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WINTER 1970-71

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SOME PROBLEMS & A FEW SOLUTIONS IN THE FIELD OF GEM TESTING WITH THE SPECTROSCOPE

by
Basil W. Anderson, BSc, FGA

(Ed. note: This is the substance of a talk given by B.W. Anderson at the 13th International Gemmological Conference in Brussels, September/October, 1970.)

Research work in a busy trade laboratory, such as ours, cannot be planned as a calmly considered academic exercise, but consists of a series of untidy, interrupted responses to urgent practical problems of gem identification. One would like very much to tie these together into a neat and shapely bundle, but time forbids. However, for this occasion I thought it would be useful to fellow gemologists if I pieced together some recent observations in the field of absorption spectra, with particular reference to those caused by chromium, cobalt and the rare earths.

Chromium Spectra

The general features of a chromium absorption spectrum are by now well known to every gemologist; but the influence of the structure of the host material is so great that deviations from the classic examples, as displayed by ruby, emerald and alexandrite, *Figures 1, 2, and 3,* are extremely wide. The luxury of sharp chromium lines in the deep red, for instance, can be expected only in those minerals in which the chromium ion enters the crystal lattice in replacement for aluminum. Even where there is such isomorphous replacement, there are some cases (e.g., spinel, pyrope) in which the line system may be absent or difficult to discern.

When one is dealing with multicrystalline materials, such as jadeite *Figure 4,* the sharpness of the red bands is decidedly diminished, whereas in stones such as chalcedony, where chromium has no properly established place, the effects are even more blurred. But these facts in themselves may

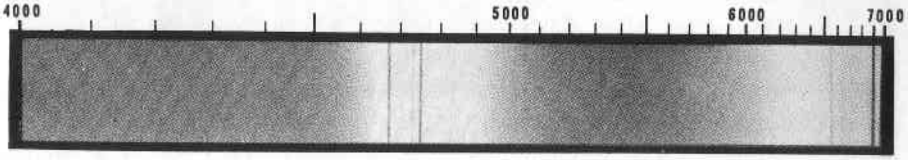


Figure 1

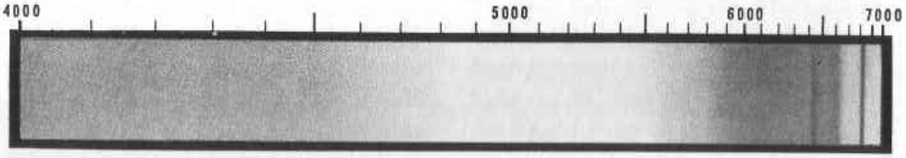


Figure 2

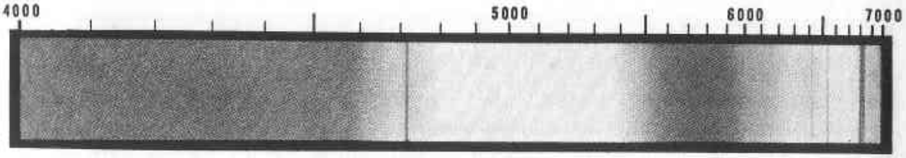


Figure 3

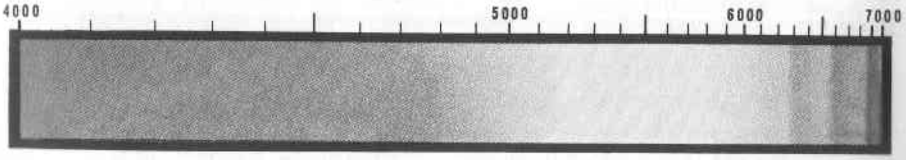


Figure 4

be helpful in distinguishing some of the translucent green gems resembling jade or chrysoprase.

Not long ago, we tested a cabochon green stone in the clasp of a ladies' mesh handbag that looked remarkably like a stained-green chalcedony but that the spectroscope revealed as a cloudy emerald. A similar story in reverse, so to speak, was when we were asked to examine a small vase reputedly carved from emerald, and here the spectroscope proved the material to be a form of aventurine quartz, untypical to the eye. There are also, of course, almost daily decisions to be made on cloudy-green cabochons that may be claimed as chrysoprase, jadeite, natural chrome chalcedony, chrome-stained chalcedony, aventurine or cloudy emerald. Usually, a spot refractive-index reading is not sufficiently definitive and the spectroscope should prove a very welcome aid.

As always, I maintain that wavelength measurements should seldom be necessary, and these are in any case difficult to carry out accurately at the red end of the prism spectrum, whereas with a diffraction-grating instrument measurements are also difficult in a region where visual acuity is so low. What is most useful, indeed almost essential, is to have on hand samples of all the stones that one is liable to have submitted for testing. A good view of the actual spectrum is better than any description – better even than a realistic drawing.

Returning to the group of green translucent stones about which I was talking, the spectrum of emerald should be recognizable beyond doubt, not only for the sharpness of its lines in the red, but from the marked variations in their strength when viewed through a rotating polarizer. The spectrum of the ordinary ray is particularly distinctive, with the line at 6370 Å appearing in almost equal strength with the 6805-6835 Å doublet. Fine green jadeite, at a casual glance, approaches emerald closely in its three-band spectrum, but the doublet centered near 6900 Å is blurred and cannot be resolved, and there is no variation in polarized light. In paler specimens, the iron band at 4370 Å can be seen clearly and gives complete assurance. The spectroscope also provides the surest test for dyed jadeite *Figure 5:* the dyestuff band in the orange is very easily detected, and the chromium bands are usually undetectable.

When the handsome chrome chalcedony from Rhodesia first appeared, fears were expressed that it would be difficult to distinguish from chrome-stained green chalcedony or from true chrysoprase. In practice, the spectra of each are distinctly different. Chrome chalcedony shows virtually only a single narrow band, surprisingly well defined, in the red at 6790 Å, whereas the stained material shows three blurred bands by no means narrow, the strongest being at the limits of our vision (beyond 7000 Å), and the others centered at approximately 6650 and 6340 Å. True chrysoprase, of course, owes its color to nickel, and shows no chromium lines. An ill-defined line in the orange must presumably be caused by nickel, although none of its green salts seem to show anything similar.

Aventurine quartz, which is essen-

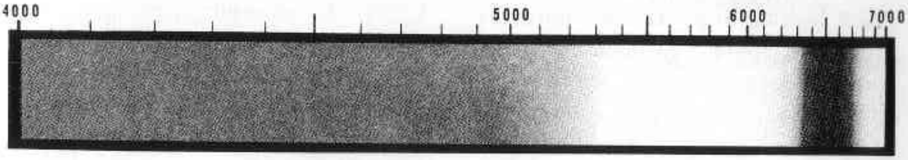


Figure 5

tially a quartzite heavily impregnated with deep-green flakes of chrome-rich mica, can, of course, usually be recognized on sight or by loupe inspection. Sometimes, however, the mica is surprisingly difficult to discern, and then familiarity with its two-band chromium spectrum (at 6830 and 6450 Å) may be useful.

In the more limited range of red chromium-colored minerals, the only difficulty arises (and then only very occasionally) in distinguishing between pyrope *Figure 6,* and spinel *Figure 7.* Since each mineral is isotropic and each belongs to an isomorphous group whose range of constants to some extent overlap, the evidence given by the spectroscope may be valuably decisive. In neither mineral does one see the narrow chromium lines in the red very clearly, but the broad absorption regions in the green are very differently placed (pyrope, 5750 and spinel 5400 Å are their mean positions), and in pyrope the almandite band at 5050

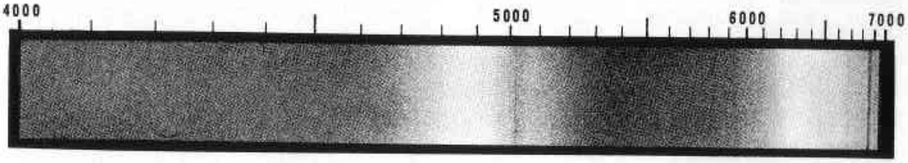


Figure 6

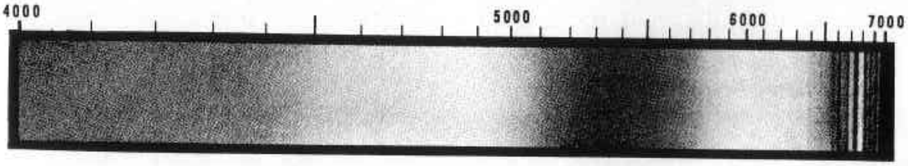


Figure 7

Å can usually be detected. The most obvious distinction, of course, lies not in absorption but in fluorescence, an effect lacking in pyrope and normally strong in spinel, particularly under crossed filters, when it provides the delightful and highly distinctive "organ-pipe" group of bright lines. An intriguing and extremely useful example of the extreme sensitivity of fluorescence effects to the structure of the host material is provided here, since one finds that synthetic red spinels, whether made by flame fusion or crystallized from a flux, display the strongest of these bright lines (at 6850 Å) in far greater prominence than in natural stones, and, in fact, presents through the spectroscope an emission spectrum strongly resembling that of ruby.

As a warning, it may be said that this useful test broke down in the case of an exceptionally chrome-rich red spinel we encountered in 1964. The refractive index of this remarkable stone was accurately measured at 1.7439 – a fairly typical pyrope value. Since it was mounted in a three-stone ring, its density, unfortunately, could not be measured. So chrome rich was this specimen that it showed no fluorescence even under crossed filters, and in transmitted light only the red end of the spectrum was visible, and framed in this "window" were numerous clear-cut lines, measured as 7030, 6940, 6820, 6730, 6620, 6550, 6480 and 6410 Å. These tallied with previous measurements and made the identification as spinel quite definite.

And as yet another warning, we were shown a red garnet not long ago by Mr. R.K. Mitchell that incredibly showed a distinct red fluorescence under crossed filters. It had a density of 3.70 and a refractive index of 1.730. It showed faint almandine bands and a hint of the spessartite band at 4340 Å.

Another green jadelike material in which chromium is responsible in part for the color is an attractive rock from Pakistan, which consists of an intimate mixture of what is now known as hydrogrossular, and massive idocrase. The two minerals are chemically and structurally very similar, the cube-edge spacing of grossular being 11.85 Å, whereas the corresponding c-axis spacing of idocrase is 11.79 Å. The mixture ranges from nearly pure grossular to nearly pure idocrase.

In the Pakistan material, showing mottled bright greens closely resembling Burma jade, in the grossular the coloring was chromium, and showed itself as a rather broad band in the orange centered at 6300 Å with a sharp edge on the green side. The green in idocrase is caused mainly by iron, and the strong and well-defined idocrase band at 4610 Å gives a clue by its strength as to how high a proportion of this mineral is present. Where idocrase is predominant, a weaker band at 5300 Å in the green can be detected, and the chromium band mentioned above is no longer visible. The better known Transvaal massive hydrogrossular, with its range of greens and pinks, also reveals the presence of idocrase in varying amounts, as evidenced by the weak or stronger appearance of the 4610 Å band. There is not enough chromium present in the grossular here, however, to produce the sharp-edged absorption maximum in the orange.

Cobalt Spectra

And now a brief look at spectra caused by cobalt, chiefly because of a newcomer to the cobalt range in the form of blue synthetic quartz.

For cobalt to produce its well-known blue coloration, it needs to be surrounded by four oxygens. With the exception of one rare mineral, this does not happen in nature, in which only the CoO_6 complex is found, giving rise to a pink color.

So it has always been true to say that when the gemologist meets a blue stone that shows the well-known three-band cobalt spectrum, he is safe in assuming that he is dealing with a manmade material, usually with cobalt glass or synthetic spinel. In glass, the bands are more widely spread and the center band is the narrowest; in synthetic spinel, this central band appears to be the broadest.

In the new synthetic blue quartz (which emanates from Russia), the bands resemble those in cobalt glass very closely in position and relative width. The center band is markedly the narrowest, and the measurements for the centers of all three were found to be 6450, 5850 and 5400 Å – figures that might apply equally to a sample of glass. It thus behooves the gemologist to check his "cobalt-glass" specimens on the refractometer or between crossed polars.

All cobalt-blue materials absorb strongly in the green and transmit freely in the deep red; hence, a red appearance under the Chelsea color filter is very characteristic. It should be added that stained-blue chalcedony often shows cobalt bands.

Rare-Earth Spectra

Finally, a look at some rare-earth absorption spectra. This is a vast and fascinating field that I have scarcely started to explore, but that I felt bound to enter on account of the synthetic "garnets" and "scheelites" now being made, in which the rich-line spectra of one or more rare earths are liable to appear.

It is worth emphasizing that the only rare-earth spectra to be observed in natural gemstones are those caused by neodymium and praseodymium, which in nature are always found together, with neodymium as the dominant partner. These two elements are conveniently known by the collective name of didymium. The sharp-line spectrum of some green andalusites from Brazil was formerly ascribed to some unidentified rare earth but, surprisingly, is caused by manganese. When used individually in glass or a synthetic crystal, neodymium induces a pink color, and its strongest absorption lines are at 5850, 5670 and 5270 Å. Praseodymium gives a yellow-green color, and its strongest absorption lines are in the blue and violet at 4890, 4750, 4520 and 4490 Å. *Where absorption lines caused by any of the other rare earths are present, or where either neodymium or praseodymium lines are seen on their own, this can be taken as proof that the material is manmade.*

The presence of groups of didymium lines in the yellow and green regions is a well-known feature of yellow apatite, and lines in the yellow can often be seen faintly in several other gemstones (scheelite, calcite, idocrase, sphene, danburite, fluorspar) in which calcium is a major constituent. This close association of rare-earth elements with the divalent calcium is rather odd, since they are in the trivalent state.

Measurements made of the strongest absorption line (caused by Nd) in all these minerals give the same wavelength (5850 Å) within the limits of experimental error. This lack of sensitivity to environment is a general feature of rare-earth ions, where the transitions producing absorption and fluorescence effects take place in an inner electronic shell. The definitions of the lines, however, is markedly less sharp in a glass or substance of low refractive index than in crystal media of high index, such as scheelite or "YAG."

Since the proportions of Nd to Pr in natural didymium might be presumed to be different in nature from those used in artificial mixtures, it was hoped that careful comparison of the strengths of Nd and Pr lines in the spectrum of natural and synthetic scheelites might yield significant results. Thus far, no success has been achieved in this ambitious project and the microscope remains the best means of distinction. But at least it can be said that a scheelite showing either *no* didymium lines or a very *strong* didymium spectrum should be regarded with grave suspicion.

As an indication of the difficulties involved, it may be noted that J. Newton Friend attempted to assess the relative concentration of the elements Nd and Pr in solutions of their nitrates. By measuring the strengths of Nd absorption lines at 5216, 5203, 5120 and 5085 Å, he achieved fairly good results for this element in solutions containing not more than 50% Pr. But when attempting to assess the quantity of Pr present by measuring the strength of a line at 5890 Å, he found the accuracy of his results was vitiated by the presence of even a low concentration of Nd.

The fact that the main didymium absorption bands are in the yellow, where visual acuity is at its height, caused Sir William Crookes to suggest the use of lenses of didymium glass for antiglare spectacles. Students who wear such glasses have found themselves haunted by a persistent band in the yellow, whatever the spectrum they examined.

In addition to their ability to provide a rich absorption spectrum of fine lines, the rare earths also give rise to bright-line emission spectra when suitably stimulated, which adds an exciting new dimension to the powers of the spectroscope in identifying the nature of any rare-earth elements present. Under strong copper-sulphate light, for instance, three strong bright lines at 6500, 6200 and 5580 Å are emitted by a natural scheelite. These are caused by praseodymium: synthetic scheelite doped with neodymium alone shows no bright lines under these conditions.

As I have already stated, the field of rare-earth spectroscopy is a vast one. The gemologist entering into it may find himself lost on a path leading nowhere, but at least he will have seen some lovely things during the journey.

THE FACTS ABOUT DIAMOND IMITATIONS

(This was written originally by the Gemological Institute of America for the Jewelry Industry Council and Retail Jewelers of America, Inc. The proliferation of recent announcements of "new" substitutes required an update.)

Like the ancient alchemists who dreamed of making gold, many men have tried to duplicate the miracle of Natures' creation – cuttable diamond – but without success.

Undoubtedly, most jewelers are aware of the many kinds of diamond imitations now available. This article is published to summarize the differences among them, as well as the differences between imitations and diamonds.

Since World War II, the trade has witnessed the development of various new stones with diamond pretensions.

In 1948, synthetic rutile was made during the course of research aiming to improve whiteners for paint. It is a single-crystal form of titanium oxide, a common material in nature, but unknown as a colorless gem material. It has a fuzzy brilliance (caused by its very high birefringence), quite unlike the sharp-edged sparkle of diamond, and always has a yellowish-white tinge. With its enormous dispersion and refractive index, it was natural to give it consideration as a diamond substitute. It has been offered to the public under a great variety of names.

In 1953, another titanium compound, strontium titanate, was introduced. This substance, unknown in nature, had the advantage of being more nearly colorless, singly refractive, and of a much more believable dispersion. Almost immediately, it superceded synthetic rutile, and has been offered to the public under various trade names. This newer material, like synthetic rutile, suffers from a lack of hardness and does not take a fine polish. In addition, it is so difficult to work that many of the stones are not cut with full diamond faceting, although most advertising would have one believe they are. With four times the dispersion of diamond, strontium titanate displays so much fire that it is easily distinguishable from a diamond.

Both titanium compounds, besides being soft, are brittle. It is rare to see a cut stone without evidence of shock damage – one of the factors that mitigated against the acceptance of colorless zircons as diamond substitutes. Various attempts to improve the wearability of both these synthetic stones have been made. "Sapphirized rutile" supposedly had a thin coating of sapphire over the stone, but it was not effective. Doublets of either synthetic spinel or sapphire crowns over a pavilion of synthetic rutile and, more recently, of strontium titanate have been introduced. This offers a more wear-resistant crown and some reduction of the fire, but most manufacturers have had difficulty creating a transparent and lasting bond between parts.

Synthetic colorless sapphire and synthetic colorless spinel have also made their appearances as diamond substitutes, but their lack of fire and brilliance gave them only superficial resemblance to diamond. Other materials, although lacking in brilliance and fire and that might confuse the layman, include colorless beryl, quartz, topaz, glass and various foilbacks, such as rhinestone. Immersion in water will cause spinel to lose brilliance, whereas diamond will remain bright.

Recently, a new substance was developed known as synthetic yttrium-aluminum garnet (YAG), but it has a relatively low refractive index and does not appear as brilliant from all angles, even with the most accurate cutting and polishing possible. This material, although somewhat brittle, is harder than any other substitute except synthetic sapphire. When immersed in mineral oil, YAG becomes transparent, whereas a diamond still shows its characteristic brilliance, although somewhat diminished. As with other diamond substitutes, it usually does not have as fine a polish as a diamond, nor is it usually faceted with the precision that gives diamond its special "twinkle."

Although any colorless material may be regarded as a possible diamond substitute, there are many important gemological differences between diamond imitations and diamond:

A. Hardness.
Even synthetic sapphire, the hardest substitute, is very much softer than diamond. Strontium titanate, the material most used as a substitute, is only five in hardness, which means it can be scratched by ordinary kitchen cleanser. Thus, the wearability of most diamond imitations is limited.

B. Cutting.
Because of their relative softness and the economic factors involved, diamond substitutes are not cut and polished with the fine precision of a diamond.

C. Fire & Brilliance.
Although the titanium compounds have a higher dispersion factor than diamond, which makes them instantly recognizable as imitations, they can lose their original

luster after a short period of wear.

D. Specific Gravity.
Because of the difference in specific gravity among the most popular substitutes of diamond, the advertised prices per carat of the imitations can be misleading to anyone contemplating an imitation to match a specific diamond. For instance, if a customer owns a 3.50-carat diamond and wishes a comparable size strontium titanate, she will have to purchase one weighing in excess of five carats.

The following are some of the hundreds of trade names that have been used for diamond substitutes:

Synthetic Rutile
Astryl
Brilliante
Diamothyst
Gava Gem
Jarra Gem
Johannes Gem
Kenya Gem
Kima Gem
Kimberlite Gem
Lusterite
Miridis
Rainbow Diamond
Rainbow Gem
Rainbow Magic Diamond
Rutile
Sapphirized Titania
Star-Tania
Tania-59
Tirum Gem
Titangem
Titania
Titania Brilliante
Titania Midnight Stone
Titanium
Titanium Rutile
Titanstone
Zaba Gem

Synthetic Sapphire
Diamondite
Walderite
Crown Jewels

Strontium Titanate
Bal de Feu
Diagem
Diamontina
Dynagem
Fabulite
Kenneth Lane Jewel
Lustigem
Marvelite
Rossini Jewel
Sorella
Pauline Trigere
Wellington
Zenithite
Jewelite

YAG
Diamanite
Diamonair
Diamonique
Diamonte
Di'Yag
Geminair
Linde Simulated Diamond
Triamond

Synthetic Spinel
Alumag
Magalux
Strongite

Doublet
Laser Gem (synthetic sapphire top & strontium titanate base)
Carnegiegem (synthetic spinel top & strontium titanate base)

COMPARATIVE CHARACTERISTICS OF DIAMOND SUBSTITUTES

Substitute	R.I.	S.G.	Dispersion	Birefringence	Optic Char.	Hardness	Characteristics Sometimes Present & Visible Under Low Magnification
Synthetic Rutile	2.62-2.90	4.25	330	.287	U+	6½-7	Yellowish body color, fuzziness from extreme doubling, gaudiness from extremely high dispersion. Polishing scratches, rounded and possibly abraded facet junctions. Higher magnification may reveal minute gas bubbles.
Strontium Titanate	**2.409**	**5.13**	**.190**	**None**	**I**	5-6	High dispersion, no doubling but polishing scratches, rounded and possibly abraded facet junctions. Higher magnification may reveal minute gas bubbles.
Zircon (High)	**1.92-1.98**	**4.70**	**.038**	**.059**	U+	7½	May have natural inclusions. Noticeable doubling of facet junctions which may also be rounded and/or abraded.
Sapphire	1.76-1.77	**4.00**	**.018**	**.008**	U-	9	May have fingerprint or other natural inclusions. Weak doubling, very little dispersion.
Synthetic Sapphire	1.76-1.77	4.00	.018	**.008**	U-	9	Same doubling and dispersion as seen in natural sapphire. Higher magnification may reveal minute gas bubbles. May show polishing scratches.
Synthetic Spinel	1.73	3.65	.020	**None**	I	8	No doubling, very little dispersion. Higher magnification may reveal minute gas bubbles which may be stringy or slightly angular in appearance as well as spherical. May show polishing scratches.
YAG	1.833	4.65	.028	None	I	8¼	No doubling. Moderate dispersion. May show polishing scratches. May show minute gas bubbles under higher magnification.
DIAMOND							
	2.417	3.53	.044	None	I	10	No doubling, no polishing scratches, facet edges not rounded, high dispersion. May show cleavage, naturals at girdle and a waxy, smooth girdle surface.

Developments and Highlights at GIA's Lab in New York

by

ROBERT CROWNINGSHIELD

Stained-Black Opal

We were recently informed that in Australia the term *black opal* is reserved for nonwhite opal, but only if it comes from the Lightning Ridge area. Here, the material may or may not have black or gray common opal on the back, but never ironstone or sandstone matrix.

We had the occasion to examine what we would surely have considered black opals on matrix. Close observation, however, indicated that the matrix was stained-black ironstone. The stones were submitted to determine if they were doublets and later to determine if the stain affected the appearance in any manner. *Figure 1* illustrates the doublet effect, and the arrow points to some of the black stain lying in polish lines. The Laboratory determined, and it was later confirmed, that the treatment of the matrix was for uniformity of appearance of the lot and it did not penetrate the matrix zone; hence, it did not affect the appearance of the opal.

Figure 2 shows the backs of two stones; on the left, the stone is as submitted and on the right, as it appears after removing approximately .10 mm., which exposed the original brown ironstone color. *Figure 3* shows the complete lot of stones and the uniform black-matrix backs.

Wisps in Synthetic Alexandritelike Sapphire

Recently, we were surprised to see irregular gray wisps in synthetic alexandritelike sapphire (*Figure 4*). We determined that they were visible manifestations of a strain pattern seen in the polariscope.

"Synthetic Jade"

For a number of years, a jadelike imitation has been offered in Hong Kong and Japan under various names such as "synthetic jade," "Iimori stone," "meta jade," etc. One distributor offers the material in 8 trans-

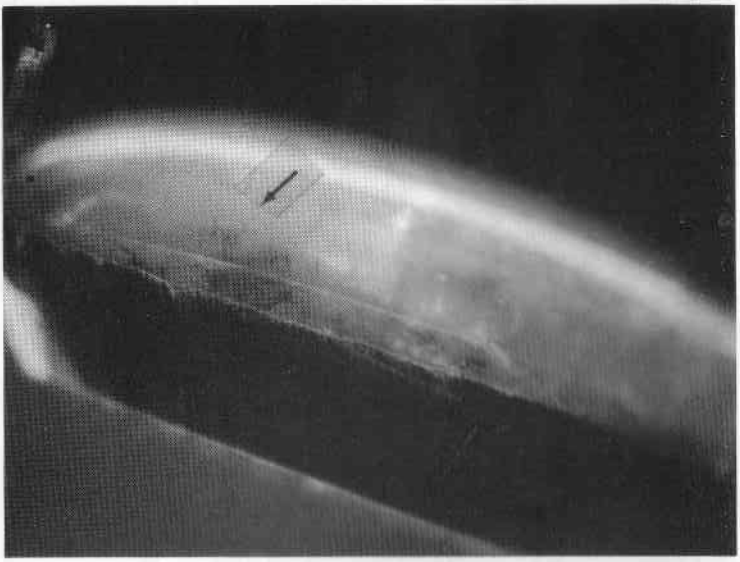


Figure 1

lucent shades of green under the names Burmese A, B and C, Australian A and B and African A and B. It is claimed that the raw materials used are white jade (jadeite or nephrite?) and quartz. The product shows gas bubbles, and the low refractive index of 1.53 to 1.55 and a specific gravity of 2.65 are well within the range for glass. Under the microscope an unusual pattern may be seen *(Figure 5)*; it indicates a possible devitrification.

Figure 2

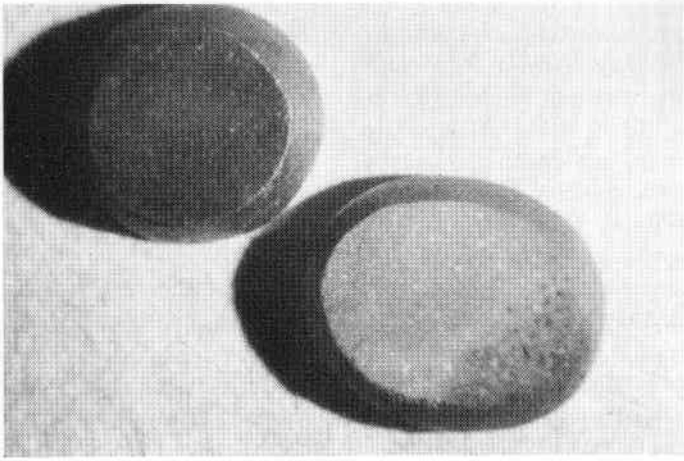


Figure 3

Figure 4

Thin specimens in the polariscope show a diminished doubly-refractive-aggregate effect. Dr. Iimori makes one type that is devitrified to the extent that radiating fibers cause a cat's-eye effect when the stone is cabochon cut. These have been called "synthetic cat's-eyes."

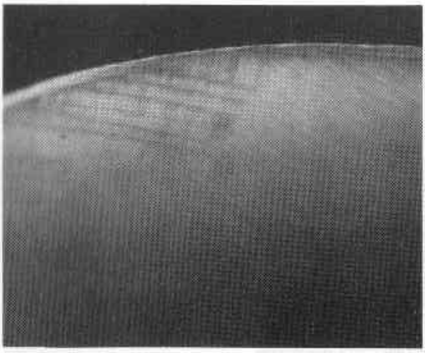


Figure 5

North Carolina Emerald

Figure 6 illustrates one of the last stones Jerry Call cut before leaving the Institute for Brazil. It is a 13.14-carat North Carolina emerald with a splendid color reminiscent of a fine Muzo stone. It was cut from a crystal of approximately 60 carats found early this year on property owned by American Gems, Inc., of Hiddenite, North Carolina (*Figure 7)*. We are indebted to Mr. Bill Baltzley of that company for allowing us to examine the crystal and the emerald cut from it. It showed

Figure 6

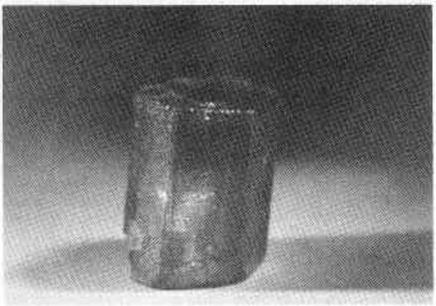


Figure 7

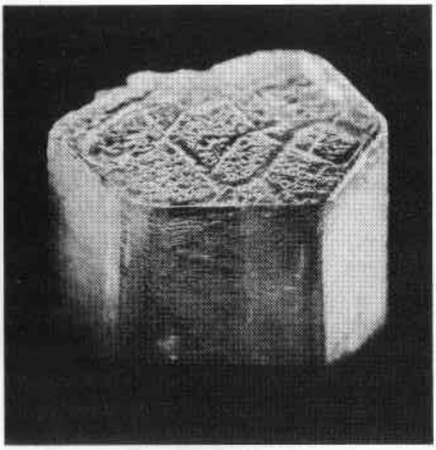


Figure 8

unusual termination etching (*Figure 8*) and was somewhat typical of emeralds from the locality, in that the central core was nearly colorless with a concentration of chrome in the outer surfaces. However, the crystal was unusual in the richness of color at the termination end, which enabled such a fine stone to be cut. *Figure 9* illustrates the core effect of another North Carolina crystal examined at the same time.

Although emeralds were discovered in the Hiddenite area as early as 1875 and the properties have been worked sporadically since, the 13.14-carat stone described here may well be the largest and best yet cut. An excellent article on the history of North Carolina emerald mining may be read in the April, 1970, issue of *The Lapidary Journal.*

The properties recorded for the cut stone were somewhat different from those of most Colombian emeralds. The refractive index was 1.58-1.588, the specific gravity 2.73 and a weak red was visible under the color filter.

Under magnification, nothing could be seen that could be termed typical, nor was anything seen such as three-phase inclusions, mica, etc., that would be confused with stones from other sources.

American Gems, Inc., has opened much of their property in and near Hiddenite to prospecting by the public from March through December. It is of interest to note in that regard that all three of the major precious minerals – diamond, emerald (beryl) and corundum – may now be searched for by the interested public, with the latter two areas in North Carolina.

Acknowledgements

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

To **Joe Rothstein**, Graduate, for several large cabochons, among which were two flat oval fuchsites. Although the material is quite soft (between 3 and 4 Mohs scale), it takes an excellent polish. The refractive index is approximately 1.60 and, of course, it shows a doubly-refractive-aggregate reaction in the polariscope. The stones appeared red under the color filter, and a typical chrome absorption spectrum could be mistaken for natural-color jadeite, although the iron line at approximately 4300 Å is missing.

To **Mr. Jan Naftule**, Nafco Gems, Ltd., for 12 of the small colorless to near-colorless grossularite garnets mentioned in the last Lab column. These are larger than the ones we mentioned, and there are two that are approximately J on the GIA Diamond Color Scale. The stones have a refractive index that approximates 1.735 and a specific gravity of 3.50. Under long-wave ultraviolet they appeared strong yellow, and medium orange under short-wave ultraviolet. X-ray fluorescence caused them to fluoresce a strong yellow-orange.

Figure 9

To **Lazare Kaplan & Sons**, diamond cutters of New York City, for a beautifully made .71-carat round diamond with an inclusion of intense red garnet (*Figure 10*).

To **Ed Cambere**, student, Trifari, Inc., for three cut yttrium-aluminum-oxide stones from Raytheon, one of the three principal American manufacturers of the material, now almost universally referred to as YAG.

To **Aldo del Noce**, student, for a large selection of imitation stones and cut "marcasites" (pyrite), all of which will prove helpful in teaching.

To **Ernestina Singer**, student, for a selection of natural and synthetic stones, all of which will be used to advantage in courses and classes.

To **Jim Taylor**, residence-class student, for his thoughtful donation of a polished half nodule and a polished slice of attractively veined howlite for our gem-display case.

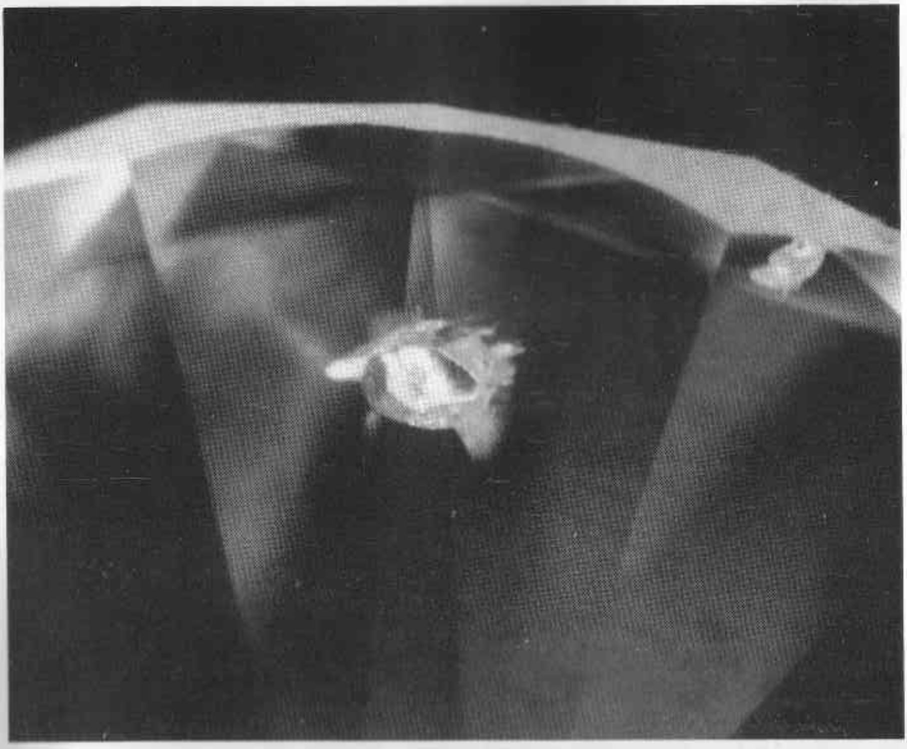


Figure 10

To **Sol Shalevetz**, of M & S Wholesale Jewelers, Los Angeles, California for 7 small diamonds, a quartz crystal with stibnite inclusions, and a bixbyite on topaz from Thomas Mt., Utah. These are welcome gifts.

To **George Harvey**, Gemologist, Denver, Colorado, for an attractive, well-shaped feldspar crystal for our display case.

To **Dell Sheftall**, Registered Jeweler of Sheftall's Inc., Austin, Texas, for several interesting opals mined in Brazil to be used in our gem identification course.

To **Walter E. Johansen**, student, Walter E. Johansen Company, Morgan Hill, California, for a selection of several small preforms of synthetic red spinel, to be used in our gem identification course.

To **Bob Flower**, student and jeweler of Junction City, Kansas, for a small, pear-shaped, rose-cut diamond.

THE ART OF DISPLAY

by

MariAnn Coutchie

Creative Display Instructor, GIA

Store image is an integral part of store success. You can enhance your store image and set your boundaries of accomplishment with the art of display. The image of Farrar Jewelers, Inc., Redlands, California, was changed in May, 1970 and its countenance became one of impressive taste. Along with the manifestation of a new image came the addition of a new clientele. Mr. Clifford Farrar knew the market he wished to reach was aware and used to shopping in more sophisticated surroundings. He realized that lack of exciting displays and poor lighting was only expressing absence of pride in his inventory. Mrs. Farrar attended a Creative Display Class and became an excellent student in executing all the dynamic aspects of visual selling. The Farrars planned with a qualified architect and knew the image Farrar Jewelers, Inc. wished to project; the result is an impressive story of accomplishment.

There has never been an era when people were so color-conscious. In the early 1950's, an extensive assortment of permanent dyes were developed. This gave the clothing industry the green light to use any combination of tints, shades and tones of the color wheel. Today, more than ever, color is the keynote of fashion. Trained display personnel know what colored stones to display as the accent for the seasons fashionable costumes. They know how quantitatively, to distribute color in the window. Use the color suggestions they offer, and you will find the preference of your merchandise will increase.

To decide which colors to use in the window you should begin with the merchandise itself, because it is the principal feature. You are always safe in using the same color as the gemstone, in a less intense tint or shade, or using a complementary color. An example would be rubies displayed on a tint of green (green + white), jade on a tint of purple (purple + white), or sapphires on a tint of yellow. The suggested colors are the complements of the gemstones. Complementaries placed side by side seem to intensify one another and they are psychologically and optically balanced, one warm and one cool color. Display with color – it will add life and beauty to the gems.

Your gems and jewelry will lack sparkle unless you use the correct type and amount of light. The intensity, or the total wattage, of the lighting system in the window should be greater than the outside light; otherwise, the glass will act as a mirror. This will make it very difficult to look into the window to see the merchandise. If necessary to defeat the mirroring effect, a lighting system on a track is the most flexible. It will enable you to move the light source to accommodate each change in the window and to switch from general lighting to spot lighting.

Windows are part of the educational process. They plant the seeds for the viewer to become used to new designs and textures in jewelry. The trained displayman plans with what and how he wishes to educate the public at least a month in advance. Each month usually has some event that can be used as a theme. The theme should be changed every other week; therefore, each month you would have two to three themes from which to plan. The theme keys the selection of merchandise. It also tells you the age of the market at which you are aiming, to help you plan the color scheme and composition.

New Home-Study Course

1971 will see a new addition to the GIA home-study courses, the *Creative Display Course.* This new course contains twenty-two lessons and a final project. Upon satisfactory completion of the course, the student is awarded a Creative Jewelry Display certificate.

The home-study course and the one-week residence class offer the opportunity to develop skills in all phases of display. Lighting, color, composition and themes for your windows will become the tools with which to build more sales.

Put the direction of your store image in the hands of a trained displayman. He is the best qualified in merchandise presentation. His selection of colors, his use of lights, and the themes with which he introduces the jewelry to the viewer will start you experiencing the success of your new image.

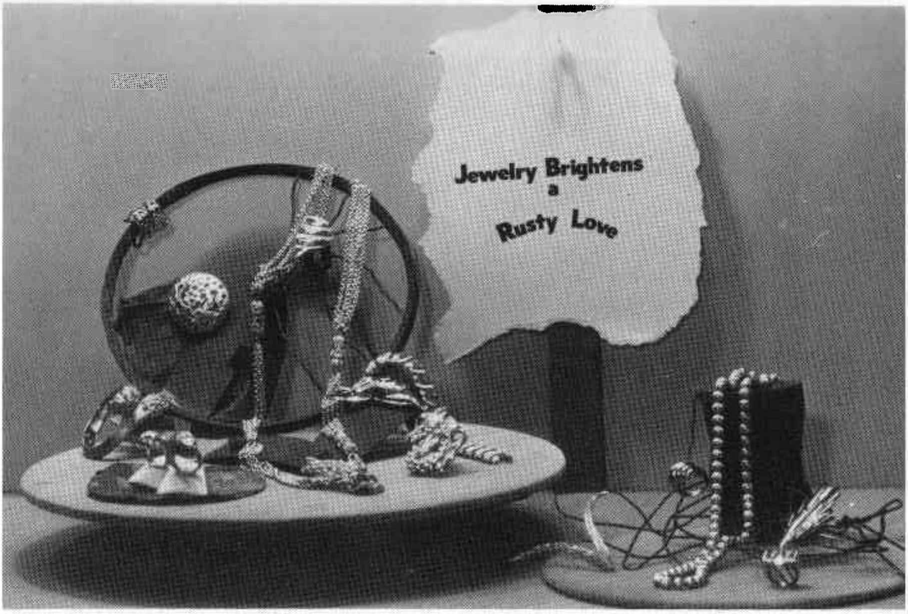
MERCHANDISE Woman's yellow-gold and pearl jewelry.

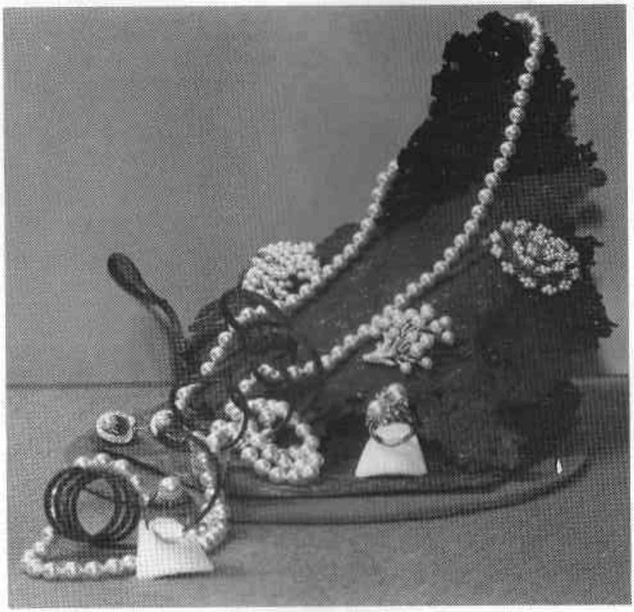
COLOR SCHEME Rust and blue.

COPY Jewelry Brightens a Rusty Love.

ACCESSORIES Rusted tins and metal. Covered pads of blue velveteen. Flooring: light rust-colored felt.

The dramatic contrast of rusted metal and gold jewelry demands attention. An old spokeless wheel propped against a crushed can lends elevation for displaying the neck chain, pins and earrings. Rusted-out cans and sheet metal bent into an interesting form all lend themselves to be functional displayers. The written message, or reader, is transferred onto watercolor paper, and the edges are torn to appear as old as the tins.





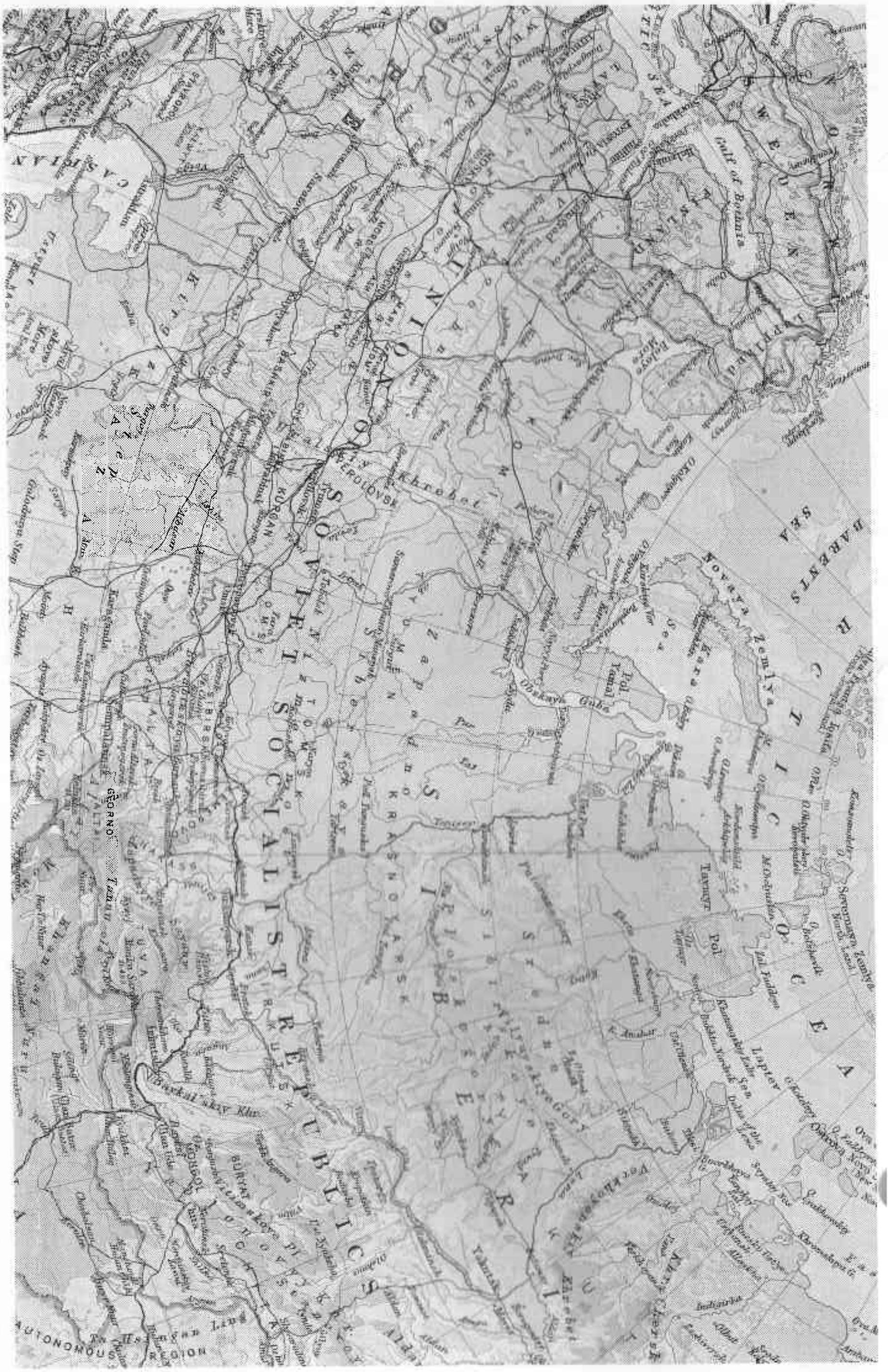
THE RUSSIAN DIAMOND INDUSTRY

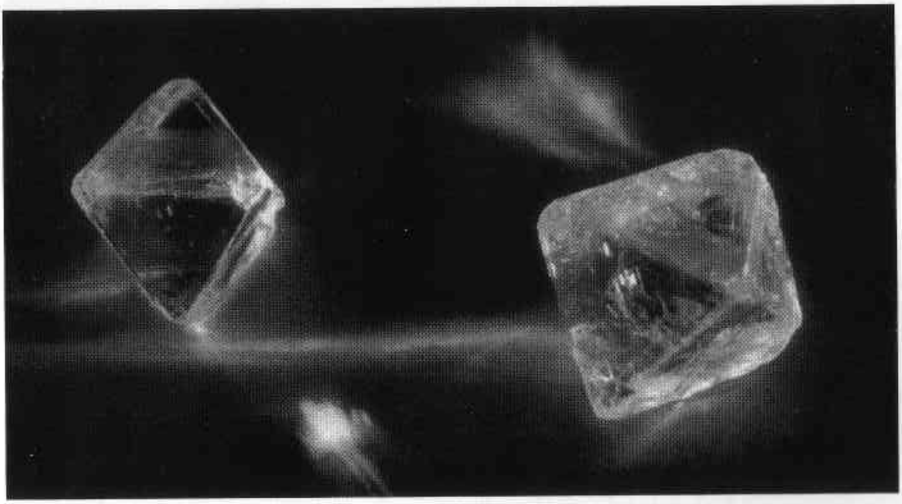
by Richard T. Liddicoat, Jr.

It was not long after the cessation of hostilities at the close of World War II that the United States declared an embargo on shipments of strategic materials to the Soviet Union. Blessed with the largest land mass under one flag, much of it largely unexplored geologically, the Russians embarked on an exploration program of an intensity probably unmatched in history. From its western border with the Eastern European Bloc, to China and the Pacific on the east, from its southern borders along the Black Sea, and the Himalayas and China to the Arctic Ocean on the north, the Soviets began their intensive search for mineral wealth.

Of the strategic materials they sought, diamonds were among the most important – their value to industry was, and is, unsurpassed. Naturally, the West embargoed diamond exports to the Soviet Bloc, because of their paramount importance. Therefore, high on the USSR's priority list was the need for finding an adequate supply of diamonds.

Their activity since World War II has been phenomenal. Their scientific reasoning must have been entirely adequate, for their results have been tremendous. In today's industrial era, it is quite obvious that industrial diamonds are vital to machining scores of products and for many other purposes. When the United States embargoed industrial diamonds and the other Western countries cooperated, the Soviet Union was forced to take dramatic action to obtain this vital mineral. They embarked on a crash program to find diamonds within their boundaries. This proved exceedingly difficult, because of climatic conditions in Siberia. This is just one of many strategic materials being sought. Their results are almost unbelievable. Our Bureau of Mines and Geological Survey together employ fewer than 25,000 persons, perhaps less than half of that. The Soviet Ministry of Geology employs 500,000. But numbers are not necessarily the main factor – Russian geologists are very well trained and capable. When vast numbers of


UNION OF SOVIET SOCIALIST REPUBLICS
ARCTIC OCEAN
BARENTS SEA
Kara Sea
Novaya Zemlya
Laptev Sea
Gulf of Bothnia
CASPIAN
Sverdlovsk
Kurgan
Omsk
Novosibirsk
Krasnoyarsk
Gorno-Altai
Tuva
Buryat
Baikal'skiy Khr.
Verkhoyansk Khrebet
Yakutsk
Obskaya Guba
Pol. Yamal
Pol. Taymyr
Severnaya Zemlya
Ural'skiy Khrebet
Yenisey
Lena
Autonomous Region

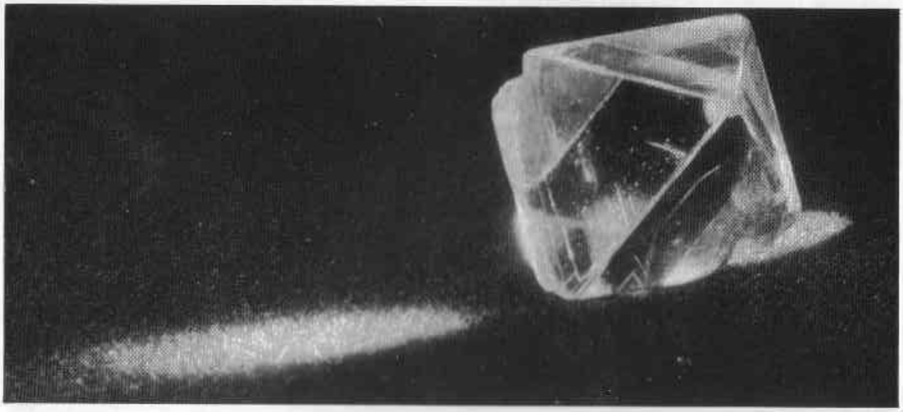


Two named diamond crystals from Mirny, Yakutsk: the 37.56-carat Toktogul *(left) and the 46.36-carat* Letny *(right). In the USSR Diamond Fund.*

competent people are mobilized, results can be highly significant.

The Russians quite naturally chose the Siberian Table, a large plateau of relatively flat sediments, as the first place to look. It has a structure very similar to that of central South Africa, in which diamond mining is important. A few diamonds were found in gravels, but the geologists decided they had probably originated in the folded mountains bordering the Table. In their efforts to locate pipes, they kept searching the gravels. The trouble with this is that diamonds are not plentiful, even near rich pipes.

Interestingly enough, the first kimberlite pipes were discovered in 1954 by a young female mineralogist named Popuguewa in the Daldyn-Alakit district, at about 67° north latitude and 115° east longitude. This is in eastern Siberia, west-northwest of the city of Yakutsk on the Lena River. First, she found gravels that contained pyrope very similar to that found in the South African kimberlites. Since pyrope is much more plentiful than diamonds, she decided to follow the garnet rather than the diamonds in her efforts to locate pipes. By looking toward increasing concentrations of pyrope in the gravels, she found the first kimberlite pipe, called *Zarnitsa,* on the Siberian Table. Less than a year later the *Mir,* or *Peace, Pipe* was discovered. It lies about 62° north latitude and 116° east longitude, on a tributary of the Vilyuy River and near the newly constructed mining town of Mirny; the Vilyuy, in turn, joins the Lena north of Yakutsk. Among the other important pipes since discovered are the *Udachnaya,* or *Chance*, and the *Aikhal,* or *Glory Pipes,* both in the Daldyn-Alakit district, appreciably north of the Artic Circle. The *Aikhal* was discovered in the Valley of the Sokholkh River; it is said to be much richer than the *Mir Pipe* but extremely difficult to reach. More recently, other deposits have been discovered in Si-



A named diamond crystal from the Mir Pipe, *Yakutsk: the 38.72-carat* Zlata Praha. *In the USSR Diamond Fund. (Note: The 166-carat* Stalingrad Diamond *and other large stones continue to be found near Mirny and elsewhere.)*

beria. The latest, which has produced diamonds from alluvial gravels only, is said to yield a preponderance of gemstones of exceptionally fine color.

Working and living conditons in this part of Siberia are unbelievably bad. It is in the area of permafrost, and winter temperatures are constantly well below zero, often 40 to 50° F. In the summer, the top surface becomes a quagmire, so it is almost impossible to move supplies or get about. When these pipes were discovered and their richness shown to be sufficient to warrant exploitation, the Russians were anxious to mine them as soon as possible; however, conditions were execrable. Consideration was given to

The world-famous 199.80-carat Orloff Diamond. *In the USSR Diamond Fund at the Kremlin.*

construct completely roofed towns. Prospecting crews work under extremely difficult conditions.

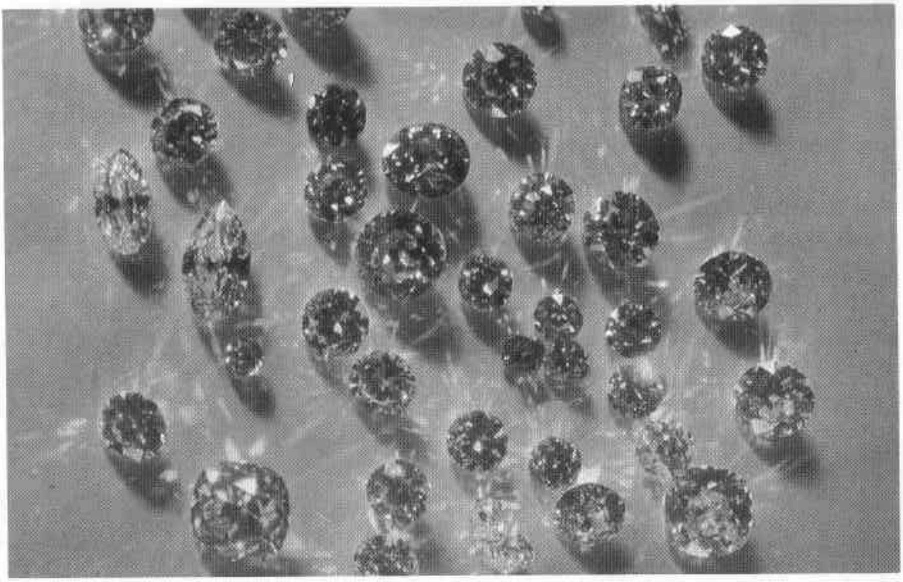
Good placer deposits have been found in the Ukraine (i.e., southern European Russia) near Perm, which is west of Sverdlovsk and slightly west of the Ural Mountains, as well as others near the Black Sea and the Sea of Azov; in Kazakhistan, the huge southern republic in central Siberia; and apparently the prospects in the northern part of European Russia, north of Moscow, are considered to be highly favorable – apparently on the basis of several discoveries.

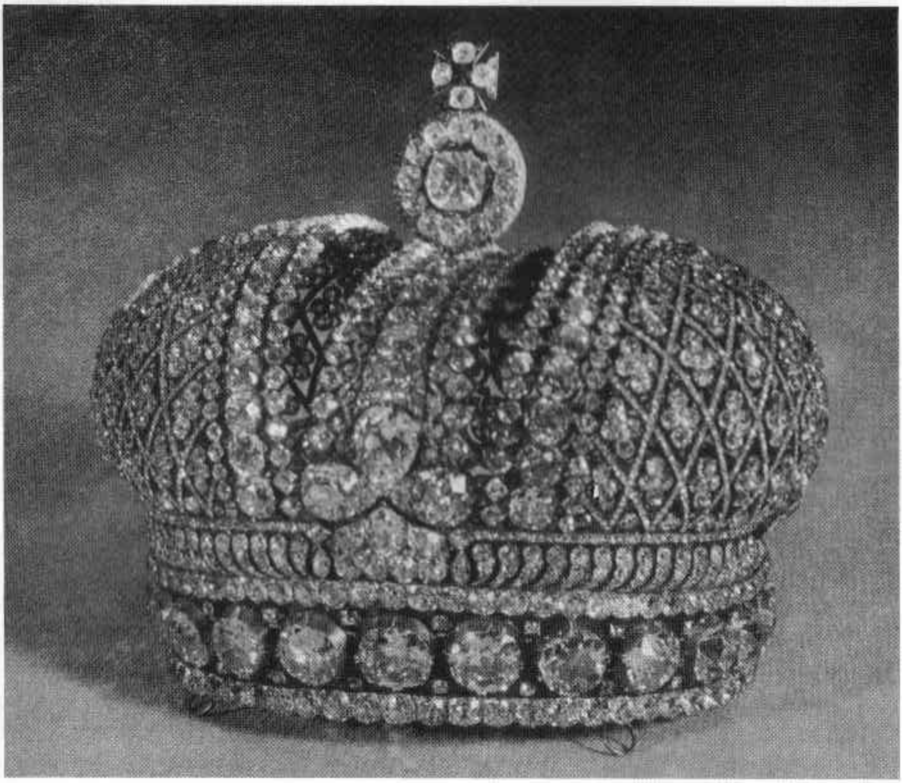
In 1969, there were six recovery plants in operation, and at least two more under construction. With the recently announced finds, far apart geographically, there will undoubtedly be many more. A 14-story plant was completed at *Mir* in 1967, and a larger one is being built at Aikhal.

Despite the discovery of many kimberlite deposits and some dikes, it is evident that only a few are being worked – probably, only the richest – because of the great difficulty of mining operations in the permafrost area. However, with all the new discoveries, it would be interesting to learn how many of the newer deposits will be worthy of exploitation. Particularly, those in the Ukraine and Kazakh, where the climate is considerably more friendly, should be emminently workable, if they are sufficiently rich to make them commercially feasible.

Of course, commercial feasibility in the Soviet Union bears little resemblance to that in a free-enterprise economy. With no stockholders to account to, costs are often disregarded, particularly if the product can be sold for hard currency or is important strategically to the Soviet Union. With

85.22 carats of Soviet-made brilliant-cut diamonds. In the USSR Diamond Fund.

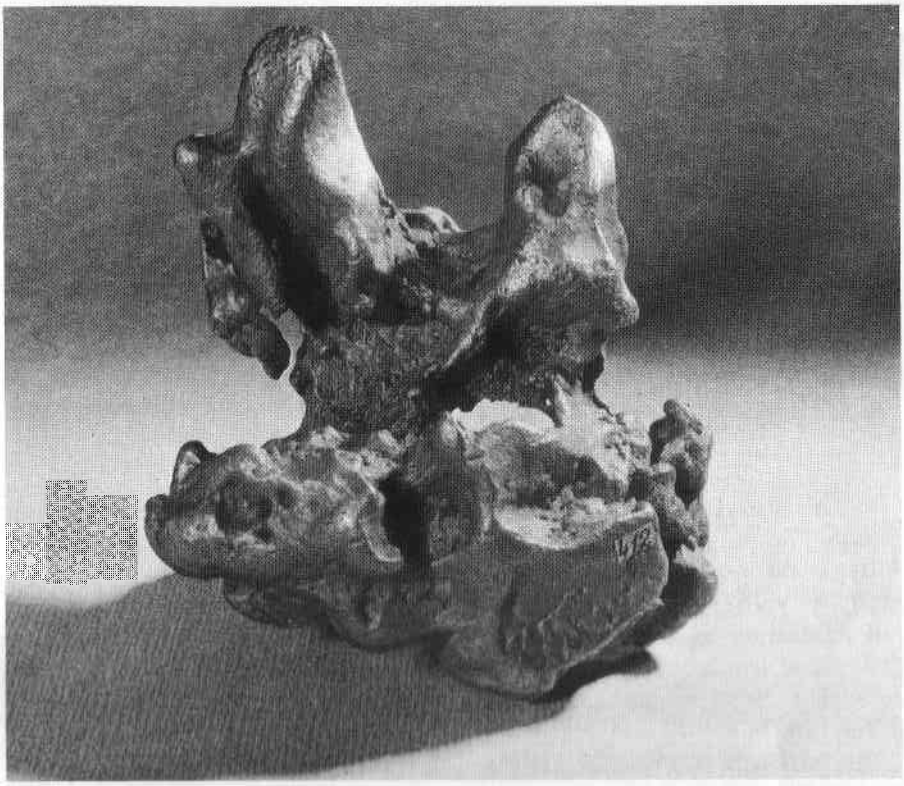




Crown of the Empress. In the USSR Diamond Fund.

the shortage of industrial diamonds available to their industry, costs of early finds were considered unimportant. Today, with so many discoveries, the USSR should be in a position to choose only the richer deposits for exploitation. Unfortunately, yields per ton of rock mined or per cubic meter washed are closely guarded secrets.

In the Diamond Treasury Room at the Kremlin there are rows of illuminated color transparencies, mostly of pipes and recovery plants. One photograph is a partial view of a room containing diamond laps; those visible in the picture number more than 250. This is only one of three plants we know about; there may be more. Obviously, this is a big and growing operation. The Russians still market through the Diamond Trading Co., Ltd., some of the rough they do not cut or use for industrial purposes. They are marketing their cut-and-polished goods through certain importers in the West. From what we can ascertain, they are endeavoring to cut the diamonds reasonably close to ideal proportions, and the product seems to be improving. One of the surprising things is that much of the melee is exceptionally well cut, whereas the larger stones are not quite as well cut, relative to Western standards. One would expect the greatest care to be accorded the larger sizes.



A 932.30-gram gold nugget, called the Rabbit's Ears Nugget, *from the Ural Mountains. In the USSR Diamond Fund.*

The latest Russian claim is that they are the second largest producer of diamonds by weight in the world. This would put them between the Republic of the Congo (Kinshasa), where most of the production is industrial, and South Africa; the latter is now producing in excess of seven million carats a year. One Soviet official stated that the entire population of the West will be "put in the shade" by 1972. They claim that 54,000 persons are employed. South Africa and South-West Africa, combined, employed only 16,000 in 1967. In his summary of world production for 1969 in the *Jewelers' Circular-Keystone* (December, 1970), Dr. George Switzer estimated 10,000,000 carats as the Soviet output. We believe it to be at least that large.

Obviously, the Soviet Union is becoming an increasingly important factor in the industry; they have been important for years in gold and platinum production. In the metals, they have been content to take advantage of Western prices. For the next several years, at least, there is no reason to believe that their actions in the diamond area will be different. At a time of an increasing shortage of gem-quality diamonds, it is possible that the Russian supply will be very significant to jewelers during the next several decades.

Gemological Digests

A DIAMOND MINE REOPENS – ANOTHER CLOSES

Koffyfontein diamond mine, thought to be the oldest in South Africa, will produce again – after nearly 40 years. It is expected to be in full production by September, 1971. The mine, which was probably discovered in 1870, stopped production in July, 1931.

Koffyfontein is situated near the Riet River, about 60 miles south of Kimberley. It is a part of a series of 16 pipes in the area, and similar in shape to the Bultfontein Mine at Kimberley. It was worked to a depth of 330 feet before being closed. Early in 1969, initial survey work was carried out to assess the prospects of reopening the mine.

Workmen are building three townships – for European, African and Negro workers – and draining the open-pit mine. They are stripping waste from the Kimberlite pipe to make mining easier.

"We can expect Koffyfontein to have a life expectancy of approximately 10 years as an open-pit mine," said Mr. R.A. McCallum, acting manager. "By that time, we'll be mining 960 feet below the surface, which is about the economic limit for this kind of mining."

During this phase, underground sampling will be carried out to test the potential of the mine as an underground producer.

Koffyfontein is typical of diamond mines, in that it is on a volcanic pipe wide at the top and narrowing with depth. Today, the mine is similar to the Big Hole of Kimberley, with a ledge running from two sides to meet in the middle. The ledge, which was used to haul rock to the surface, will be one of the first areas to be mined when operations start again.

Workmen are blasting out the sides of the hole to make it wider. A spiral road will lead down to the working area. As the mine gets deeper, the hole – 1200 feet in diameter at present – will be enlarged until the 960-foot limit is reached and the mining possibly goes underground. When that happens, the mining process – a relatively simple matter with open-pit mining – will become more complicated.

In open-pit mining, the rock is blasted with an ammonium-nitrate fuel mixture prepared on the site. The rock is then taken to the plant by truck.

In underground mining, a series of tunnels with 15-foot centers is drilled through the pipe. Then a complete slice is mined out 30 feet above the tunnels, and draw points (small tunnels) are run opposite each other from the tunnels to the mined-out slice.

The loose material from the slice runs through the draw points of the tunnels, where it is scraped through into another tunnel and loaded in trucks. The rock is crushed underground before being taken to the plant on the surface.

There are many methods of separating the diamonds from the waste rock. The method that will be used at Koffyfontein is the heavy-media separation method, which relies on the fact that diamonds have a high specific gravity. A high specific-gravity medium is made, and the rock passes through. The waste floats, whereas the diamonds sink.

Book Reviews

ANTIQUE PASTE JEWELLERY, by M.D.S. Lewis, FGA. Published by Boston Book & Art Co., Boston, Mass., 1970. 106 pages. Clothbound. Illustrated with black-and-white photographs and line drawings and eight color plates. Price: $10.95.

Mr. Lewis, an FGA who also holds the GIA Gemologist Diploma as well, is regarded by many as an authority in the field of antique paste. He has written what is probably the first profusely illustrated book dealing with all aspects of the subject.

At its best, antique paste is to be compared with the finest jewelry for sheer artistry and craftsmanship. Here, Lewis presents an authoritative and succinct account of the evolution of antique paste, its great flowering in the 18th century, and its gradual decline in the 19th century. He is careful to relate it to genuine-stone jewelry, particularly diamond-set pieces.

Two sections of special value for the collector and connoisseur are those on methods of distinguishing between paste and natural stones.

Antique Paste Jewellery will prove enlightening and absorbing reading for those with an interest in this age-old and little-written-about kind of jewelry. The book is the first volume in the Faber Collectors' Library. (Note: The name Faber refers to the London, England, publisher, Faber & Faber, Ltd.)

GEMS – THEIR SOURCES, DESCRIPTIONS & IDENTIFICATION, by Robert Webster, FGA. Published by Butterworth & Co., Ltd., London, 1970. 836 pages. Clothbound. Illustrated with numerous black-and-white photographs and line drawings and 22 color plates. Price: $45.

One of the truly fine books in the gemological spectrum is *Gems – Their Sources, Descriptions & Identification,* by Robert Webster of the London Laboratory. The book first appeared in 1962 in a two-volume edition; a new second one volume edition was published in London a short time ago. There is an increase in the number of pages from 792 to 836. The arrangement is a tremendous improvement over the first, in that one often appeared to be looking in the wrong volume for the information sought, whereas with a one-volume edition it is much easier to locate the needed page.

Robert Webster's long experience in laboratory work and his inquisitive nature led him to record religiously the experiences he encountered in all kinds of laboratory problems. When such a problem occurred, he was one who would seek every possible source of information until he could satisfy himself that he had every bit of data available to make a complete decision. This is certainly evident in both editions of his fine book.

As with any book, it is possible to find minor flaws. Although even those not interested in phosgenite or ulexite will accept their presence in the interest of all-inclusiveness, they may consider some sections rather brief. For example, there is no reference to the reason for imitating the inexpensive mineral hematite – so the figure can be pressed into it, instead of requiring the expensive labor of carving, thus furnishing the easiest clue to its detection.

On the whole, however, this is an exhaustively and satisfyingly complete book, now with considerably better color plates than in the first edition. It is without question a must for any gemological library.

In Robert Webster, gemology has a very able writer, one who is exceptionally well qualified to write a book that can be used for a text or for a thoroughgoing source of information for anyone interested in gemstones. It is a welcome addition to the gemological literature.

If a gemologist were limited to only two books, *Gems* by Webster, and *Gem-Testing* by his colleague, Basil Anderson, Director of the London Laboratory, he would be as well supplied with information as any two books in English could provide.

NEW DESIGN IN JEWELRY, by Donald J. Wilcox. Published by Van Nostrand Reinhold Co., New York City and Toronto, Canada, 1970. 120 pages. Hardbound. Illustrated with 8 pages of full color and more than 200 black-and-white photographs.

This book, conveying an explicit and exciting view of "new jewelry," exhibits precisely the modern styles that flood the jewelry market today. Its primary focus is directed toward the high degree of craftsmanship in Scandinavian jewelry, encompassing the entire spectrum of jewelry design from folk art to exciting contemporary works in plastic, steel, gold, silver and other familiar materials.

The reader is introduced to the following subjects: Elements of Design – Where do Ideas Develop?; Materials and Their Uses – What Types of Low-Cost Materials Can be Used Effectively in Formulating a Design?; Jewelry, Function and Fashion – Is an Item of Jewelry Comfortable Yet Durable, While Conforming to the Modern, Contemporary Styles of Fashion?; and, Summary: A Word to the Conservative – Can a Person be Unobjective and Close His Eyes to a New Trend in Jewelry Design? These are just some of the questions that are answered in this book, which encompasses the new look in design.

The bulk of the book consists of photographs, which are used in conjunction with the previously mentioned text. They enhance the point by expressing a quite complete view of new Scandinavian designs today.

The author is a member of the Vermont Council on the Arts, and his sculpture in wood, leather and clay has been exhibited at one-man and group shows in Vermont and elsewhere in the United States. He is currently living in Scandinavia and is working on several new projects, including a book on leather working and one on rya rug weaving.

This attractive and very informative book should prove beneficial to those wishing to delve into the fascinating world of Scandinavia's *New Design in Jewelry*.