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Fire Agates of Deer Creek

By JAMES L. SWEANEY, G.G.
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Santa Monica, California
With photographs by Michael R. Havstad, Gem Media

Mention the word "agate" and many people think of beach pebbles, rock hounds, or a child's polished marbles. Indeed, for centuries agate has been the do-it-yourself gemstone, commonly available, easily worked, and universally attractive. The earliest shamans probably carried talismans of agate in their "magic" bags, and since that time, men have used agate and other varieties of chalcedony for amulets, engraved seals, carvings, and gemstones. Notably, in recent times, Faberge often set the humble agate into objets d'art for kings and princesses. The great Lalique chose from the chalcedonies for components in his visions of l'art nouveau. Seen against this background of time and tradition, the emergence of a totally new variety of chalcedony is truly exciting.

The fire agate, discovered little more than thirty years ago, is one of a growing number of new gems of the twentieth century. Its brilliant and varied iridescent hues and unique forms are especially appealing in a world increasingly dominated by mass production. This article will examine the occurrence of the fire agates found at Deer Creek, a notable locale in southeastern Arizona. We will look at the history of the area, the current mining operations, and the mode of occurrence and formation of these stones. Basic fashioning techniques and an approach to choosing good stones will be discussed. Several particularly fine gems will be shown.

History and Location of Deer Creek

The time and location of the original discovery of fire agate is open to some question. In a search of the literature, one article seems to have been taken at face value as the first recorded discovery of fire agate. According to J.W. Baker, the discovery of fire agate took place in the fall of 1945 or spring of 1946 in southeastern California near the Arizona border at Wiley Well, also known as Coon Hollow. The account of this discovery, given in the article "Fire Agate of California," is referred to by several authors.

There is evidence, however, that this may not be the first discovery. The time of discovery of the Deer Creek fields is in some doubt. Canton (1974) states that this area has been known since about 1964. In contradiction to this, Warren Hughes, one of the old-timers at Deer Creek, refers to fire agate as being known in the late 1930's. Furthermore, one of the miners at Deer Creek stated that this area was producing agate by the late 1940's, and referred to an earlier discovery at the Day Ranch, near the Duncan and Bowie locations. Knowing the caginess of some rock hounds, it would not be too hard to imagine that whoever first stumbled onto the fire agate might have kept the discovery to themselves. It seems clear that although the discovery described by Baker stands as the earliest documented occurrence, there is reason to believe that earlier discoveries may have taken place. Whatever the original discovery, the fire agate has since been found to be indigenous to the Sonoran Desert of Arizona, California, and northern Mexico, and to the Central Basin of Mexico.

Located about forty miles west of Safford, Arizona, the Deer Creek agate beds lie high on the north slopes of the Galiuros Mountains at an elevation of about 5500 feet. The area is remote, about ten miles from the nearest settlement. Access is limited to a crude single lane dirt road which is impassable during periods of bad weather. The area is snowbound in winter months, and quite hot during the summer. The beds occupy approximately 720 acres in Section 12, T9S, R20E, and Section 7, T9S, R21E, G&S, according to Canton (1974). More recently, claims staked in the spring of 1976 on lands administered by the Bureau of Land Management have been developed into the One Track Mine. The author made a field trip to the area in the spring of 1978, and was able to examine several of the local mines. Rough material and specimens shown in this article were personally collected at the One Track Mine.

It should be emphasized that the Deer Creek agate fields are *not* open to the public. Unauthorized visitors will likely be met with suspicion or even outright hostility, since poaching has been and will continue to be a problem for the miners. Persons wishing to visit the area should get permission from the lessees.

Mining Methods

At Deer Creek, five claim groups are currently being mined by open pit methods. At several of the earlier mines, now deep pits, the miners have encountered severe drainage problems. The mines fill up, becoming ponds for much of the year. The One Track is the most active mine at present, and is represented by the lessees as one of the largest fire agate mines currently producing in the U.S.A.

The mining method is basic. The mine is on a sloping hillside, with a vertical rise of about twenty feet per one hundred feet of horizontal distance. The miners remove the topsoil with earthmoving equipment to expose the agate bearing country rock. At the bottom of the claim area, the first bench or step is begun by placing numerous drill holes, about five feet deep, along a fifteen-foot wide strip which follows the hillside for about fifty feet. A soft charge of dynamite loosens this strip, which is then carefully picked through, often by hand, to expose the small pockets and crusts of agate. The likely looking pieces are set aside, and the remaining rubble is moved onto a dump area by a backhoe tractor. In this manner, the One Track has been terraced into steps which are about fifteen or twenty feet deep and five feet high. Four such benches were originally made and in evidence when this writer visited the mine. Since then, according to the miners, these benches have been cleared and widened so that the deepest part of the mine is twenty feet below the hillside, and the face extends one hundred feet along the hill. Plans are being made to expand the mine by approximately three times the current size.

Mode or Occurrence and Formation

The Deer Creek area shows evidence of relatively recent volcanic activity. Flows of basalt and rhyolite comprise the country rock, which is an agglomerate structure, showing evidence of considerable movement and activity. The primary deposits of agate are found in the fine-grained rhyolite, in fissures, veins, and especially in cavities and pockets which range in size from one inch to two feet and more in diameter.

Secondary deposits are indicated since the topsoil is rich with agates which have weathered out of their original implacement. The alluvial areas below the primary deposits may yield good material. Agate is found at surface and throughout the overlayer of topsoil, which varies from one to eight feet in depth. The material found in this region is likely to be structurally inferior to that mined at depth, since the weathering processes act on the iron oxides within the chalcedony, causing the material to come apart along the layers. Curiously, the miners at One Track report that stones from near surface often have the best fire!

Samples collected from pockets at a depth of about two to five feet, which are typical of the agate found near surface, are shown in *Fig. 1.* Notice that the growth surfaces are iridescent. *Fig. 2* shows a closeup of a weathered agate from near surface. The effects of weathering can be seen in layers which have discolored and have begun to flake apart.

The oldest and deepest mine at Deer Creek, the Van Dusen mine, is reported to have reached a depth of about forty feet. Whether these deposits will continue deeper remains to be seen. Some of the Mexican mines are said to be producing at depths of eighty to one hundred feet.

Ore from greater depths occurs in generally larger, more solid pieces,

Figure 1.

Figure 2.

Figure 3.

Figure 4.

Figure 5.

Figure 6.

Figure 7.

Figure 8.

usually overgrown by non-iridescent layers of clear chalcedony. *Fig. 3* shows a large piece with brown iron-bearing chalcedony merging into colorless chalcedony, indicating a more continuous growth sequence.

Several of the pockets excavated at a depth of about five feet yielded very interesting specimens with quartz crystals in close proximity to or growing directly on the chalcedony. *(Figs. 4 and 5)* The presence of overgrowths of iridescent chalcedony coating quartz crystals is shown in *Fig. 6*.

Fig. 7 shows a cluster of divergent spikes of an unknown mineral which are being engulfed by a rising tide of chalcedony. In *Fig. 8*, the same cluster is seen in closeup. Note the clear chalcedony coating the thin spikes. The iridescent chalcedony to the right of the spikes shows a mammillary form, suggesting a similar growth sequence carried further along. *Fig. 9* shows another formation, again with thin spikes of an unknown mineral, and thicker tapered formations of iridescent chalcedony. These formations of iridescent spikes, known as sagenite, are quite rare and beautiful when fashioned. The curious features of overgrowth noted in these specimens indicates varied sequences of growth.

These samples and others, collected at surface and at depth, show features which indicate hydrothermal formation at low pressure and temperature. What follows is a possible scenario, based on direct observations and associated research, of the formation of these agates.

Hot waters saturated with colloidal silica and iron oxide invaded cavities and spaces in the country rock and began to cool. Chalcedony with iron oxide imparting brown color began to grow on any surface available. These solutions had to be highly saturated for chalcedony to form, and growth could have been rather rapid. As the solutions lost silica through growth, too much iron oxide remained in suspension, so periodic adjustments restabilized the solutions. When conditions were right, iron oxide precipitated onto the growth surface of the chalcedony, creating an extremely thin layer of very tiny regularly arranged crystals. Once restabilized, the solution continued the growth of chalcedony. The cycle repeated, creating regularly layered sediments of iron oxide, known as Schiller layers, within the chalcedony. These layers cause the brilliant interference colors we see as "fire." The solutions were probably replenished periodically with silica, but at some point, the source of iron ran out. The chalcedony continued to grow, but was now colorless.

Fashioning Techniques

Cutting fire agate is challenging yet rewarding. Lapidaries who have worked fire agate know it is one of the most difficult gems to cut. The secret is in understanding how the layered structure and botryoidal form influence the cutting technique. We have seen how extremely thin layers of iridescent iron oxide are deposited onto the growing surface of the chalcedony bubbles, only to be covered, in turn, by a layer of chalcedony. The cutting process is essentially a reversal of this growth pattern. After careful

Figure 9.

Figure 10.

study to determine the structure, the lapidary carefully grinds away all the excess chalcedony, leaving only a thin clear window which exposes, yet protects, the fire layer. By following the natural contours of the material, by "peeling the onion," the cutter can create a gem with fire glistening from the entire surface.

Several good articles describing methods for cutting fire agates are listed in the bibliography. Regardless of the method, the common denominator is the need to follow the natural contours, carefully grinding away excess chalcedony to expose the fire layers. What follows is a description of the basic cutting procedure used by the "One Track" group, which will be referred to as "contour cutting."

First, the rough is carefully examined in strong light, preferably sunlight, to see where the layers run and where any fire is obvious. This determines the orientation of the top of the stone.

Next, the rough is trimmed of excess matrix and overgrowth by whatever means is most efficient (usually a combination of careful sawing and rough grinding). The back of the stone is often prepared at this

Figure 11.

stage, and if not much chalcedony covers the fire layers, the outline or perimeter of the stone may be established by grinding away all material with no evidence of fire. Grinding at this stage is done with medium coarse wheels, run wet to avoid overheating.

The critical step now begins. The face of the stone is carefully contoured. The stone is hand held to the edge or corner of a 220 grit *wet* grinding wheel, and gently carved along the contours. Patience and frequent checking in good light are necessary at this stage, since the fire layer is easily ruined by overheating or over-grinding. When the fire is fully exposed, with just enough chalcedony left as a protective cover, any adjustments to the outline or back are made, and the stone is ready for finishing. The "One Track" people use a tumbling process at this point to sand and polish. Conventional sanding and polishing or carving techniques may also be used to finish the stone.

Acceptance and marketability of the fire agate has been significantly affected, in ways both positive and negative, by the special cutting problems. The obvious desirability of standardized shapes has led to many attempts to impose the standard cabochon shape on fire agate. A few such attempts succeed, but most end in disaster. Many stones, especially those from the United States, have only one good fire layer. If a layer is ground away in an effort to achieve a particular shape, the fire is gone forever. A fair amount of the Mexican material has flatter and more numerous layers, and can be cut into excellent cabochons.

The Mexican cutting of fire agates was, for a time, notoriously bad. Stones were excessively heavy on the bottom, and fire layers were ground away or indiscriminately oriented. To make matters worse, traders were forced to buy in lots, ending up with numerous poorly cut stones for every good one. Recent efforts to upgrade the Mexican cutting industry are beginning to bear fruit. The result is a more expensive, but eminently more desirable product. These excellent cabochons are usually buff top, and somewhat baroque in outline.

Standard shapes and sizes are generally not in the cards for fire agate, and the skill necessary to do justice to the material is not easy to come by. Each stone is essentially custom cut, so the fashioning can be a major factor in the price of good stones. It is difficult, at present, to find well cut stones at a reasonable price and in good supply because of the time and effort involved in cutting. Recent advances in cutting technology may remedy this problem. For Deer Creek agates, the contour cut is most often suitable. *Fig. 10* shows an array of well-cut stones, mostly from Deer Creek.

The unique shape and pattern of each stone is an important aspect of the character and charm of this material. The challenge of cutting such fine and colorful gems has created a devoted following among rockhounds for Deer Creek agates. Fine fire agates are especially popular with jewelers and goldsmiths who specialize in custom jewelry, and with collectors of the unusual. The domain of the fire agate has been, and probably will continue to be, with those who value the one-of-a-kind.

Choosing Good Stones

The questions most often asked about gems are: "What is it?," "How good is it?," "How much is it worth?." Indeed, selecting good gemstones is perhaps the most crucial step the jeweler must take. Professional gem traders must know the answers to these questions before they can buy and sell effectively.

The situation with fire agate is

reminiscent of what happened with black opal. In the early days at the fabulous Lightning Ridge opal fields, the miners knew they were on to something very special, but the buyers were puzzled by these now famous black opals. The stones were so new, so different from any opal previously mined, that few dealers were willing to pay anything but the lowest price.

Later, as people learned to appreciate the unique beauty of these gems, they became valued more than all other opals. Like the black opal, the fire agate has encountered resistance, probably because it is so different from other gems. Now, its star rising, the fire agate is increasingly sought after. Some of the best jewelry houses, like Tiffany's, feature fine fire agates.

Choosing a good fire agate is not difficult, once you know what to look for. Their beauty really speaks for itself, but a prospective buyer should know the relative merits of the various qualities of these gems. The following discussion will describe the factors which affect the beauty and thereby the value of fire agates. These factors are best considered separately, so that the stones may be graded in a consistent manner.

Color is probably the most desirable characteristic of gems, and since fire agate often present a kaleidoscope of colors, this quality should be evaluated from several aspects. First, pure spectral hues which stand out from the brown body color should be noted. Almost any color may be seen, but some, because of their rarity, are more desirable. In order, the value is usually highest for the primary colors blue, yellow, and red, then the secondary colors violet, green, and orange. Bronzy or metallic colors have little merit. The intensity of color as well as other factors can easily outweigh this order. At Deer Creek, the Van Dusen claims are noted for stones with a predominance of violets and blues, while the One Track claims yield particularly fine greens and reds. *Fig. 11* shows three fine stones from Deer Creek, with distinct spectral colors predominating in each.

Next, the number and juxtaposition of colors should be considered. As a general rule, the greater the number of distinct colors, the better the stone, but the contrast of these colors is also very important. For example, the visual impact of violet is less when seen next to blue than when it occurs next to red, green or yellow. Unusual color combinations, such as violet and red, blue and orange, red and green, are rare and should be rated accordingly. *Figs. 12* through *15* show the magnificent coloration possible in a fire agate. When first cut, this 39-carat stone was mostly red and green, but because it had multiple fire layers, parts were recut to reveal more purples and blues. The closeups show a full spectrum of colors in interesting and unusual combinations.

Regardless of what colors and what combinations may be seen, the brightness or intensity of the colors is especially important. The fire in these stones is like that of a burning coal. The very best stones radiate color which can be seen from thirty or forty feet away. The brightest fire agates are at least as bright as the best opals.

Figure 12.

Figure 13.

Figure 14.

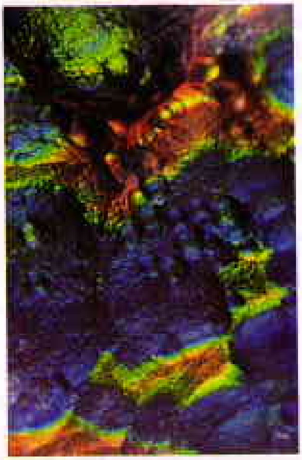

Figure 15.

Figure 17.

Figure 16.

Figure 18.

Since no verbal description can convey the quantitative differences that can be seen, prospective buyers should endeavor to see a range of stones, including some exceptionally bright ones.

The amount of color covering the face of the stones should be noted. The best stones will usually have color covering ninety percent or more of the face. A fine stone can show less coverage, between seventy and ninety per cent, but with less color, the brown body color begins to detract from the appearance of the stone. Generally, the less color coverage, the less desirable the stone.

There is a peculiarity seen in stones from Deer Creek. Fire agates from other locations usually have a direction or orientation which shows the color best, and directions which are "dead." If such stones are viewed face up and rotated, the colors will brighten and then recede, depending on the orientation. Stones from Deer Creek show their colors in all directions with no dead spots. Whether this quality is due to cutting or to some structural anomaly is not known, but it is a distinct advantage.

The color coverage, and to a lesser degree, the brightness of color, reflect the quality of cutting. These features, as well as others, such as the level of polish and the amount of superfluous weight, will indicate whether or not a stone is well cut. Cutting flaws should be considered as negative features, and should lower the value according to their severity. Similarly, inherent flaws like cracks, pits, and the appearance of matrix on the face of the stone, detract from desirability. Other cutting characteristics, such as polished backs which show fire or unusually baroque forms, may enhance value.

The size of the finished stone is an important consideration: most stones range in size from one to twenty carats. Fine stones over twenty carats are rare, and to find a stone over thirty carats which ranks high for all the criteria, is to find a true collector's item.

The stone shown in *Fig. 16* is a prime example of a finely crafted fire agate. The stone exhibits an intense, very bright green covering the full face. The polish is excellent and both sides are polished. The unusual shape evokes animal-like images when viewed from different perspectives. The cutter developed this delightful form quite by accident, as she took care to follow the green color layer throughout the stone.

Certain rare qualities can enhance the value of a stone considerably. At Deer Creek, the rare sagenitic formation is found in relative abundance. *Fig. 17* shows a beautifully sculpted piece cut from a sagenitic formation. The small bubbles seen are actually sagenitic spikes which have been ground down parallel to their base. *Fig. 18* shows a small stone in which the sagenitic formation is seen to best advantage, lying parallel to the polished face. These spikes of fire, radiating a bright burst of color, can increase value by as much as one third. Unique color patterns are sometimes encountered, and if attractive, should be considered as an enhancement, and rated accordingly. A stunning pattern has been seen, with thin streamers of fire running through the stone like a spider web.

A good idea of the relative merits of a particular stone can be reached once all factors affecting beauty have been examined. Since no standard grading or pricing structure exists, some price discrepancies may be encountered, but usually, prices will be competitive. Most dealers have developed their own grading system, based on their marketing experience. No firm prices are available, but some recent trends have been noted. Prices have been steadily on the rise over the past few years, and the trend has been for dealers to change from per stone prices to per carat prices, particularly for the better stones.

Five years ago, a very good fire agate of ten carats or so could be bought for less than $50. Top quality stones, those with desirable very bright colors covering the full face, good shapes with high polish, currently fetch from $10 to $25 per carat wholesale. Very exceptional specimens are priced on an individual basis, and may run considerably higher. Good to better quality stones, with good bright colors covering at least fifty per cent of the face, usually referred to as commercial grades, range from $2 to $10 per carat. Stones of lesser quality may be sold on a per stone basis, ranging from $1 to $10 per stone, reflecting little recent price change. In defense of these higher prices, it should be emphasized that today's stones are usually of much better cut, and much more suitable for fine jewelry. With prices for more conventional gems at an all time high, the fire agate is still a good bargain, offering intense colors, interesting patterns, and unusual forms at reasonable prices.

Acknowledgements

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The Renaissance of The Art of Scrimshaw

By JEROLYN DIRKS
Santa Monica, California

With Photographs by Michael R. Havstad, Gem Media

When President John F. Kennedy was interred at Arlington National Cemetery, an engraving of the presidential seal on whale's tooth ivory was buried with him. Many other examples showing the high esteem in which the art of "scrimshaw" has been held could be cited.

The history of engraving on ivory is an ancient and honorable one. Prehistoric man carved and engraved on ivory thousands of years ago. More recently, American Indians, Polynesians and Eskimos decorated bone, shell, horn, and ivory items well before Columbus landed in the New World. It is almost certain that American whalers were inspired by this native art which they saw en route to their Pacific whaling grounds. This inspiration, combined with an abundance of leisure time on board ship, created this truly American folk art.

Sperm whales were sought all over the world for their superior oil; the fact that such whales had teeth was an added benefit. Each sailor was given his share of teeth or bone to carve or decorate as he wished, filling the long hours at sea with a very pleasant pastime. It was reported that the men became so involved with their "scrimshanding" that they would occasionally fail to spot a whale so they could continue their more enjoyable activity.

Some of the items that were scrimshawed were ornamental objects, small toys and useful items to bring back to wives, as well as equipment for use aboard ship. These items, which included sewing boxes, writing desks, clothes pins, pie crimpers, jewelry and combs, were scribed with details of life at sea as well as with fanciful scenes.

To carve their drawings on the ivory, the whalers used tools that were readily available such as jack knives, sail maker's needles imbedded in wooden handles or finely sharpened nails. By rubbing lamp black or soot into the carved lines, they were able to bring the scenes into clear relief. However, occasionally color was added from tobacco juice or from the juice of berries and the plants which they collected in the tropical islands.

Some sailors were very fine drafts-

SCRIMSHAW IN FOSSILIZED MASTODON IVORY

Osprey Preparing to Land.

Bald Eagle in Flight.

Mastodon Eating.

SCRIMSHAW IN FOSSIL WALRUS

Jaguar Resting

Hare on Alert

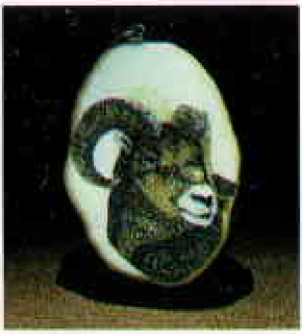
Porpoise

SCRIMSHAW ON AGED ELEPHANT IVORY

Horned Owl

Raccoon in Tree

Dragon Necklace With Ruby Eye



Ram's Head

Lion's Head

men, but since most were not artists, they either produced fairly crude drawings or traced designs from magazines. Before leaving on a long voyage the sailors' wives would place books and magazines aboard ship; it was from these early magazines (including Godey's Ladies' Book) that whalers copied fanciful scenes and pictures. Other drawings depicted ships, whaling adventures, battles, nostalgic scenes and many other subjects that entered the imagination of sailors at sea.

It is not surprising that the early scrimshanders developed the name "scrimshaw" from two words commonly used in their day, 'scrim,' meaning to scrimp and save and 'shaw,'

Sea Otter

Hummingbirds Feeding

Monarch Butterfly in Flight

Galleon Under Sail

Cottontail Rabbit at Rest

meaning the use of time in idle pursuits. The art waned with the decline of whaling in America, but there have always been a few artisans who have continued to practice the craft. In its heyday, owners of fine homes in New England generally boasted of a few fine scrimshaw objects in their curio cases, side by side with more exotic objects from the Orient such as netsuke from Japan and carved jade from China.

Currently there is a renaissance of this important American art form and scrimshaw itself is rapidly changing and growing. Refined techniques, better tools, and color-fast inks enhance modern scrimshaw far beyond the black and white creations produced in the eighteenth and nineteenth centuries.

The preparation of the ivory surface is a time consuming procedure, beginning with the careful cutting of each piece to the desired shape. This is followed by a sanding process using four grades of sandpaper ranging from #100 coarse to a very fine #600 grit, bringing the surface to a dull finish. Water must be used during the sanding to insure that the ivory does not overheat, which could result in cracking; also the water helps achieve a higher degree of smoothness.

The final surface preparation includes applying a polishing compound to a jeweler's buffing wheel, after which the ivory is polished to a soft satin sheen. This writer uses two buffing wheels which vary in softness. The result is a high gloss surface enhancing the beauty of each finished piece.

Motifs are then achieved with incised lines of crosshatching and stippling done entirely by hand. Extremely fine styli such as intaglio points or sharpened dental tools along with razor sharp knives are used to lay a single line of color into each delicate groove.

The material shown in the illustrations is of antique elephant and mastodon ivory and fossilized walrus. The fossilized ivory is purchased from Eskimos who dig in the short summer months (when the permafrost is only five or six feet deep). Some of the walrus ivory is 2,000 years old while mastodon ivory can be thousands of years older. Most of the digging for walrus material is done in the old hunting camps and the same families will dig season after season. Like other irreplaceable materials, the price goes up every year.

Minerals absorbed from the earth through the centuries have shaded the ivory; it can range from creamy white to dark brown. Walrus ivory can be recognized by its distinctive "tapioca" patterning. Ivory continues to change as it gradually absorbs natural oils from contact with skin, darkening and enriching in tone, adding to its natural beauty and value.

Ivory, like any other fine jewelry material, must be treated with care. It is relatively soft so it must be protected against abrasion. No matter what the age of ivory, it is sensitive to heat, so it cannot be stored in overheated places.

Wearing scrimshaw jewelry can be compared to wearing a unique work of art and, in an age of increasing mechanization, that makes these delicately carved miniatures rarities. Fortunately, this craft, with its romantic history, has been preserved through the efforts of artisans who not only work in the same fashion as the whalers did, but with equally the same enthusiasm and dedication. In so doing, they have continued to preserve this truly American art form.

The author of this article is a Southern California artist who has been making scrimshaw for several years. Her works are widely collected as art objects and unique articles of jewelry. She offers her work in the United States through the Wing Gallery in Encino, California, and in Canada through Steve Knight of Ontario.

Developments and Highlights at GIA's Lab in New York

By ROBERT CROWNINGSHIELD

Treated Blue Sapphires

One of the best kept commercial secrets in the jewelry industry has been the artificial (?) color treating of blue sapphires. According to reports, poor quality faceted and cabochon sapphires of near colorless to milky white appearance have been bought up at inflated prices by Thai visitors to Sri Lanka. Reports are that through heat and possibly chemical treatment milky stones are made more transparent while blue color is induced, producing blue faceted stones unlike normal so-called Ceylon quality. Also, cabochons properly oriented for asterism are made blue and the star considerably improved. The latter process was patented by the Linde Company when they were engaged in the jewelry business *(Fig. 1)*. We examined 13 reputedly treated blue faceted sapphires which in general had a dark but watery appearance. Twelve of them showed greenish fluorescence much like synthetic stones do. The inert stone showed a weak iron line while the others showed no line. Ten stones had cracks or fractures radiating from included crystals or fingerprints. Three showed no evidence of heating. At this writing, we have to include treated sapphires along with blue topaz, some violet jades and some green treated diamonds in the list of products not always identifiable in the gem labs of the world.

Meanwhile, we identified a quite dark blue synthetic sapphire by virtue of its curved color banding and gas bubbles – in spite of the fact that it showed a somewhat fuzzy absorption line at 4500 A.U. in the spectroscope. A similar absorption band was shown by a dark uniform blue synthetic sapphire of 4.33 carats. It had a faint chalky blue fluorescence. Both of these stones could have been confused with a treated stone which so far, seems to have weak or no absorption and may have fluorescence! It is wise to immerse the unknown and check the color banding.

Cultured Pearls

A six-strand necklace of round to near round pearls, part of which is shown in *Fig. 2* enlarged 1½X deserves mention because it is the handsomest collection of Lake Biwa mantle tissue nucleated cultured pearls we have ever seen. *Fig. 3* is the x-ray. Although most of the natural colored black cultured pearls we have seen are amazingly round, like ball bearings, we have seen unusual shapes as the x-ray in *Fig. 4* shows. Since the fisheries in Tahiti waters have come into production, we have seen many cultured pearls ranging in color from shimmering black through gray to creamy white *(Fig. 5)*. Most of the black and gray pearls fluoresce reddish to brownish and are considered to be untreated or naturally colored, which we state on a report. Unfortunately, the creamy white and lighter gray cultured pearls cannot be called "natural color," probably for the same reason that no commercial pearl is natural color considering the bleaching and occasional tinting that is practiced.

All the pearls in the pendant earrings in *Fig. 6* are imitation, and date from the time wax filled glass spheres or baroque globes were used. Occasionally we encounter such so-called "destructible" imitation pearls with a gritty surface which we are told was accomplished by dipping the glass into hydrofluoric acid. If one used the tooth test alone, he or she could be fooled.

Alexandrite Oddities

An Alexandrite of 4 plus carats removed from an old setting and repolished before it was submitted to us for testing proved to be flawless. The color change was good, but the daylight color was somewhat "muddy." Fluorescence was weak and the iron line in the spectrum quite strong. This combination of characteristics, plus the size, indicated natural origin. At the moment the two best known sources of synthetic alexandrite do not produce stones with these features. Those made by Created Crystals Inc. in California are flux grown and exhibit characteristic inclusions and fluorescence. Few have been seen larger than 4 carats. Stones grown by Kyocera in Japan and marketed as Inamori Created alexandrites are not flux grown but "pulled" by the Czochralski method. Large and flawless stones may be produced, but with minimal iron and strong fluorescence.

In the past year we have had the occasion to identify red chrysoberyls which refused to turn green – hence are not alexandrites. *Fig. 7* illustrates the latest one seen in which the color is dark and very garnet-like. Because of the scarcity of alexandrites, we are often asked to "rule" on chrysoberyls with color change so slight as to be imagined or changes from greenish brown to yellow brown – hardly a description a layman would recognize as green/red color change.

Cubic Zirconia

Although we have been informed that manufacturers of cubic zirconia have been able to increase the size of their rough crystal fragments considerably in the past year, the largest stone we have seen in New York was cushion antique shape, modern brilliant in cut, weighing just over 37 carats. It was faint brown in color ("K" equivalent) and had been sent to a diamond cutter with instructions to

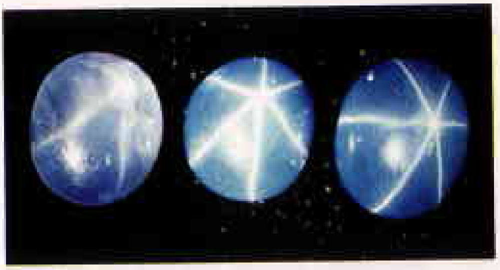


Figure 1.

Figure 2.

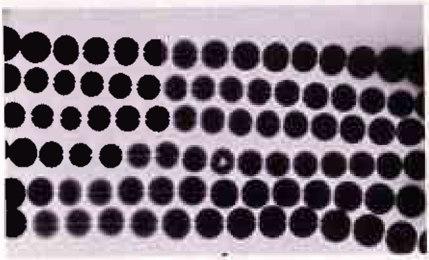


Figure 3.

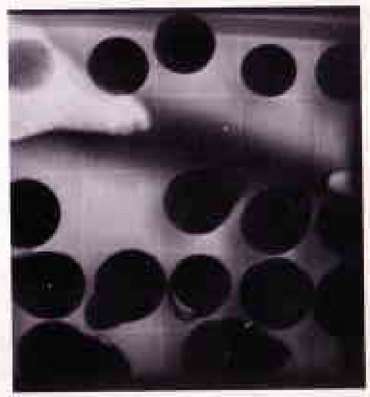


Figure 4.

Figure 5.

Figure 7.

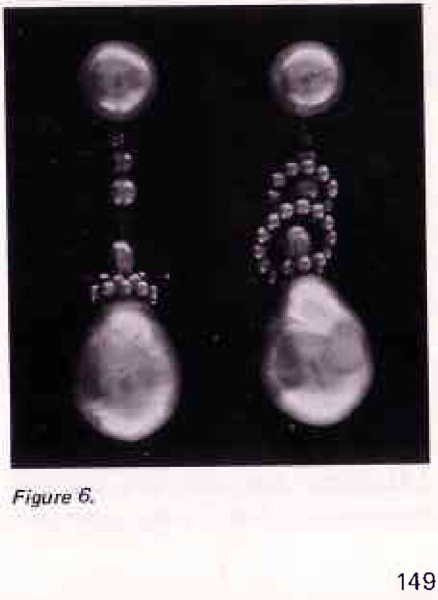


Figure 6.

improve the polish! We have received in the mail two parcels fully insured, as if the contents were diamond and not cubic zirconia – which was established by the weighers and measurers. In one case the jeweler admitted that he had purchased an engagement ring and was impressed with the quality of the stone – but failed the identity test.

Unusual Fluorescence

We were surprised to see a rather strong green fluorescence under long ultra-violet in a natural pink spinel. It resembled the fluorescence of many glass imitation stones viewed under short ultra-violet. A handsome 18-carat bright orange topaz with distinct chromium lines in the spectroscope showed a strong orange fluorescence under long ultra-violet.

A fancy brown old mine cut diamond showed the characteristic 5040 A.U. pair of absorption lines in the spectroscope seen in most green transmitters. However, this stone, while showing the green transmission, fluoresced moderate blue rather than the expected green to yellow-green.

Some Unusual Lines of Transmission in the Spectroscope

Ordinarily we consider bright lines in the spectroscope to be connected with fluorescence. Typical examples are ruby, some red-orange topaz and treated pink to purple-red diamonds – all of which fluoresce orange. Recently we tested a blue, treated pear shape diamond which had no fluorescence. However, it showed a distinct line of transmission at approximately 5040 A.U. Every now and then we have encountered faint pink diamonds which fluoresce strong orange. Most of them have a line of transmission in the spectroscope at approximately 5750 A.U. – the same position as the bright line in treated diamonds. (The presence of this line in orange fluorescing pink diamonds was first noted by Basil Anderson at the time the famous "Princie" pink diamond was sold in 1960.) The mystery of what type of diamond will treat to become pink or purple-red has not been solved. However, since all we have tested have fluoresced a characteristic orange to yellow orange, suggests that possibly they started out as orange fluorescing faint pink stones. This might also account for the fact that most treated pink stones have been well under a carat in weight. Had such stones been larger – even though very faint pink – they would have had an appeal which would preclude their being consigned to irradiation.

A 3.22-carat blue-green, treated, pear shape brilliant showed no fluorescence, but it had a strong fluorescent line at approximately 5050 A.U. in the spectroscope. A pale green natural emerald, with red transmission when on the spectroscope light, showed a red fluorescent line at approximately 6800 A.U. – and resembled the spectrum seen in most rubies.

More On Cubic Zirconia

A client called from Phoenix, Ariz., to make an appointment to have a large stone graded. When he arrived at the window he did not know the stone's weight so it was weighed before a receipt was given. The weigher immediately suspected that it was not diamond since it gauged for about a 4 carat round brilliant but checked in at around 6 carats. After the client left, we examined the stone closely and noted very poor polish. However, when we used the pen test the ink spread just as it would on a diamond both on the top and bottom facets. We used cerium oxide and a bit of water with a hard cardboard as our "lap" and the table quickly became clean and the ink behaved as it should on cubic zirconia, which the stone was. The client was heard to remark after receiving an identification without a grading, "Well, I am glad they are on top of things." About the same time, and the time we were experimenting with ink formulas, we received an Old European brilliant in a bezel setting for identification only. The stone clearly was a diamond – by the cut, inclusions, presence of naturals – and a cape Spectrum. However, ink "balled" up instead of spreading as one expects it to on diamond. Brisk use of our cardboard "lap" with cerium oxide did not do the trick. Only after spreading concentrated hydrochloric acid over the table and allowing it to dry out, then washing the stone did the ink spread properly. The client had evidently used the ink test and was puzzled by the false reaction. So, it is well to know that imitation diamonds can be coated to behave like diamonds and unknown coatings (possibly from ordinary wear!) on diamonds can make them behave like imitations.

Testing Colored Diamonds

We have been happy for early results Dr. Vince Manson has been able to report using cryogenic techniques on the recording spectrophotometer.

This is especially applicable to identify color origin of green stones. One green old mine cut stone was presumed to be of natural color by virtue of a knowledge of its history and prominent green naturals on the girdle and culet. Later, the stone was recut and all naturals removed so that we could not state that the color is of natural origin. It is hoped with these new studies in the visible and infrared portions of the spectrum that we now will be able to do so.

A red-brown stone known to be treated failed to show the 5920 A.U. line in the hand spectroscope but it did show a line at 6400 A.U. We have been informed that this line too is a part of the series of lines right up into the infrared which appear when a diamond has been colored by irradiation. It was so identified by Dr. Manson.

Recent publicity from London that it is possible to re-heat treated diamonds to remove the 5920 A.U. line does not pose the threat it did at first.

Synthetic Amethyst

By now most gemologists are aware that there is currently no test for a flawless amethyst. Even those with inclusions may be difficult to identify, especially in view of a rumor that a method – not hydrothermal – is being developed in which very natural appearing fingerprints, etc. may occur. The bulk of the synthetics we have seen have been pleasing in color, but not exciting – and entirely without

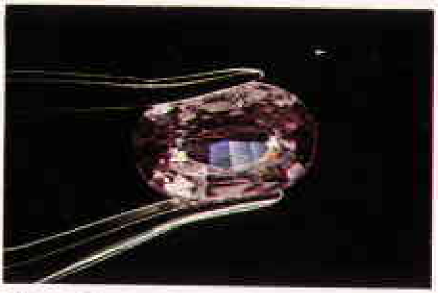


Figure 8.

Figure 9.

inclusions. A lot we purchased recently for class use were 6.00 x 8.00 mm. ovals and most showed almost a molded facet appearance. It was amusing to find about 20% of them were

Figure 15.

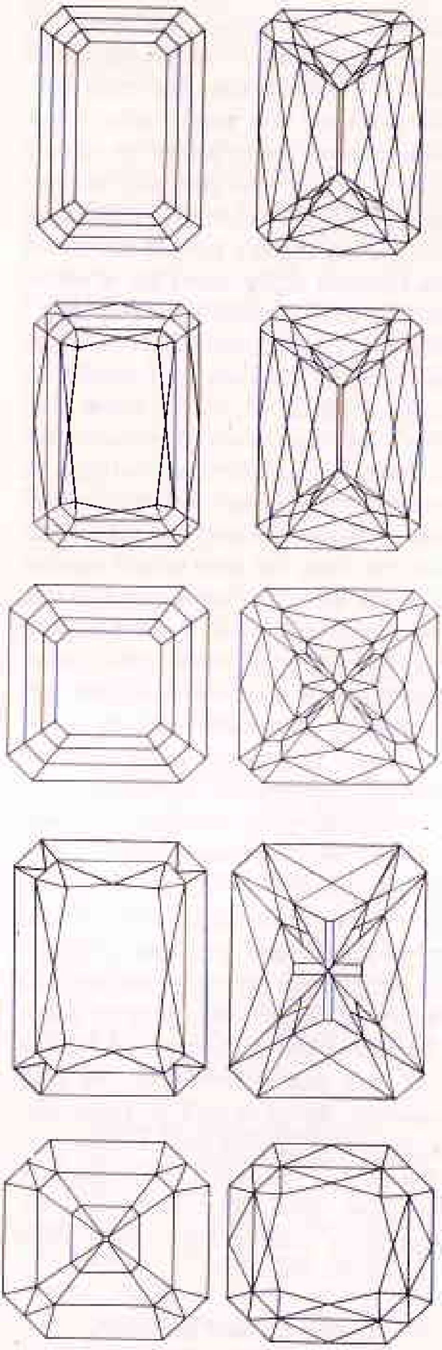


Figure 10 – Figure 14.


Figure 16.


Figure 17.


Figure 18.


Figure 19.

natural stones by virtue of their inclusions. It is presumed that the raw material accounts for very little of the value and cost of cutting a large number is quite low, thus the substitution of Brazilian cut natural stones for Idar cut synthetics.

Colored Stone Oddities

Not really an oddity but certainly a rarity was a 2.71-carat Taafeite seen recently in the Laboratory. It was a pleasing pinkish, gray-purple and contained a nice crystal inclusion *(Fig. 8)*. We have heard of a slightly larger stone being sold at auction in Europe for $10,000 per carat.

Fig. 9 illustrated a normal Verneuil synthetic ruby with pronounced curved straie and needle-like inclusions of an unknown nature.

A handsome glass imitation of emerald with swirls and "garden" resembling those seen in so-called "Ferrer Emeralds" had the unexpected refractive index of 1.75.

Diamond Design

We could keep one person quite busy making precise diagrams for every slight variation we see in facet design and placement. Designs that have been patented and which we expect to encounter frequently are drawn for Laboratory use. However, some newer ones appear to be one of a kind, and do not merit the effort to make a supply of diagrams. Several, such as the ones here shown *(Figs. 10-14)* are attempts to make cushion, cushion octagon, and square cuts appear more brilliant. *Fig. 15* was a surprise in that it had 9-fold symmetry instead of 8-fold. It hardly merited expending the effort to draw an actual diagram, and since it was nearly flawless we did not have much plotting to do.

Imitating Emerald

Most triplets imitating emeralds which we have encountered give themselves away with the simplest of tests – they remain green under an emerald filter (as will certain natural stones too). The discovery of a green cement or plastic which has good emerald color and also appears red under the filter was made some years ago and we are seeing more of it used. *Fig. 16* shows part of a necklace of pale green beryl beads coated with green plastic which is red under the filter. *Fig. 17* is a recent shot of the most realistic imitation emerald crystal we have encountered. It was purchased in Bogota by a tourist. Evidently the relatively low price paid was the cause of suspicion which brought him to the Laboratory. Again, it appeared red under the color filter. To the unaided eye, it resembled emerald crystals such as the "Patricia" at the American Museum of Natural History. On close examination large flat gas bubbles could be seen and these were found to be in green cement a few millimeters beneath the crystal faces of the quartz crystal forming the periphery *(Fig. 18)*.

Ultraviolet disclosed epoxy "joints" indicating that the crystal had been cracked in half, hollowed out to accommodate a smaller quartz crystal which was then cemented into position. The "terminations" were cleverly made of epoxy, matrix and broken quartz fragments. Heretofore, we have only seen such fakes with more matrix than crystal. *(Gems and Gemology*, Fall, 1976, Page 220.)

More on Testing Colored Diamonds

One type of light green diamond which we feel can be considered natural in color owes its color to green graining. This is shown in *Fig. 19*.

Fashioning Cubic Zirconia

By BILL KERR, G.G.
Faceting Instructor
Gemological Institute of America
Santa Monica, California
With photographs by Michael R. Havstad, Gem Media

Some of the older books written 50 to 100 years ago that attempted to cover the then guild- or family-controlled subject of lapidary treatment of gemstones, were filled with much misinformation. The writers indicated that the appeal and beauty of the gems that today we call "colored stones" was due solely to their intrinsic color. The low optical properties of these stones could not be expected to contribute anything in the way of brilliance and dispersion. Considering the poor quality lapidary treatment (cutting) most commonly employed in those days, it is understandable how these views came about. In fact, many of the rare and beautiful gems in our museums today must continue to struggle against the inferior lapidary treatment inflicted upon them, and display to the public their inherent beauty and charm as best they can.

Today's well trained and well informed jeweler is very much aware of that *extra* beauty seen in well-cut stones. They realize that the laws of optics apply also to materials other than diamond.

We "cutters," having worked our way thru the Y.A.G.'s the G.G.G.'s and the assembled diamond substitutes, were handed, about a year ago, a new and much better material, "Cubic Zirconia" (C.Z.), *(See Gems & Gemology*, Summer, 1978). *(Lapidary Journal*, July, 1977.) This article covers a faceting process that produces a very believable diamond simulant.

Cubic Zirconia is singly refractive, as is diamond. It has an S.G. of approximately 5.60, an R.I. of approximately 2.20 and a dispersion of about .060 or approximately one and one third that of diamond. The hardness of the Mohs scale is between 8 and 9. With these properties, a diamond substitute is easily indicated.

Rough pieces of cubic zirconia are usually irregular in cross section. Unlike many other synthetic materials formed in round boules, the shape does not lend itself to a high recovery percentage. Sawing and preforming are troublefree and done as is usual with any faceting material. Standard round brilliant preforms, intended to be diamond simulants, are accurately rounded or turned on a fast, true running, medium coarse grit diamond lap on a modern facet machine. The material is first shaped into a cylinder, then the end intended for the pavilion is turned to a cone shape at approximately a 43° elevation angle with the girdle plane.

Several faceted shapes of Cubic Zirconia ideal for use as diamond substitutes.

This well-cut red-orange Cubic Zirconia shows the potential of the colored material.

The dispersion of Cubic Zirconia is apparent in this stone.

The recommended angles for faceting are 36° for the crown and 42° for the pavilion mains. Logic tells us to use angles that are slightly steeper than those for diamond (34½° and 41°) since the R.I. (2.20) is not quite as high as that of diamond (2.417).

The actual cutting or grinding of facets on Cubic Zirconia is no different from other materials such as corundum or Y.A.G. Coarse grit laps seem to pull out small pieces of the material, leaving cavities or pits. These may be dressed down and the final cutting and alignment done on a well used 1200 or 1500 grit lap.

Although it is possible to polish Cubic Zirconia on a tin lap with "Linde A" (aluminum oxide), this is rather slow and not recommended.

Use a ceramic lap with spray diamond to polish. This cutter's *Original Ceramic* lap has one face ground optically flat. One-fourth (¼) micron (100,000 mesh) diamond in a pressurized spray container is used to charge the lap for polishing. A new lap may require a few hours use before it polishes well.

The R.P.M. of the polishing lap should be slow (100 to 300). Higher speeds are likely to cause a peculiar spiral-like spalling of the facets. This is more common on the smaller facets and is probably caused by a heat buildup, since cubic zirconia is a very poor conductor of heat. Use a light to medium pressure and keep the facet moving across the lap.

A working technique might be described thus:

Spray diamond lightly and only briefly on the slowly rotating lap. Work the diamond into the lap pores with a freshly ground facet swept fully across the lap. Wipe the excess liquid and diamond off the lap with tissue.

A graphite stick supplied with the lap was not found to be necessary after arriving at a successful polishing system.

Do not use any liquid. Wipe all cutting residue from the lap face regularly since this can cause scratching. Keep the surface clean and dry. Do not touch the sidewalls of the splash pan with fingers or tissue, as this can carry cutting residue to the lap face and contaminate it. After the lap has polished a few stones, it will require very little additional spraying of diamond. If spalling occurs, change the direction of polishing and ease up on the pressure or lap speed. The final polish is often done with the lap completely stopped.

The slow removal of material gives the cutter time to align facet junctions perfectly for that "diamond cutter" precision look. Perhaps ½ micron diamond spray would produce an acceptable "commercial cutting" finish.

As in all gemstones, correct proportions and cutting angles contribute greatly to the beauty of finished cubic zirconia. The table percentage should be 58% to 65% of the girdle diameter. The pavilion girdle facets are cut at an elevation angle of only 1° numerically greater than the pavilion mains and should extend 75% to 80% of the way down from the girdle toward the culet. Cut a very very small culet and polish it on the ceramic lap. Cubic Zirconia is not as tough as corundum and the sharp culet junctions need some protection against possible breakage.

The girdle is usually sanded and not polished since the usual intent is to simulate a cut diamond. The girdle edge may be processed by sanding first on 400 wet or dry silicon carbide paper resting flat on a magazine back on a desk or table then with 600 grit. Spray diamond on a wood lap will polish the girdle edge nicely, if desired.

The colored varieties of cubic zirconia are capable of producing beautiful cut stones rivaling natural colored or irradiated diamonds. When colors are available that can match the more desirable hues of natural stones such as ruby, sapphire, and imperial topaz, then there should be a considerable demand for them in jewelry affordable to everyone.

1979 Schuetz Design Contest Winner

Winner of the 1979 George A. Schuetz Memorial Fund Jewelry Design Contest was John F. MacDermaid of Union Lake, Michigan. He is employed by Rose Jewelers, Oak Park, Michigan.

This was the sixth Schuetz Design Contest, which was established in 1973 in memory of George A. Schuetz, Sr., late President of Larter and Sons, Newark, New Jersey. The contest is administered annually by GIA.

Mr. MacDermaid's winning design, pictured here, is for a 14K yellow-gold man's ring set with a trilliant-cut diamond and two ruby baguettes. His prize is a $500 scholarship to be used

for any jewelry-related training at any institution of his choice.

Second Place in the judging went to Aleta J. Ford of Bakersfield, California, for her design of a tie tack to be cast in 14K white gold with one .20-carat triangular-cut diamond and nine single-cut rubies set in platinum.

Hirofumi Yamaguchi of Osaka, Japan, was given Third Place for his design of a yellow-gold man's ring set with black onyx and three round brilliant diamonds.

Laszlo Mosonyi of Jewelry by Laszlo, Los Angeles, California, received two Honorable Mentions, one for a man's yellow-gold zodiac pendant set with one .25-carat diamond, and one for a white-and yellow-gold man's initial pendant set with .02 to .04-carat diamonds.

Vance Hanna of Vance Hanna Design, Southfield, Michigan, also received an Honorable Mention for his design of 18K yellow-gold cufflinks with five diamond baguettes set in a 14K white-gold bezel.

There are no prizes for Second Place, Third Place, or Honorable Mentions.

The four judges are asked to select the winning design based on its beauty and originality, feasibility of wear, manufacturability, and effective use of materials. Entries must be for men's jewelry and must be either color renderings or wax models; no actual pieces are accepted. With 103 entries from 48 contestants, the task of picking the winner was not an easy one for the judges, and we wish to express our gratitude for their time and effort to:

Nancy Levy, Designer, Los Angeles
Clifford R. Fisher, Kearley's Watch & Jewel Shoppe, Santa Monica
Lillyan Collard, Designer, Donavan & Seamans Co., Los Angeles
Beverly Hori, Instructor, GIA, Santa Monica

We also wish to thank all the entrants and to congratulate them on a group of fine designs. Information about the 1980 Schuetz Design Contest will be available from GIA, Santa Monica, after October of this year, and the entry deadline will be the end of February, 1980.

Acknowledgements for Gifts Received By The Institute

Santa Monica Headquarters

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

To an anonymous donor for a collection of opals, both cut and rough, for displays and research.

To an anonymous donor of a spectacular 117.85-carat opal to be used in our display collection.

To *Benjamin O. Anderson* of Oakland, California, for an unusual orange YAG of 140.52 carats to be used in our reference study collection.

To *Hans Bagge*, of Los Angeles, California, for a fine 0.35-carat benitoite which will be used in our display collection.

To *Mr. and Mrs. Carl*, Rancho Santa Fe, California, for an unusual collection of mineral specimens to be used in display, research, and class programs.

To *Santpal Singh Chalwa*, of S.S. Agencies R.O.P., Bangkok, Thailand, for an array of colored sapphires for the research study collections.

To *James Daly* of William Colucci-Gomez and Company, San Francisco, California, for an extensive collection of approximately 880 stones including synthetic spinel, synthetic corundum and smoky quartz to be used in our correspondence and residence gem identification programs.

To *Joseph F. Decosimo*, Chattanooga, Tennessee, for a thoughtful gift of a 1.74-carat sphene and a 17.84-carat morganite for our display collection.

To *Dr. Vincent and Susan Ewy*, Las Vegas, Nevada, for the donation of a 77.15-carat kornerupine, reported to be the world's largest, which will be used in our display collection.

To *Frank Faff,* Severna Park, Maryland, for his kind gift of over 100 gems to be utilized in our gem identification programs.

To *Pierre Gilson, Jr.*, Aire, France, for synthetic turquoise beads and created lapis beads to be carefully studied by the students in our gem identification courses.

To *Daniel J. Henkin*, Elkhart, Iowa, for a generous donation of 40 strands of pearls, representing an extensive range of colors, qualities, and sizes.

To *Johnson and Company*, Jewelers, Stanford, California, for a set of 42 carved jadeite figurines to enhance our gem displays.

To *Dr. Day McNeil, Jr.* Houston, Texas, for a set of gemstones including amethyst, topaz, peridot, and a labradorite of 11.36 carats.

To *Peter Paulin*, for one round brilliant cut 1.87-carat cubic zirconia to be used for research purposes.

To *John L. Ramsey*, Cardiff by the Sea, California, for a spectacular blue topaz with a terminated quartz crystal which will be appreciated by everyone who views our displays.

To *C. Schomburg and Son, Inc.*, Columbus, Georgia, for a menagerie of colored stones, including sapphires and aquamarines to be used in student study sets.

To *Richard Schuster*, Max Schuster of California, Incorporated, Los Angeles, California, for a generous donation of 5,599 grams of rough garnet material to be used in research studies and gemstone displays.

To *W. Taylor*, Indian Harbor Beach, Florida, for an extensive selection of gems to be used in the student test sets, and which includes an actinolite cabochon of about 5 carats, and a cabochon of boulder opal.

To *Charles Tintinger*, Great Falls, Montana, for a 1.45-carat cubic zirconia to be a part of the study stones for the gem identification program.

To *Alfred Woodill*, American Gem Society, for a copy of *The Birthday Book.* The exquisite gem photographs will be enjoyed by everyone who uses the research library.

To *Clara T. Younger, M.D.*, Cypress, California, for a collection of gems that includes tourmalines, garnets, fluorite, and scheelite, which will be used for research and display projects.

New York Headquarters

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

To correspondence student *Nick Angiulo*, Gemco Importing, Wall, New Jersey, for a very nice example of multi-star quartz and a partly finished cabochon of same which he brought back from Sri Lanka at our request.

To *Mr. Norman J. Cantin*, Balfour Co., Attleboro, Massachusetts, for a nice selection of natural and synthetic stones and baroque pearls.

To *Mr. Bob Estes*, Capri Jewelers, Grants, New Mexico, for turquoise specimens from the Phelps Dodge Copper Mine, Clifton, Arizona.

To *Fortunoff's*, Westbury, New York, for another very useful selection of colored stones for use in classes.

To resident student *Howard Foxman*, Hartsdale, New York, for some almandite garnet crystals.

To *Lloyd Hermann*, Gloria Gem, New York City, for an oval yellow beryl for the display case, four tourmaline cats' eyes for stone sets and a yellow chrysoberyl.

To *Mr. Tony Peluso*, resident class student, for several gem and mineral specimens useful for the reference file.

To *Mr. Arthur Reik*, Laboratory member of long standing, for contributing a "Z" (fancy yellow) master stone for the second floor laboratory.

To *Strickler Brothers*, 580 Fifth Avenue, New York, City, for several cabochons of "Eilat" stone and amber.