Gems & Gemology

GIA

SUMMER, 1971

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Gems & Gemology

Volume XIII — *Number 10*

SUMMER, 1971

IN THIS ISSUE

GENERAL ELECTRIC'S CUTTABLE SYNTHETIC DIAMONDS

(Including a First Report of the Examination of Faceted Stones)

by

ROBERT CROWNINGSHIELD

In anticipation of the same trade and public reaction to the announcement last year that General Electric had succeeded in producing cuttable-sized synthetic diamond crystals, we asked for the chance to examine the first stones cut from these crystals prior to the presentation of a selection to the Smithsonian Institution in Washington, D.C.

Three cut stones and an uncut crystal were presented on June 17th at a press party well attended by guests with wide diversity of interests. Through the good offices of Dr. Rodney E. Hanneman, Manager of the Inorganic and Structures Branch of the Physical Chemistry Laboratory at G.E.'s Research and Development Center, Schenectady, New York, the writer was able to spend a fascinating morning on June 14th examining not only the three stones to be given to the Smithsonian but a fourth colorless oval brilliant and several uncut crystals. For unknown reasons reporters at the presentation did not pick up the story or failed to note the significance of the achievement, for we have heard of no newspaper releases about cut GE synthetic diamonds. Perhaps this is just as well as far as the jewelry-buying public is concerned. The jewelry trade press, of course, took due note of the event, and articles to appear in the *Jewelers' Circular-Keystone* may well spark publicity not realized following the presentation itself.

Drs. Herbert M. Strong and Robert H. Wentorf, Jr., who are responsible for the development of the techniques that produce large, single-crystal synthetic diamonds, have indicated that it is possible to produce colors other than the ones we have seen. The writer was also shown one light-blue crystal that had accidentally been changed to gray during experiments with subatomic bombardment. Small green crystals and nearly black ones have been reported but not shown.

Dr. Herbert M. Strong (upper left) and Dr. Robert H. Wentorf, Jr., developers of the gem diamond processes, ready a giant press for a "run" at the GE Research and Development Center, Schenectady, New York.

The colors of the cut stones examined were colorless or near colorless, pale blue, very dark blue and intense yellow.

The purpose of this present article is not to review the details of the exquisite scientific techniques needed

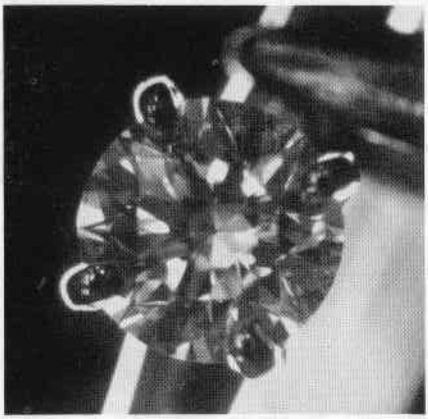

Figure 1

to produce cuttable-sized synthetic diamond crystals in the laboratory, but rather to record the observations made by members of the Gem Trade Laboratory staff on the stones mentioned above, as well as three additional cut stones examined since. Through the generosity of Dr. George Switzer, Department Head, Mineralogy and Petrology of the Smithsonian who personally brought the three Smithsonian cut stones to New York, we were able to conduct a more detailed study in our own laboratory.

Undoubtedly, jewelers and the public alike would be most interested in the "white" stones. It should be noted that at the moment the stones to be described are perhaps the only true cut synthetic diamonds in the world. All the many trade names for various synthetic products, such as strontium titanate, yttrium aluminum garnet (YAG), synthetic spinel, doublets, etc., are all imitations, not synthetic diamonds, as we sometimes read. Perhaps this is one reason the press did not use the GE news release after the presentation.

COLORLESS TO NEAR COLORLESS G E SYNTHETIC DIAMONDS

Size and Appearance

"GE-1" in the Smithsonian collection weighs .305 carats (*Figure 1* illustrates the stone mounted). An oval examined in Schenectady is slightly larger, and another round brilliant examined since weighed .26 carats. All stones examined were beautifully proportioned and polished, as one would expect of stones cut by the firm of Lazare Kaplan & Sons, Inc.

GIA Color Grades

"GE-1" graded J on the GIA color grading scale, whereas the oval graded approximately G and the .26 carat stone, a remarkable F. It was suggested by Dr. Hanneman that color can be controlled and that GE has confirmed what the Diamond Research Laboratory in Johannesburg published some years ago that yellow in natural diamonds is caused by the presence of nitrogen impurities.

Clarity

Of all the cut stones examined, "GE-1" appeared the most natural and with the least number of inclusions. All others contained somewhat flattened black inclusions of the nickel-iron catalyst in which the crystals grew *(Figures 2 and 2A).*

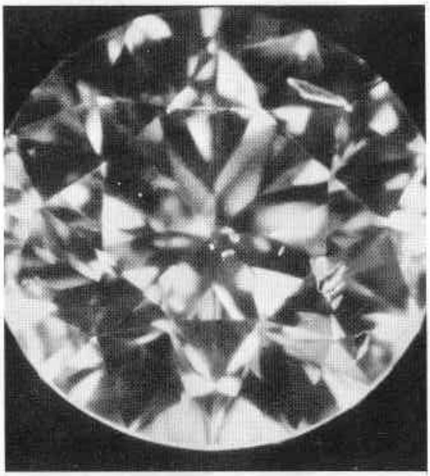

Figure 2

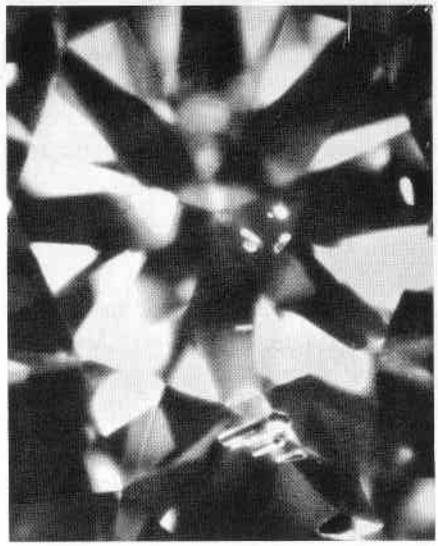

Figure 2A

Some of them had radiating stress cleavages. In two stones we saw rod-shaped inclusions *(Figure 3)* of the catalyst material, and in the Smithsonian stone two form an exclamation mark *(Figure 3A).* As one can surmise from an examination of a diamond report for this stone *(Figure 4),* if he did not know he was looking at the report of a GE synthetic diamond he would not suspect it. Under a 10x loupe the inclusions plotted would not excite suspicion. Under higher magnifi-

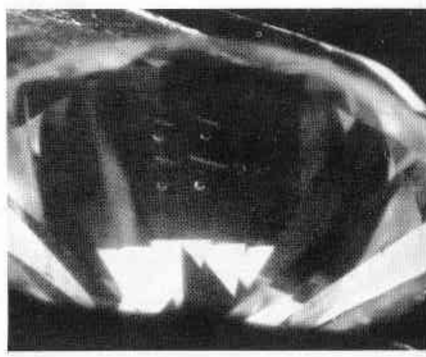

Figure 3

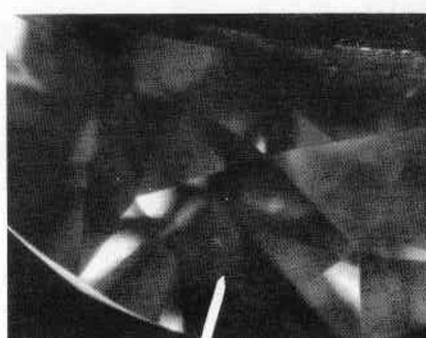

Figure 3A

cation, as we reported in the uncut crystals examined last year, we do see unnatural-looking, randomly scattered pinpoint inclusions *(Figure 5).* We have seen these in all colorless and blue stones examined so far.

Ultraviolet Fluorescence

As we found with the uncut crystals examined last year *(Jewelers' Circular-Keystone,* July, 1970), none of the cut stones was fluorescent under long-wave ultraviolet (3660 Å). By itself, this would not be diagnostic. However, under short ultraviolet (2537 Å), the colorless (and pale blue) stones fluoresced – a most unusual occurrence with natural diamond. They also phosphoresced brightly for a long time after the lamp was extinguished. Unlike the effect one sees

ORIGINAL

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NY 653488

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NEW YORK LABORATORY

Received from

Smithsonian Institution
Washington, D. C.

Date June 28, 1971

the following for identification:

DESCRIPTION	TESTS AND FINDINGS
1 transparent near colorless round brilliant measuring approx. 4.34-4.37 x 2.61mm.	binocular magnification Diamondlite and master color diamonds long ultra-violet - short ultra-violet ++ - phos. Leveridge Gauge and mm. reticle electro-conductometer++ spectroscope - x-ray fluorescence -+ yel, phos. diamond balance

Conclusion:

-------SYNTHETIC DIAMOND, weight: 0.305 ct. See attached Diamond Report ---------

This report sets forth the results indicated by the tests performed. Neither the Institute nor any of its employees shall be responsible for any action that may be taken on the basis of such report.

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- No Appraisals or Evaluations -

Figure 4

Gemological Institute of America

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Scientific Identification of Gemstones and Pearls

Diamond Report
No. NY 653488
6/28/71

In the opinion of the Laboratory, the following are the characteristics of the stone, or stones, described on the attached report as based on measurements and also on observations made through the Gemolite (10X binocular darkfield magnification) and in the Diamondlite, utilizing master comparison stones. Mounted stones graded only to the extent that mounting permits examination.

Shape and Cut: round brilliant cut
Measurements: 4.34-4.37 x2.61mm.
Weight: 0.305 ct.
Proportions:
Depth Percentage: 60%
Table Diameter Percentage: 57%
Girdle Thickness: thin to slightly thick
Culet Size: slightly large
Finish: very good
Clarity Grade: VS_1
Color Grade: J
Fluorescence: none

Comments:

KEY TO SYMBOLS

- included crystal

(Red symbols denote internal characteristics; green, external. Symbols indicate nature and position of characteristics, not necessarily their size.)

Gem Trade Laboratory
by [signature]

GIA
COLOR- AND
CLARITY-GRADING
SYSTEM

D E F G H I J K L M N O P Q R S T
Colorless — Light Yellow

Fl VVS₁ VVS₂ VS₁ VS₂ SI₁ SI₂ I₁ I₂ I₃
Flawless — Imperfect

Figure 4

Figure 5

with natural Type IIB blue diamonds, which characteristically phosphoresce after being exposed to short ultraviolet, we could not visually determine when the rays were cut off because the intensity of the yellow glow did not diminish immediately.

In the routine grading of colorless diamonds one does not usually use short ultraviolet. If GE diamonds were ever to be marketed and they continued to be manufactured with similar properties, diamond graders would find the use of short ultraviolet imperative, since in nature it is only diamonds with tints of blue (or laminated blue and brown) that have been found to be phosphorescent. A fluorescent and phosphorescent colorless or faintly-tinted yellowish diamond would be highly suspect.

An interesting observation of both the colorless stones and the light-blue stone examined in the GIA Laboratory is that their phosphorescence forms a quadrant pattern with a dark cross. It was explained that both this property and that of electroconductivity is crystallographically oriented. If a stone is cut with the table paralleling the cubic direction, this pattern will be seen. Since all the stones were cut from variations of good octahedral rough, all were cut in this manner, so that we were unable to determine the appearance of a stone cut with other orientation.

Absorption Spectroscope Observation

As with the use of short ultraviolet, diamond graders do not, nor do we in the Gem Trade Laboratory, ordinarily test colorless diamonds in the spectroscope.

After we tested the uncut crystals in the spectroscope last year and found no absorption lines in stones of any color, we examined many colorless to near colorless diamonds during the year. We found that the vast majority of natural diamonds that have a tint of yellow (GIA color grade F and below) show the so-called Cape absorption spectrum in varying degrees of strength and completeness *(Figure 6).* Nearly colorless stones will show

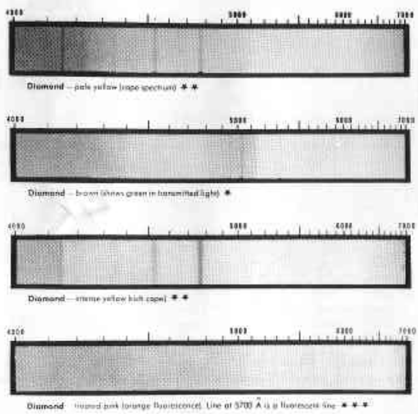


Figure 6

only the 4155 Å line whereas stones of N color and darker begin to show the entire absorption spectrum. Diamonds dark enough to be considered fancy will, with rare exceptions, show a spectrum like *Figure 6.* More about the exceptions later.

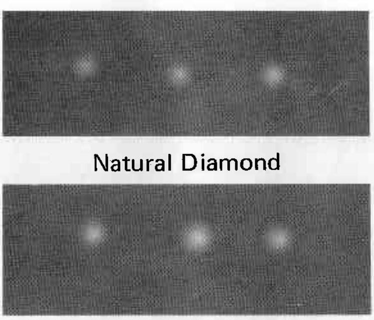
The fact that in the nearly colorless GE stones no absorption lines are seen is significant. Not being top color and showing tints of yellow (not brown), they should have exhibited at least the 4155 Å line. Natural top light-brown diamonds do not show any of the Cape series absorption lines.

Again, if GE diamonds were ever to be marketed commercially as cut gemstones, it might have to be routine practice to examine colorless as well as fancy-colored diamonds in the spectroscope.

X-Ray Fluorescence and Radiography

GE synthetic diamonds transmit X-rays indistinguishably from natural diamonds (*Figure 7*). This was to be expected. However, when viewed in a dark room with our X-ray unit set at 80 KV and 4 MA with stones approximately one inch from the target, we found that the two round colorless brilliants fluoresced strong yellow. They also phosphoresced for a long period of time when the X-rays were cut off.

GE Diamond



Natural Diamond

Figure 7

We do not ordinarily expose diamonds for the purpose of noting their X-ray fluorescence. Over the years, however, in the process of fluorescing pearls we have noted that most colorless or near-colorless diamonds fluoresce blue, not yellow, and seldom phosphoresce. This could be a significant test.

After discovering the unusual X-ray characteristics of the GE stones, we proceeded to examine as many natural "white" diamonds as possible and came up with some surprises. Two very large D color stones cut from the same piece of highly grained rough fluoresced strong greenish blue and phosphoresced for as long as an hour. Another 10-carat pear-shape stone that had been graded H on the GIA color-grading scale fluoresced bright orange with no phosphorescence. Obviously, we would have to examine many more stones, both natural and synthetic, before relying on X-rays as a means of distinguishing the two.

Polariscope Observation

Our observation of both uncut crystals and the cut stones tends to confirm statements made by Dr. Arthur M. Bueche, GE Vice President for Research and Development, that GE can control impurities extraordinarily well, resulting in nearly strain-free crystals with amazing heat conduction as well as semiconductive properties. We found most of the crystals to be devoid of strain, except around flux inclusions. We saw none of the typical strain seen in natural diamonds in which interference colors, in addition to the gray of false double refraction, may be present.

Electrical Conductivity

In the Laboratory at GIA, we do not usually test colorless to near colorless diamonds for semiconductivity, reserving that test for blue or gray diamonds that will pass current that can be detected on a simple electroconductometer, such as GIA's instrument shown in *Figure 8.* All the near-colorless GE stones examined were semiconductive and were thus distinguishable from natural stones of similar color.

Figure 8

Colored General Electric Synthetic Diamonds

Of the three colors of synthetic diamonds examined to date, the light blue and intense yellow would be classed as fancies, if they were natural, and to the eye alone their appearance is that of natural diamonds. An extremely dark-blue stone was unlike any colored diamond we have seen, and was perhaps unnatural in appearance.

Yellow Stones

When we examined yellow crystals last year, we predicted that if any were ever cut they would be handsome stones indeed. In actuality, they surpass our estimation. One gentleman involved in the cutting of the stones exclaimed that one of the cut stones is a finer color than any natural stone he has ever seen. It is perhaps because of the pure, intense tone of yellow without either green or brown that prompted him to make this statement. Under magnification, the yellow stones contained inclusions of the metallic flux, although one stone examined could have been cut without any inclusions with only a bit more loss of weight.

A feature of the yellow crystals examined last year was present in the cut stones: an unusual color distribution without orientation and with no clearly defined zoning. *Figure 9* illustrates this effect. GE scientists have explained that the yellow color of most natural diamonds is due to the presence of nitrogen impurities not homogeneously distributed but in so-called platelets. In the GE yellow stones, the nitrogen is not in platelets but somewhat evenly distributed, resulting in a number of electrical and industrial advantages.

One yellow crystal examined this year in Schenectady had an octahedral inclusion in the center of a nearly

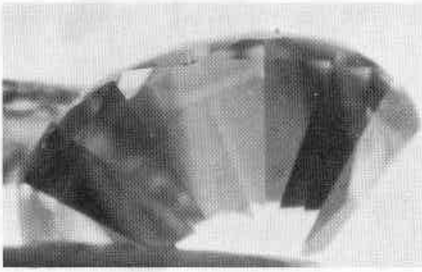


Figure 9

colorless area. It was explained that this could possibly be the synthetic diamond seed crystal, and that initially it was selective and drew only carbon atoms to itself. Later, the growing crystal was overwhelmed with the presence of nitrogen impurities and the resulting crystal was therefore intense yellow. *Figure 10* was an attempt to use the Photoscope on this

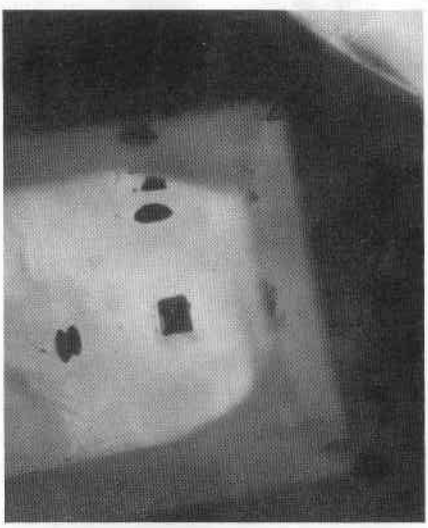


Figure 10

fascinating crystal. Another yellow crystal contained inclusions precisely like the horse-tail inclusions in demantoid garnet (*Figure 11*).

Drs. Hanneman and Strong told me that these inclusions, as yet

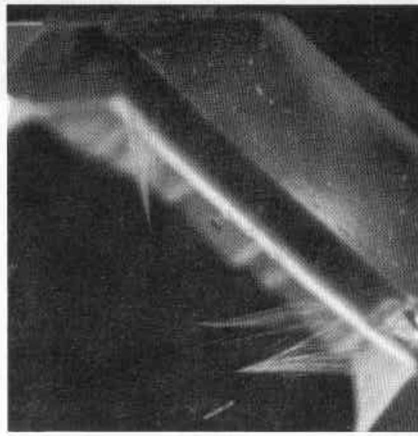


Figure 11

unidentified, occur near the surface and would not be expected to be seen in a cut stone.

In agreement with our discovery last year, studying the uncut yellow crystals, none of the yellow cut stones showed absorption lines when viewed in the spectroscope. A few intense yellow natural diamonds also showed no lines or bands. These stones are usually the finest natural colors available and many trade people consider them the "true canaries." However, according to Basil W. Anderson, head of the London Laboratory, (and our observations agree), these "true canaries" always fluoresce a strong yellow under long ultraviolet. The GE stones do not fluoresce under either long or short ultraviolet. Of the two yellow cut stones we examined under X-rays in the New York GIA Laboratory, one fluoresced yellow with a short period of phosphorescence and the other was virtually nonfluorescent. Since we have had little chance to examine a selection of "true canary" natural diamonds, no conclusion can be made regarding X-ray fluorescence as a means of testing yellow stones.

The accompanying report on the yellow stone presented to the Smithsonian (*Figure 12*) indicates the tests needed for identification. With this stone, the significant tests are magnification, lack of ultraviolet fluorescence, and lack of absorption lines in the spectroscope.

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JUdson 6-4880

Received from
R Smithsonian Institution
Washington, D. C.

Date June 28, 1971

the following for identification:

DESCRIPTION	TESTS AND FINDINGS
1 transparent intense yellow round brilliant measuring approx. 4.68-4.70 x 3.91mm.	R. I. 1.80+ refraction - single magnification long ultra-violet - short ultra-violet - spectroscope - electro conductometer - x-ray fluorescence +, yellow phos - weak

Conclusion:

-------SYNTHETIC DIAMOND, FANCY COLOR. Weight: 0.39 ct.---------

This report sets forth the results indicated by the tests performed. Neither the Institute nor any of its employees shall be responsible for any action that may be taken on the basis of such report.

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Figure 12

Blue Stones

As mentioned above, the light-blue crystals and cut stones examined have the colors and general appearance of some natural diamonds we have seen. In fact, they resemble very closely a beautiful natural stone worn by cutter Lazare Kaplan himself. The dark-blue crystals and cut stones are inky in appearance, with decided color banding, and do not resemble natural stones we have seen.

Under magnification all blue stones we have seen have inclusions of the metallic flux in either rod or flattened form; these can be seen under 10x. Under higher power, all of the blue stones we examined have aforementioned inclusions of pinpoints scattered somewhat randomly and appearing different from anything we have seen in natural stones. In the dark-blue stones, these inclusions do become oriented into a misty crosslike pattern; an attempt to include this pattern in a cut stone is shown in *Figure 13.* Because of the deep color, this does not show up without magnification.

None of the blue stones fluoresces under long ultraviolet, but they both fluoresce and phosphoresce under short wavelengths. In addition, they fluoresce and phosphoresce under X-rays. The intensity of the fluorescence under short ultraviolet and long phosphorescence is unlike any natural Type IIB stones we have seen. We are not yet prepared to conclude anything significant about their X-ray fluorescence.

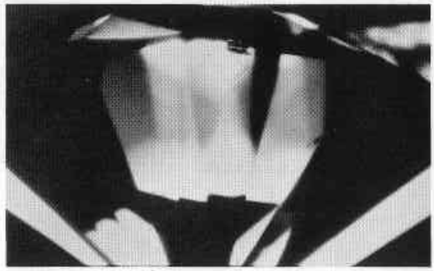

Figure 13

As with natural blue diamonds, GE's synthetic blue stones are good semiconductors. In using the conductometer, the probe has to contact specific areas, since the conductivity is directional. It is interesting to note that following the test, if done in a dark room, the stones phosphoresce. We have not had the occasion to test natural Type IIB stones in the dark; they may well have a similar reaction.

Figure 14 is a report on the light-blue Smithsonian synthetic diamond in which the significant tests that distinguish the stone from a natural Type IIB diamond are the magnification, which reveals the metallic inclusions and the unusual pinpoint inclusions, and the strong ultraviolet fluorescence, together with the long phosphorescence.

In view of the fact that GE scientists can control the color and clarity, as well as the electrical properties of their cuttable crystals, the observations made here can obviously not be considered definitive. Whether or not a jeweler will ever be called upon to determine the natural or synthetic origin of a

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Received from
R Smithsonian Institution
Washington, D. C.

Date June 28, 1971

the following for identification:

DESCRIPTION	TESTS AND FINDINGS
1 transparent light blue round brilliant measuring approx. 4.35-4.39 x 2.60mm.	binocular magnification R. I. 1.80 + refraction - single long ultra-violet - short ultra-violet ++ - phos. spectroscope - electro-conductometer + x-ray fluorescence +, yellow phos - strong

Conclusion:

---------SYNTHETIC DIAMOND, FANCY COLOR. Weight: 0.31 ct.----------

This report sets forth the results indicated by the tests performed. Neither the Institute nor any of its employees shall be responsible for any action that may be taken on the basis of such report.

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Figure 14

diamond is unknown at present. For the moment, it seems that by manufacturing large single crystals GE has accomplished its purpose, which was to study in depth the optical, electrical, thermal and other properties of diamond not possible with even the largest industrial synthetic stones previously available. Economics and further research will decide whether they will ever produce cuttable-sized stones commercially, and even then, the electronic applications may win out over the limited demands of the jewelry industry for what will undoubtedly be a very expensive and probably not very large synthetic.

Developments and Highlights at GIA's Lab in Los Angeles

by

RICHARD T. LIDDICOAT, JR.

As usual, the interim between the last report and this brought one or two new problems and the repetition of a few older ones.

Structure in Clam Pearl

We have seen quite a number of clam pearls from molluscs in a range of shell sizes from the giant *Tridacna* down to mussels only a few inches in diameter. In the *Tridacna,* pearly concretions we have studied were characterized by a rather modified version of the beautiful, distinctive flame structure we expect to find in conch pearls. We had never noted such a structure in a clam pearl, with the exception of the *Tridacna* concretions. Even in these, the flame structure was much finer and smaller than in the conch pearl.

Recently, we examined a brown clam pearl that showed a very strong flame structure. *Figure 1* shows a flame structure in a conch pearl that was very similar to that seen in the

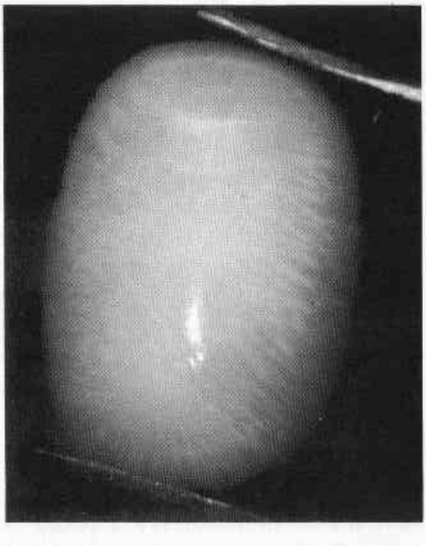

Figure 1

clam pearl that has been described. While examining these pearls, we looked at one of the beads frequently cut from conch shells that shows quite a different structure from the usual conch bead (*Figure 2*). These structures are among the most interesting one encounters when examining concretions from clams.

Figure 2

A Purple-to-Violet Cabochon

A former GIA instructor was asked to identify three large cabochons said to have originated in Thailand. They puzzled him because they were distinctly different from anything he had encountered in the past. Although he was quite certain of their nature, he brought one of them to us for discussion.

It was quite interesting in that it had a very low refractive index – approximately 1.42 or 1.43 – and a relatively high specific gravity. From the action in his heavy liquids, he assumed the specific gravity to be somewhat in excess of 3.10. He had no microscope, but could discern a curved structure within the amethystine-colored mass that puzzled him.

He was aware of the structure of the blue-john variety of fluorite, but had not seen fluorite with such a structure in this color. This turned out to be, as one might assume, a variety of fluorite. We had not known of fluorite in this color range and with this structure from Thailand.

A Beautiful Idocrase

We received a very attractive, almost transparent yellowish-green cabochon mounted in an attractive yellow-gold ring, set with diamond melee. It showed a 1.70 spot reading and a strong 4650Å absorption line in the spectroscope. These characteristics served to identify the stone without question as idocrase – one we considered exceptionally attractive. It had been offered to the jeweler as a californite, and he was just verifying its identity.

Dr. and Mrs. Trueheart Brown

We were pleased to have a visit from Dr. and Mrs. Trueheart Brown. Dr. Brown is the originator of the Kashan flux-fusion synthetic ruby. During his visit, he informed our staff that he is now producing synthetic ruby clusters. These he initiates without seed, in contrast to his large synthetic rubies. When no seed is introduced, nucleation is widespread in the nucreant liquid, and many small crystals start to grow almost simultaneously. The result is that a very attractive crystal aggregate of synthetic ruby grows, a form that has proved to be very interesting to many designers – according to Dr. Brown. This is so different from the inexpensive flame-fusion synthetic rubies that such an acceptance is easy to understand.

Further Report on Black Opals with Very Low Properties

In several issues of *Gems and Gemology* we have discussed a new form of black-opal treatment, the nature of which had not been disclosed to us (*Volume XIII – Number 4, pages 117 and 127; Number 5, pages 148 and 163; Number 7, page 231 and Number 8, page 249*).

When we first encountered these very dark opals, we were given a story about the method of treatment, but did not believe it fully. There were certain properties and other characteristics that did not seem to fit the story. We have ultimately concluded that the method described is probably correct.

The method given to us was that a white opal is enveloped completely with brown wrapping paper. The covered white opal is placed in a crucible, and is then heated slowly with a torch until it is hot enough for the paper to char. This "smoking" imparts a black color that penetrates less than one millimeter.

There were two particular elements that made us doubt the authenticity of this treatment. One was that the harsh heat treating, we thought, would cause the opal to craze heavily – if it did not explode. In addition, this did not seem to jibe with a reaction we found to be an unusual characteristic in such stones: when a point of a needle was pressed against this distinctive black opal, the indentation that resulted would disappear when the point was removed. This suggested plastic impregnation.

On the other hand, a plastic impregnation would have sealed up the interstices so effectively that the resulting material would have been nonabsorbent, yet this black-treated opal absorbed water in great quantities. We encountered one that actually floated for quite a number of seconds before absorbing enough water to sink rather slowly. Usually, we obtained refractive indices on the order of 1.37 or 1.38 and specific gravities almost unbelieveably low – at approximately 1.25. Having tried this kind of treatment ourselves, we are now satisfied that it can be done by this method, and that the characteristics of a particular kind of opal from Jalisco, Mexico, when heated and treated in this fashion gives results substantially the same as those we have encountered in the obviously treated material.

We might add that, with the exception of considerably higher properties, there is some resemblance between this kind of treated opal and the so-called stabilized opal produced from the Virgin Valley black opals.

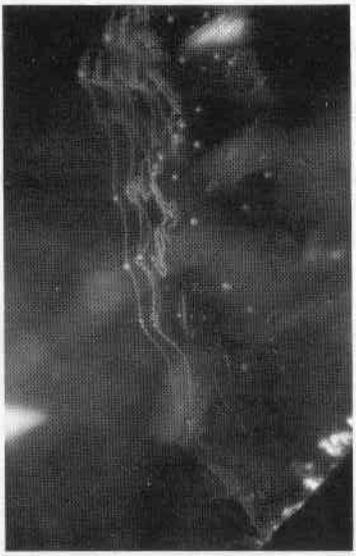

Figure 3

Interesting Inclusions in an Imitation

Figure 3 shows some lacy groups of bubbles in a glass imitation of a gemstone. Unfortunately, it was not feasible to use high enough magnification in producing this photograph to show that these are not continuous strings but individual spherical bubbles. This photograph was taken at 63 magnifications.

X-Ray Diffraction Can Be Helpful

Often in testing, we encounter the kinds of material that well-qualified individuals are not able to identify satisfactorily by ordinary gemological methods. One we received very recently would not have yielded satisfactorily to any of the usual tests available. This material was in the form of a double cabochon, and so only spot readings were possible by refractometer. It was opaque and we could get no absorption spectrum of any description. The specific gravity at 3.84 was not particularly significant.

Turning to a very rarely used test in the Laboratories, we found that this black cabochon could barely scratch a synthetic ruby, and it in turn was scratched by the ruby. With a spot refractive index on the order of 1.78 and a specific gravity on the order of 3.84, we seemed to have a refractive index in excess of that of corundum and a specific gravity appreciably lower. Thus, we seemed to have no possible answer that would fit the information gathered.

Fortunately, we were able to scrape a minute amount of material from the girdle and to run an X-ray powder photograph to determine its nature. Our first impression, before we had taken a hardness test, was that in all probability this was a member of the spinel group. However, when the material proved to be so exceptionally hard (when actually we would expect a slightly lower hardness from a spinel-group material with the elevated refractive index and specific gravity), we felt that this was not a really excellent possibility. However, when Chuck Fryer's film was developed, there was no question but that this was black spinel. We have no way to account for its exceptional hardness.

Clear Rubies

One of the remarkable sights in gemology is the somewhat roiled effect often encountered in fine Burma rubies. We received two exceedingly attractive rubies, one between one and two carats and the other between two and three, both of which were reasonably free from inclusions. However, under the right lighting conditions, they did show the highly distinctive appearance of a lovely Burma ruby with its roiled body structure. This appearance is shown in *Figures 4* and *5*.

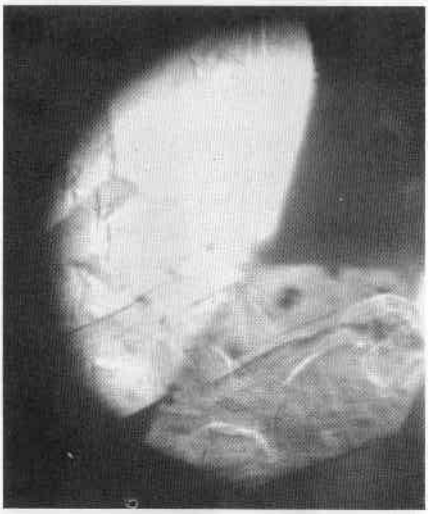

Figure 4

Unusual Feature in a Cultured Pearl

When examining a group of cultured pearls, we noticed one that had a black mark. This was a long thin line that had the appearance of a pencil or ink mark that had been placed on the mother-of-pearl bead before it had been inserted in the mollusc. This line is readily visible through the transparent nacre in *Figure 6*. Of course, there are often blackish areas of conchiolin, but this is the first instance in which we have encountered what probably was a pencil mark on the bead.

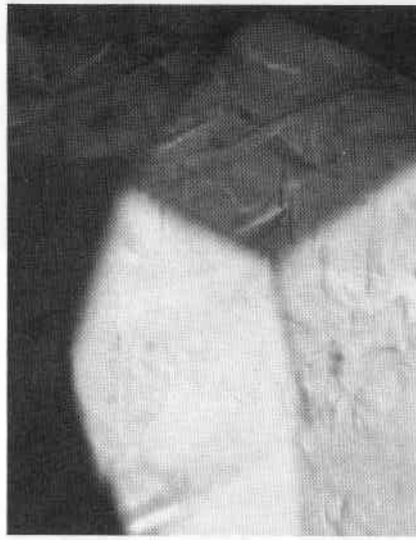

Figure 5

Figure 6

A Very Attractive Spessartite

An identification we were called upon to make recently was of a particularly attractive, richly colored spessartite. Charles Fryer noticed the inclusion pattern shown in *Figure 7*, with its dodecahedral pattern in part, and photographed it.

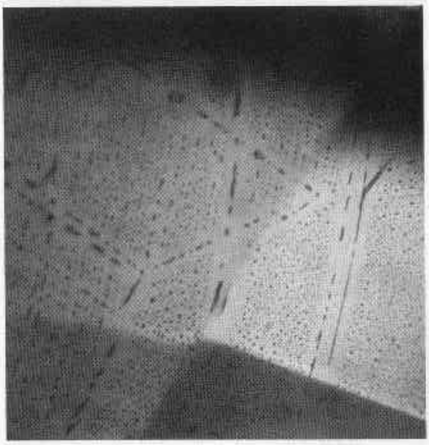

Figure 7

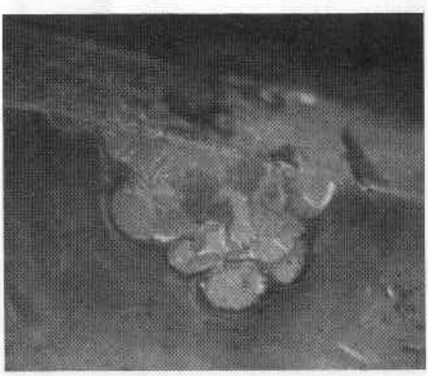

Figure 8

Coated Beryl

We had a bright-green stone to identify that we found to be beryl, but it had a very obvious coating on the back and some bubbles in which the edges are shown in *Figure 8.* Since no chromium lines were visible in the spectroscope, we assumed that this was an almost colorless beryl, to which the green plastic coating had been applied. It was a very clumsy effort to deceive.

An Unusual Flux-Fusion Synthetic Ruby

All of our reports in the past with respect to flux-melt synthetic rubies have indicated that the seed crystal used is natural corundum.

Recently, a large stone purported to be ruby was brought to us for identification; it proved to be exceptionally interesting. It is shown in the next four figures. The first (*Figure 9*) shows a bubble, as indicated by the arrow, and curved striae. The second (*Figure 10*) shows the bubble as a dark object against a white

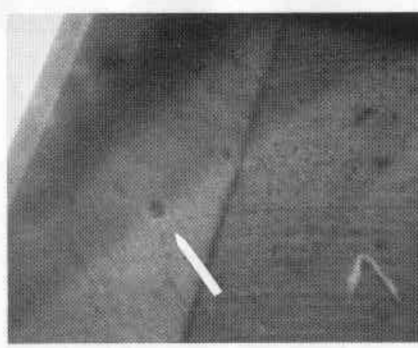

Figure 9

background. In the third photograph (*Figure 11*) the curved striae in the synthetic seed is very apparent. *Figure 12* illustrates the kind of surface that joins the overgrowth layer between the material that formed the seed and the overgrowth, which may have been either flux-fusion or hydrothermal. This is very reminiscent in appearance

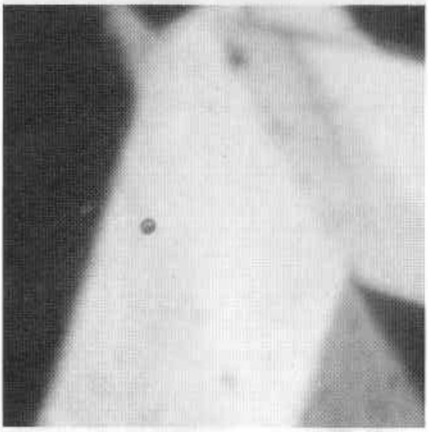

Figure 10

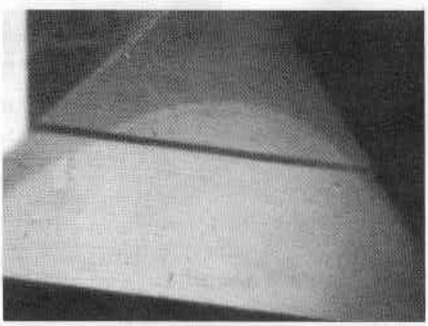

Figure 11

of the material introduced as Linde synthetic emerald, which was actually a Lechleitner hydrothermal overgrowth of synthetic emerald on prefaceted natural beryl.

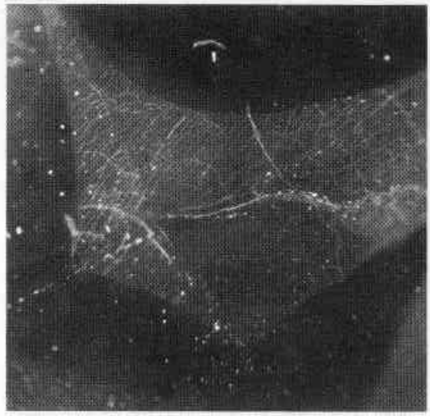

Figure 12

Our impression of the material was that a manufacturer of synthetic rubies by either flux-melt or hydrothermal processes had used a flame-fusion synthetic ruby as the seed. We believe that both announced manufacturers disclaim the use of flame-fusion synthetic seeds, so it is possible that there is another manufacturer of synthetic rubies coming into the market unannounced.

Synthetic Opal?

We received recently for identification (with a query about their identity) from a cultured-pearl and colored-stone dealer two small oval cabochons, one of which turned out to be as nice a fire agate as we have ever seen. The other had a white center area at the surface, with a good play of color surrounded by a nonopalescent dark-brown edge. When the dealer had broken this open, he found what appeared to be a milky-white button at the center.

We found the button to be singly

refracting and hard, so we first assumed it to be glass. It was surrounded by a fairly thin, white, highly opalescent layer and then, on the edges, the dark-brown, nearly opaque zone. The whole seemed obviously artificial, and because of the manner in which the layers were joined, it seemed that the opal showing play of color was grown on the outside of the white translucent bead we first assumed to be glass. An X-ray diffraction powder photograph showed a high cristobalite pattern, suggesting that the whole stone is a very unusual opal. In *Figure 13*, a piece of the white-opal layer is seen at the left, and the white-glass bead coated by white opal and the dark-brown layer is shown on the right.

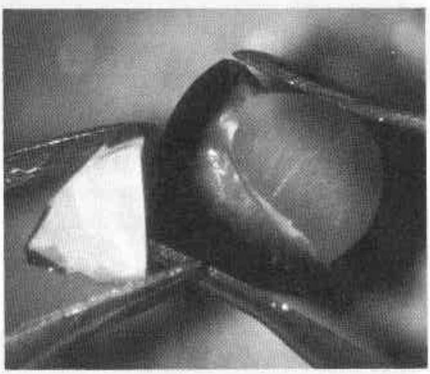

Figure 13

We have never seen anything even closely resembling this material. We are trying to obtain more, so that we can examine it in an unbroken state.

Space Capsules

On a few occasions in the past we have shown some pictures of inclusions in amethyst that closely resembled moon-shot vehicles. The latest is probably the most Apollolike we have seen (*Figure 14*). Slightly out of focus is one that appears to be presently firing.

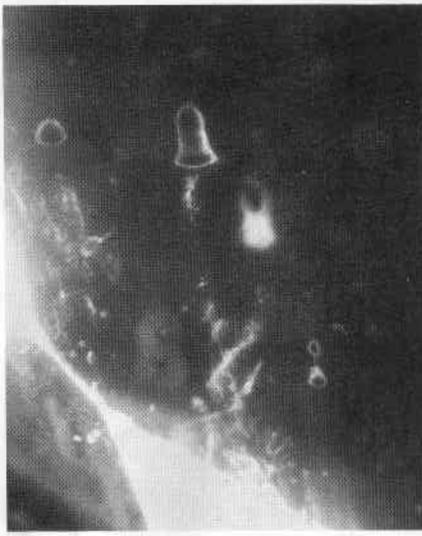

Figure 14

Large Water-Worn Crystal of Peridot

We were surprised to receive for identification a large water-worn crystal of peridot of magnificent quality that weighed 137.5 carats (*Figure 15*). Well-formed peridot crystals are not too common anyway, and to have such a huge one of fine quality in for identification was unusual. We judged that this one was from Burma.

Russian Synthetic Quartz

Some time ago we reported Russian synthetic quartz in several colors. Chuck Fryer was interested in the

Figure 15

surface growth structure on the material and took a photograph (*Figure 16*) showing the surface. He also took another photograph to show the colorless seed crystal and the dark, deeply-tinted growth area (*Figure 17*).

Crystalites in Glass

Occasionally, natural-appearing inclusions show up in glass when glass

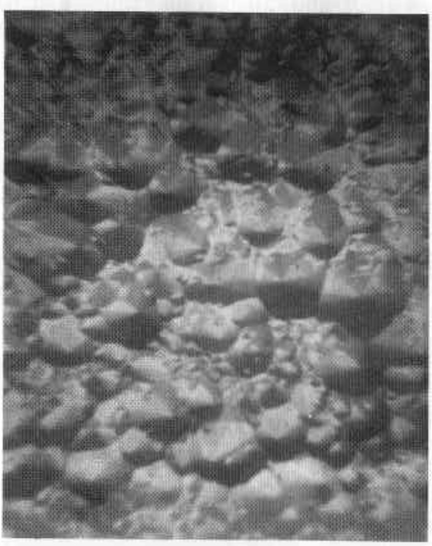

Figure 16

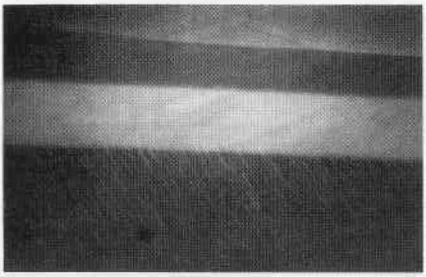

Figure 17

has had the opportunity to cool rather slowly. Chuck Fryer noticed and photographed some crystalites in a glass imitation as shown in *Figure 18.*

Dyed Light-Violet Jade

We have been plagued recently with a large number of lavender jadeite cabochons. The color does not appear to be totally confined to tiny cracks in many of the pieces we have examined. The usual method of detection of artificial coloration that we have used in the past relied on detection of the coloring agent confined to interstices, and, in some cases, a dye line centered at approximately 5700 Å in the spectroscope. It also fluoresced under long-wave ultraviolet in a red color. The material seen most recently, when fairly dark, showed a faint smudge line centered around 6100 Å

We examined one that was offered by a local dealer who had bought a supply as "treated" jadeite in Hong Kong. When it was boiled in sulphuric acid it lost some, but by no means all, of its color. The color was much less noticeable in the interstices after the boiling. We are satisfied that a high percentage of the material that has suddenly flooded the market in Los

Angeles has been dyed, but at the moment we are not satisfied that we can detect it in all cases.

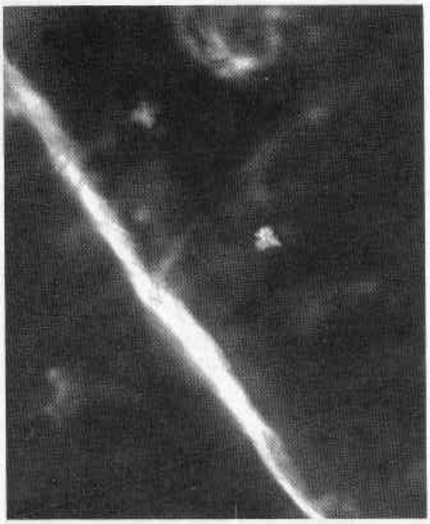

Figure 18

Acknowledgements

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

To **Kim Standard**, GIA student, Hawkinsville, Georgia, for a large selection of gem-quality tourmaline and assorted cut gemstones for class use.

To **T. A. Plagis**, Salisbury, Rhodesia, for several rough garnet crystals and uncut glass.

To **Louis G. Davis** of Davis Jewelers, Setauket, New York, for a large assortment of gemstones and synthetic gem material to be used in our Gem Identification course.

To **Dave Widess** of I. Widess & Sons, Los Angeles, California, for his thoughtful donation of three large specimens of emerald crystals in matrix to be used in our gem-display case.

To **Ed Swoboda**, Los Angeles, California, long-time friend of the Institute, for a beautiful selection of agates representative of Idar-Oberstein, for use in our gem-display case.

To **De Beers Mines**, for 100 brilliant-cut diamonds; these 50 4-grain and 50 6-grain stones will be put to use in the grading portion of our Diamond course.

To Graduate **Eugene Rose**, Denver, Colorado, for several fine specimens of dioptase crystals in matrix, which will be an addition to our collection.

DIAMOND PRICES OF A CENTURY AGO

by

RICHARD T. LIDDICOAT JR.

An early student of GIA, Bill Bolender, of Rockford, Illinois, recently donated a book to our library that his father had for many years. It is entitled *The Jeweller's Guide and Handy Reference Book,* a new edition by William Redman, published in Bradford, England in 1883. We were grateful for the opportunity to examine it and to give some thought to some of the ideas expressed at that time. Although very small in size, it is perhaps comparable to a portion of the GIA book *The Jewelers Manual,* which was published by the Institute several years ago.

The Jeweller's Guide and Handy Reference Book discusses diamonds, emeralds, rubies, sapphires and the various qualities of gold. Since it gives a number of prices, it was possible to compare present-day figures with those that were extant at the time this book was published almost ninety years ago. Although the publication date was 1883, many of the figures cited were for a period ten years or more before the book was printed. Some of the very interesting figures were the prices given for diamonds; for example, prices are cited for 1865 and 1867. A one-carat diamond was listed at 18 pounds (or $90) in 1865, and 21 pounds (or $105) in 1867. Below the table of prices is a qualifying statement that says, "The least defect, want of (or over) spread, or faintest tinge of any colour, reduces these values considerably." Thus, we have a one-carat diamond that is apparently without flaw or color and of a very fine cut listed at $90 for the 1865 price; and $105 for the 1867 price. Three-carat stones are listed at 125 pounds (or $625) which is not the price per carat but the total price for the 1865 figure; and 140 pounds (or $700) for the total price of a three-carat diamond in 1867. A five-carat diamond, (referring to a quality without the least defect in clarity or the faintest tinge of any color and that is not badly cut) is listed at 320 pounds ($1,600) for the stone in 1865; 350 pounds ($1,750) for the stone in 1867.

The author gives a method for valuing cut diamonds – to quote him: "An example is here given to show in what manner the value of a manufactured or wrought diamond of one carat is to be found, upon the principle advanced. Suppose rough diamonds to be valued at 2 pounds ($10) per carat, the weight of such stones must be doubled, on account of half being lost in working them, which is considered their original weight, making two carats; then multiply the weight of each stone by itself, which squares it and makes four; lastly, multiply the four by two, which produces 8 pounds, which is the value of one carat wrought or polished, and is equal to the value of rough diamonds of two carats, out of which it is supposed to be made. This single instance is here given to show the value of rough diamonds in the price of wrought ones. As a further explanation of the rule of valuing them, and previously to offering any other, it is to be observed that although two pounds is laid down as the general price of rough diamonds, it is to be understood that rough diamonds differ in their value according to their different degrees of perfection, and according to the loss of weight they may be supposed to sustain in being truly wrought, as it is well known that some will lose more than others, from their ill form and other defects that may attend them.

First Instance

To find the value of one of five carats the weight must be doubled, on account of half being lost in working, that replaces its original weight and makes ten carats; then multiply by ten, that squares its weight and makes 100 carats; and lastly, 100 must be multiplied by two pounds, the price of one carat, which produces 200 pounds, and is the value of a wrought stone of five carats, the price of the diamond when rough." The price given earlier for a top quality five-carat stone was 320 pounds ($1,600); 200 pounds (or $1,000) is the price for an average stone.

The author also discussed two magnificent rubies that came to London in 1875. After recutting, one weighed 32 5/16 and the other 38

9/16 carats. He said the smaller stone was sold abroad for $50,000, and the other was sold on the continent for $100,000. Thus, even a century ago rubies were coveted and brought huge prices. He mentioned sapphires as $60 to $125 a carat, and a splendid gem of 165 carats that he called "by far the finest sapphire of its size in Europe," that was sold in Paris for $35,000 to $40,000. Mr. Redman mentioned that emeralds of "very fine dark colour, velvety and without flaws" were priced as high as $200 to $300 a carat. He stated however, that this is very rare, but mentioned a six-carat emerald that sold for $5,000.

We are indeed indebted to Bill Bolender for this unique and informative contribution to the GIA library.

Book Reviews

GEM TESTING, by B. W. Anderson, B. Sc., FGA. Published by Butterworth & Co., Ltd., London, England, 1971. 384 pages. Clothbound. Well illustrated with black-and-white and full-color photographs and line drawings.

B. W. Anderson's outstanding text, *GEM TESTING,* has just been updated in a new Eighth Edition, published this year by Butterworth and Company in England. First published in 1942, Anderson's fine book has long been an outstanding contribution to the gemological field and continues in the Eighth Edition to be an exceptionally valuable sourcebook in gemology.

Since the Seventh Edition was published in 1964, quite a number of changes have taken place; they have been duly noted by Mr. Anderson. He has added such new synthetics as quartz, cuttable diamond, scheelite, synthetic rare earth garnet, and new types of synthetic emeralds. He has also added some of the rarely encountered new synthetics such as lithium niobate, periclase, and bromellite.

There are changes in most of the chapters to bring things up-to-date and to clarify a subject. He has added explanatory matter on the spectrometer, additional data on such newly encountered materials as transparent blue zoisite, transparent grossularite, the jadelike idocrase from Pakistan, chrome chalcedony, and other gem materials. There has also been a certain amount of rearrangement for the convenience of the user of this outstanding book.

GEM TESTING is a must for every gemological laboratory and the additions and changes from the Seventh Edition make the new Eighth Edition well worth adding to a library.

ROCK & GEM – Published by Behn-Miller, Inc., Encino, California.

The mineral-and-gem field is becoming an increasingly active avocation of many people. The professional as well as the amateur lapidarist will be pleased to find a new publication to further aid their endeavors. *ROCK & GEM* made its debut in March, 1971 and each issue contains articles covering all possible facets of the lapidary world.

There have been detailed articles on opal, beryl and tourmaline, as well as work projects for the cutter ranging from simple to advanced levels. For those interested in collecting specimens, field-trip information is provided to ensure lucrative finds.

Experts in gemology, mineralogy and the lapidary arts such as John Sinkankas, Dr. Joel E. Arem and Marvin Wilson will be recognized among the contributors. The articles are well-written and informative; the format is imaginative; and the photographs are excellent supplements.

ROCK & GEM is published bi-monthly. The subscription prices are: United States, $4.00 a year and single copies, $.75 each; Canada and all other countries, $5.00 a year. Subscriptions should be sent to *ROCK & GEM,* 16250 Ventura Boulevard, Encino, California, 91316.

The Institute is well-pleased with this new periodical and extends wishes of success to the publishers and staff of *ROCK & GEM.*

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