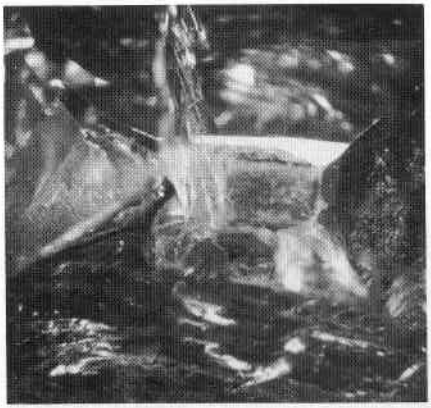


Figure 20

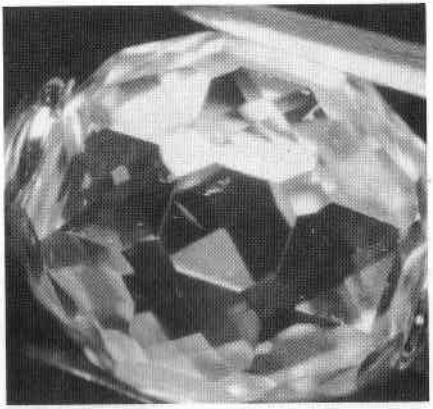


Figure 21

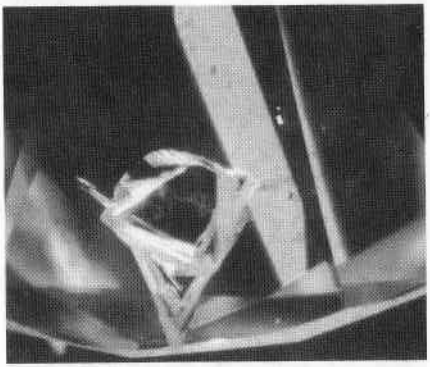


Figure 22

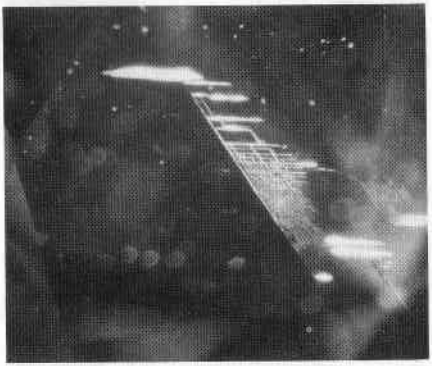


Figure 23

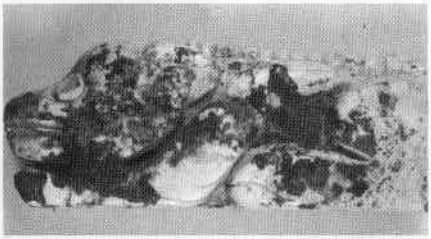


Figure 24

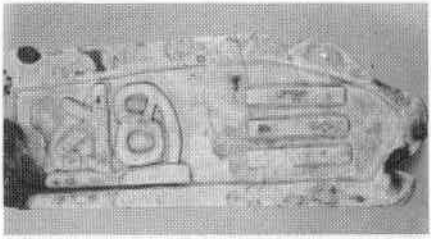


Figure 25

pyroxene, probably enstatite, but that it is altering at the surface to another mineral.

New Treatment for Turquois?

Recently, we have encountered highly translucent turquois which gives a good absorption spectrum. It shows no reaction in the form of the welling up of paraffin under the hot point and no odor of plastic to the hot point but which, very obviously to the eye, has been subjected to some form of treatment. The high degree of translucency of the material and its deeper than natural blue color suggest that it has been impregnated with a blue plastic that does not give an odor to the hot point. Since all the stones that we have had the opportunity to test of this type of turquois have been in American Indian jewelry that is bezel set, we have been unable to remove any pieces to give it further testing. Usually such material, if plastic treated, would have been very low in specific gravity and, if it could be subjected to destructive tests, would reveal its nature, if it had been plastic treated. With the limited tests available to us of a nondestructive nature, we could not prove that the material was treated, but we were well satisfied that it must have been.

Diamond Prices

Now that diamond prices appear to have stabilized, to a degree at least, and in some instances to have dropped back appreciably, we are beginning to be able to assess the present condition in what has been a very chaotic market. Apparently for the last several months the greatest demand was for larger sizes in very fine qualities from Japan and Europe, which was the force behind the rapidity and strength of the price advances. The demand for lower clarity grades and lower colors had not been nearly as great. Thus, Chart B in GIA's diamond grading system shows much lower percentage figures, in general, below the top one or two clarity and color grades, than in the past. In other words, the prices of the very fine grades went up much more rapidly than those in the lower categories.

Canned Oysters

Retail jewelers, and the public as well, have become very familiar with the canned pearl oyster with a cultured pearl inside. These are to be seen

and available for purchase in a wide variety of retail outlets. The presumption is that these are all rather recently operated *Pinctada martensii* from Japan, where the bead has been in the mollusc for too short a time to have had any chance of producing a gem cultured pearl. Over the years we have been called upon to test cultured pearls removed from such a canned mollusc on several occasions.

The most recent examination was by far the most dramatic in that when we tested the bead that came from the *Pinctada martensii,* we found not a cultured pearl, but an imitation pearl. This is a new one in our memory. Since we opened the can ourselves, there was no substitution involved.

Acknowledgements

We wish to express our sincere appreciation for the following gifts:

To *Dr. Edgar F. Borgatta,* G.G., Ph.D., of Gempro Distributors, Rupert, Vermont, for a large assortment of jadeite cabochons, a group of rough spinels, and 5¾ pounds of garnets to be used in our gem identification courses. This is a most welcome gift.

To graduate Gemologist *Ben Gordon,* of Gordon Jewelry Company, Houston, Texas, for another of many splendid donations of a large collection of miscellaneous natural, synthetic and imitation gemstones for our gem identification course. They will be put to good use by our students.

To *Donna May,* a 1970 full-time Resident Graduate, from San Antonio, Texas, for a benitoite which has been placed in our display case and a green zircon from Australia for use by our resident classes.

To *John Ruskis,* Graduate Gemologist, from Columbus, Ohio, for several cut blue sapphires for our gem identification classes.

To *Clarry Drayton,* from Bellevue Heights, South Australia, for a selection of sugar-treated opals for our collection and class use.

To *George Bosshart,* Graduate Gemologist, now in Switzerland organizing a gem lab, for a gift of two large specimens of ulexite.

To *Diane B. Starkey,* student, from Santa Monica, California, for a generous donation of miscellaneous stones to be used by our gem identification classes.

To *Albert Carrier,* recent student at G.I.A., from Los Angeles, California, for a gift of a fine specimen of sodalite to be used in our collection.

To *Allen B. Smith,* student, from Grand Junction, Colorado, for two magnificent gem-quality barite specimens in matrix. These exceptional crystals are a most welcome gift for our reference collection and display case.

To *Jeff Skelpsa,* currently a Resident Student at the Institute, from Jacksonville, Florida, for an old mine cut diamond to be used in our diamond course.

To *Gary Grelick,* Graduate Gemologist, of Bomi Wholesale Jewelers, Buffalo, New York, for five faceted natural emeralds for classroom use.

To *Larry Breckenridge,* student

from Anaheim, California, for a large assortment of rough and slabbed gem materials and cabochons. These will be put to good use in our gem identification course.

To *Glenn Vargas,* noted author on faceting and gem materials and stone dealer from Thermal, California, for several fine pieces of gahnospinel rough material for use in our courses and for reference.

To *Peter T. Martino,* of A. Foxx Company, Providence, Rhode Island, for a gift of seven faceted amethysts showing the typical herringbone pattern inclusion. This is a welcome gift for our students in the identification course.

To *Marcus R. Switzer,* GIA student, of Switzer's School of Faceting, Manhattan Beach, California, for a superbly faceted transparent labradorite for our reference collection. Thank you, and congratulations on your School's certification by the State of California.

To *Edward R. Swoboda,* of Pala Properties International, Inc., Fallbrook, California, for a very fine selection of rare gem rough, including alexandrite cat's-eye, manganotantalite, cat's-eye bustamite, rare colors of kyanite, rhodonite, cat's-eye tanzanite and transparent grossularite in a range of colors. Other gifts include a large lot of tumbled spinels, corundums and two tumbled, polished transparent sillimanite. All these stones are greatly appreciated and will be put to good use.

To Graduate Gemologist *Leon M. Agee,* manufacturing jeweler from Spokane, Washington, for a large collection of 31 mixed stones which always are welcome for student study purposes.

To *Rock H. Currier,* Graduate Gemologist, of Jewel Tunnel Imports, San Marino, California, for some very fine apophyllite crystals that would be cuttable into very attractive gemstones and for a lovely grossularite crystal group.

To *Maurine Price Harvey,* of Highland Park, Illinois, for a much-needed pair of diamond earrings for diamond appraisal practice.

To *C.D. "Dee" Parsons* of Burbank, California, for donating a specimen of the recently-described gemstone tugtupite for our collection.

To students *Betty* and *Jerry Magyari,* of Westlake Village, California, for a nice assortment of Yogo sapphire crystals, through the good offices of Chick Kunisaki of Sapphires International, owners of the mine.

To *William A. Bolender,* C.G., of Bolenders, Inc., Rockford, Illinois, for two pear-shape Burma rubies of excellent quality that will prove invaluable in demonstrating this quality to classes. Also, an attractive opal carving of exceptional quality was donated which will make an outstanding addition to GIA's exhibit case for students to see.

To *Ralph Pierro,* C.G., of Pierro's Jewelers, Bradenton, Florida, for two rare books: two volumes of *Der Diamant,* 1911, by Gersmann and Goldschmidt. These books will make welcome additions to GIA's ever-increasing library.

In Memoriam

BEATRICE W. SHIPLEY

1888-1973

We regret to report that Mrs. Robert M. Shipley, Sr., passed away on Monday, July 30, 1973, at the age of 85. Beatrice Shipley was born in Riverside, California, and lived most of her life in the state. The Shipleys met at the Louvre in Paris, while attending art classes there. They were married in 1930. Long active in Girl Scouting, Mrs. Shipley was President of the Los Angeles Girl Scout Council.

In the early days of the Gemological Institute of America, Mrs. Shipley was a key factor in the growth and development—even the survival—of the organization. While Robert M. Shipley worked on the courses and on proselytizing jewelers all over the nation in his efforts to demonstrate to them the essentiality of gemological knowledge to all jewelers, Mrs. Shipley managed the operation of the Institute in Los Angeles. She built a solid foundation upon which the organization was able to grow and function effectively.

The Shipleys were a wonderfully effective team. Robert M. Shipley had complete faith in Beatrice W. Shipley's judgment of people and on the operation of the office. In home-study, efficient office management is vital in order to make sure that assignments are on hand so students are not delayed and that every questionnaire that is received is graded and processed promptly. Those who served on the GIA staff in those early days regarded Mrs. Shipley with a combination of respect and affection that brought forth their maximum effort. It is doubtful that Robert M. Shipley could have been as highly effective an organizer and developer of the Institute had he not been able to depend so fully on Mrs. Shipley's management in his absence. Even when he was in Los Angeles, he would not have had as much time to devote to development of new course material had he not been able to rely on the fact that the Institute would function smoothly and effectively under her astute guidance.

Beatrice Shipley's host of friends and admirers will miss the warmth of her presence.

■

In Memoriam

CHARLES JAY PARSONS

1894-1973

Reprinted from *Lapidary Journal,* Vol. 27, No. 8, November 1973.)

It is with deep regret that we must announce the passing of Charles Jay Parsons, G.G., F.G.A., 4430 Dale Street, La Mesa, California, Friday, September 14, 1973 following a very short illness.

Charlie, as he was known to his close friends and associates, was born on a farm near Wenatchee, Washington, October 1, 1894. His parents, Charles Jay Parsons and Ida May Parsons, had both been school teachers before their decision to settle on the farm permanently. Charlie left the farm at an early age

In 1917 he joined the United States Navy as a radio operator. During his naval career in the field of electronics and communications, he was assigned to shore duty at a large radio transmitter station at Pearl Harbor in Hawaii. While stationed there, he met and married Sarah Cabral in Honolulu, Hawaii, in 1923. Following his retirement from the service during the late Forties, he attended a jewelry trade school under the auspices of the G.I. bill and became proficient in engraving and jewelry manufacturing. He worked for several years as a graver in the jewelry trade and during this time he became interested in gems and minerals. He then studied with and later worked for the Gemological Institute of America as a Graduate Gemologist. He was also a Certified Gemologist (C.G.) of the American Gem Society for sixteen years. In 1952 he passed, with distinction, the British examinations and became a Fellow of The Gemmological Association of Great Britain (F.G.A.).

Then in 1955 Charlie brought together a small group of instructors and students to form the Gemological Society of San Diego. Charlie was a very humble but able leader and organizer whenever it involved gemology. Charlie never failed to provide a helping hand or encouragement for any of his students and instructors and was responsible for helping several of his instructors and students convert their hobby into successful business careers in various phases of gemology.

Charlie was a co-author of the "Gem Material Data Book" and "The Handbook of Gemology," both of which are now out of print. Later he wrote another series of "Practical Gem Knowledge for the Amateur" which ran serially and was later republished in book form by *The Lapidary Journal.* He continued to teach the fourth year classes until he became ill.

Charles Jay Parsons, "Charlie" to all those who knew him well, was indeed a dedicated person and truly a "King of Gems." He will be greatly missed by his family and all who knew and loved him.

(Ed. note: Charlie Parsons assisted the late Lester L. Benson, Jr., GIA's then Research Director, in three-week classes A and B in Chicago and Los Angeles for several years. Students and staff had the highest regard for Charlie's knowledge, skills, and his unmatched willingness to help those who shared his interest in gemology.)