

# GEMS & GEMOLOGY

VOLUME XXX

FALL 1999



PROCEEDINGS OF THE THIRD INTERNATIONAL GEMOLOGICAL SYMPOSIUM

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## RETAILING IN THE NEW MILLENNIUM

**Editor's note:** Because of contractual restrictions, we could not include the talks of business speakers Peter Ueberroth, Al Ries, Don Tapscott, Art Laffer, and Rushworth Kidder. However, audio recordings of most sessions, including the last four business speakers, can be purchased through The Sound of Knowledge ([www.tsok.net](http://www.tsok.net)).

Note that, unlike a regular issue of *Gems & Gemology*, none of the articles or other information in this volume was submitted to peer review, although several internal reviewers were involved in the editorial process. Also because of its special nature, this issue is paginated separately from the other issues of *G&G* in this volume year, and it has a separate index as well.

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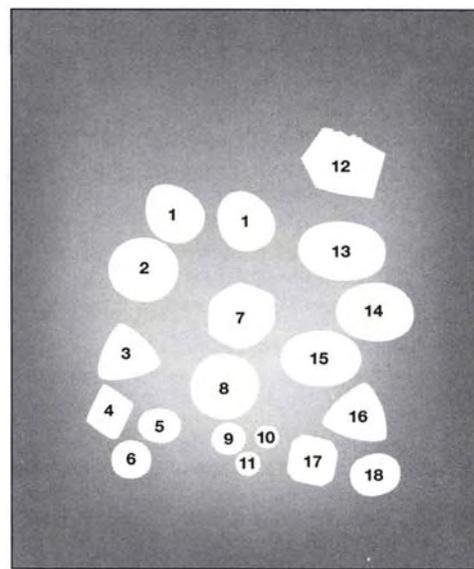
**ABOUT THE COVER:** The diversity of presentations at the 3rd International Gemological Symposium—from old localities to new, from period jewelry to contemporary, from diamonds to a vast array of colored stones and pearls—is illustrated on the cover of this special Proceedings issue: (1) Antique platinum earrings with white drop-shaped natural pearls (each 14.3 x 10.5 mm) and diamonds; (2) a 12.5 mm Tahitian cultured black pearl; (3) a 4.40 ct violetish purple spinel, Sri Lanka; (4) a 3.83 ct pink spinel crystal, Mogok, Myanmar; (5) a 1.76 ct blue spinel, Sri Lanka; (6) a 1.53 ct purple-red spinel, Vietnam; (7) a 16.95 ct dodecahedral yellow diamond crystal, Ivory Coast; (8) a 6.58 ct "Jubilee"-cut J-VS<sub>1</sub> diamond; (9) a 0.65 ct Fancy Vivid yellow diamond; (10) a 0.30 ct Fancy Deep blue diamond; (11) a 0.31 ct Fancy Intense purple-pink diamond; (12) a 10.07 ct tanzanite in a platinum and gold ring designed by Bernd Munsteiner; (13) a 12.64 ct spessartine garnet, Kunene River, Namibia; (14) a 7.54 ct green tourmaline, Paraíba, Brazil; (15) a 5.84 ct greenish blue tourmaline, Paraíba, Brazil; (16) a 5.04 ct ruby, Malawi; (17) a 2.12 ct emerald, Coscuez, Colombia; (18) a 3.05 ct sapphire. Stones and jewelry from the collection of Michael M. Scott.

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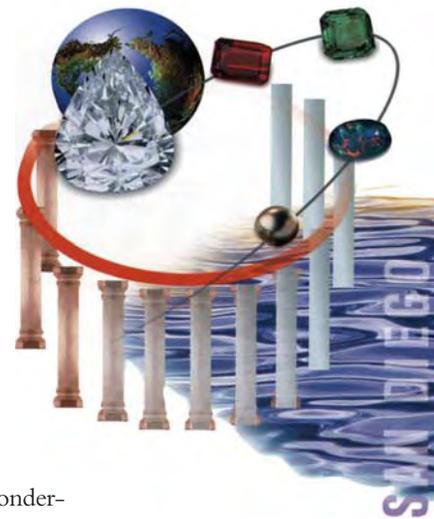
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# The 1999 INTERNATIONAL What GEMOLOGICAL a SYMPOSIUM Ride!



For four days in June, from the 21st to the 24th, we enjoyed one of the most exhilarating experiences in the history of our industry. More than 1,400 people from 49 countries came together at the Third International Gemological Symposium to learn, to listen, to work, and to play. Representatives from major diamond mining companies met the manufacturers who cut diamonds, the dealers who sell them, the designers who set them, and the retailers—from online shopping networks to large chains to single-store operations—who deliver them to the consumer. The sharing of information outside the presentation rooms was almost as powerful as the knowledge that was imparted by the more than 200 speakers, panelists, War Room participants, and poster session presenters.

And lest we lose sight of our roots, who will ever forget the words and wit of Richard Liddicoat, Bob Crowningshield, Bert Krashes, and Glenn Nord at the special “Gemology Greats” session? Over the course of the last 60 years, these four men have transported gemology from a trade to a profession, from a skill to a science.

The gemological information was framed by some powerful business speakers. Former Olympics chairman Peter Ueberroth opened Symposium by emphasizing the importance of “two at the top”—if we are to get ahead, we must share our leadership. On the final day, marketing expert Al Ries declared the brand—not the salesperson—as king in today’s battle for consumer dollars. “It’s the brand itself that provides credibility,” Ries said. Cyber-guru Don Tapscott, reminded us that “we are seeing the first generation to grow up digital—the first generation to be bathed in bits . . . there are 80 million members of this generation in the United States and they are *all* going to wear jewelry.” Distinguished economist Arthur Laffer asked rhetorically whether we thought (Federal Reserve Board Chairman) Alan Greenspan was going to “lose his nerve and . . . ruin the last 20 years of financial credibility?” Said Laffer: “No, of course not . . . the best is yet to come.” And noted ethicist Rushworth Kidder told jewelers at Symposium that information cannot hide forever. It always comes out. Kidder’s message was resounding: “Disclose or be disclosed.”

Rounding out Symposium were wonderful social events that encouraged networking and camaraderie. Highlights included the fabulous international food at the opening reception, the Canadian wines that flowed at the San Diego Natural History Museum diamond gala, the spectacular jewelry at the platinum breakfast and the pearl reception, and a melange of fine Italian jewels and opera in “Arte in Oro.” Our heartfelt thanks to the many sponsors who made these and other special aspects of Symposium possible.

We have put together this Proceedings volume to share some of the vast information that was provided during these four days in June. In the longest issue of *Gems & Gemology* ever published, we are pleased to provide the closing speeches of Maurice Tempelsman and Bill Boyajian, a special update on GE-processed diamonds, extended abstracts of 45 feature presentations, and summaries of the eight panels. Also included is a photomontage of the people and events that gave life to Symposium. Rounding off the formal program are summaries and dialogue from each War Room, a unique open forum at which hundreds of attendees argued and advocated in search of solutions to some of the industry’s most pressing concerns—branding, appraisals, diamond cut, and disclosure. The volume concludes with more than 70 abstracts from the poster sessions, which proved to be a true “Marketplace of New Ideas.”

WE DEDICATE this special Proceedings issue to Dr. Vince Manson, whose heart and considerable intellect made the 1999 Symposium a reality. Vince mobilized an entire army of speakers, panelists, presenters, and volunteers. And he did so while waging a private and most courageous battle for his own life. We rallied at Symposium, inspired by his vision and bolstered by his enthusiasm. Vince passed away on July 3rd, leaving us with one of the most memorable experiences of our lives. Vince, a toast to you . . .

*Alice Keller & Kathryn Kimmel*  
Co-Chairs, Third International Gemological Symposium

# Globalization and Technology: Dynamic Forces for the 21st Century

**By Maurice Tempelsman**  
*Chairman, Lazare Kaplan International*  
New York

**O**URS IS A DYNAMIC INDUSTRY—driven by the creative energy of the men and women who combine the skills necessary to run a successful business with the sense of joy, aesthetics, and beauty that add an extra dimension to the great human adventure. We help our customers celebrate the memorable moments in their lives: engagements, wedding anniversaries, births, or that wonderful moment when a gift of beauty and distinction is the tangible expression of love, gratitude, or recognition. And because of this, ours is also an industry of service, for in some small way we participate in the spirit of each occasion we help to celebrate.

I congratulate the organizers and planners of this symposium for their selection of experts and speakers. You chose well and carefully. In the last few days, we have heard presentations on specific technical and trade issues as well as on broader themes that set a context. This is as it should be, for our industry is very much part of the broader economy, and is affected by the dramatic political and economic forces that affect all other industries.

When I stood before you in 1991 at the Second International Gemological Symposium, in celebration of GIA's 60th anniversary, I could not help but reflect on the wisdom and foresight of GIA's founder, Robert Shipley, who also founded the American Gem Society. I paid tribute to his vision to foresee that an increasingly knowledgeable consumer

required a more knowledgeable approach, and to his tenacity in establishing what has become the most recognized and respected research and educational center for this industry. This was true in 1991, and it is even more so in 1999. The GIA provides technical education to more than 15,000 students in residence, distance education, and extension courses. Today there are more than 250,000 GIA graduates. The numbers are impressive. But even more impressive is the fact that this represents a storehouse of gemological expertise, knowledge, and ethical values on which the industry can draw. GIA focuses on attracting young people to this industry. Since 1991, GIA's "Career Fair" program has helped place thousands of qualified graduates. There is no greater satisfaction than starting a young person on a successful career path. By doing so you energize the industry and bring it new ideas and fresh viewpoints to meet the future challenges.

## **Looking Back, Gazing Forward**

As we bring to a close this tumultuous century and look to the new millennium, a few thoughts come to mind. "It was the best of times, it was the worst of times." How right Charles Dickens was.

It was a century that saw some of the most monstrous deeds that humans can inflict on one another. It was also a century that witnessed marvelous breakthroughs and accomplishments in science and discov-

*Jewelry captures the spirit of a special occasion, as with these diamond anniversary and engagement rings, set in gold and platinum. Courtesy of Lazare Kaplan International.*



ery. With these developments came the reevaluation of what is right and what is wrong, and what we must do to make this a better place for ourselves and for our children.

As we approach the new century—let me add, with anticipation and a measure of optimism—it is useful to look at the one that is just about to end. I suggest we do so through the vision of Thomas Jefferson, who said “I like the dreams of the future better than the history of the past.” Although I am more comfortable with that than with Shakespeare’s “What’s past is prologue,” today more than ever humanity can shape its destiny for good or evil. The tools exist. The challenge is to muster the will, make the choices, and deploy the organizational skills to use these tools effectively and creatively.

This century was harsh on ideologies (communism, fascism, and other “isms”). Who would have thought that communism—as an idea, a form of governance, an economic system, an empire—would implode, not by conquest or war, but through its inability to come to grips with the objective realities of our age. A broader worldview and scientific advances are defining and redefining daily the substance of power and wealth. This is true for nations large and small, and for companies large and small.

This century was harsh on experts. Which political analyst or economic pundit had the foresight or temerity to predict the developments that, with 20/20 hindsight, we now accept as having been obvious and inevitable? At GIA’s 60th anniversary, the U.S. economy was in recession and our diamond and jewelry industry was stagnant. We believed that eco-

nomic growth would come from other parts of the globe—Japan, the Pacific Rim, emerging markets. The U.S. market was labeled mature, tired; a new triumphalism that proclaimed economic miracles in other parts of the world prompted us to look elsewhere for growth and innovation. Nor was it only our industry that turned to other regions for its future. Political leaders also lamented or bragged (depending on which side of the miracle they found themselves), wise economists forecast, and shrewd investors committed substantial capital to these expectations. However, all did not quite work out as proclaimed—a useful reminder of our fallibility and, let me add, our courage in the face of what is inevitably an uncertain future.

This century was generous—particularly in its closing years—to systems of governance that struck a balance between the freedom needed to nurture individual initiative and enterprise, and the accountability and transparency—openness—essential to government by consent and the successful workings of a free economy.

Now that the post-Cold War euphoria is over, in politics as well as economics, a new sense of reality has set in. The end of communism in Russia did not produce the automatic flourishing of democracy and free-trade economies all over the globe. Nor did the “economic miracles” and newly emerging markets avoid the pitfalls and disciplines of the marketplace. Nations, like individuals and companies, can only learn from past mistakes. It takes time to establish a new mindset, a new infrastructure—all the things that are necessary for a functioning society to survive, adapt, and flourish in this rapidly changing world.



*The economic and cultural systems that have evolved in the U.S. give the individual freedom to create. This “Web of Life” platinum bib-style necklace is set with diamonds on one side and pearls on the reverse. Designed by Robert Lee Morris, it was awarded the Grand Prize at the 1998 “Platinum Passion” design competition hosted by Platinum Guild International, and was on display in the 1999 Nature of Diamonds exhibit at the San Diego Museum of Natural History. Photo © GIA, by Harold & Erica Van Pelt.*

The corrective measures cannot be imposed from outside; they must come from within and must reflect the history, culture, and values of each society. We cannot, nor should we attempt to, export in a package what has worked so well in the U.S. in recent years. Nor does our apparent success justify our own form of triumphalism. But with caution, and a measure of modesty, it may be useful to examine why the U.S. economy has responded so well to the dramatic, often wrenching, changes brought about by the greater impact of global developments and rapid technological change. We possess no magic formula, nor are we guided by a manifest destiny. Nevertheless, through a combination of energy, luck, wisdom, and historical legacy, our system has become structured so

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that the individual is free to create, grow, and benefit, while at the same time is held accountable to the needs and laws of society and to the transparency required in a modern functioning economy. This, and the capacity to self-correct, are the essence of the resilience that has enabled the U.S. economy to absorb, not without pain and dislocation, but with more stability than other economies, the unexpected and unforeseen changes we have had to confront and accept. And what is true for this economy in general is equally true for our industry.

### **Trends for the Future**

Now, if you will permit me, I'll share my thoughts on two trends that will have an ongoing impact on the diamond and jewelry industry in the years to come. They are obvious, and they are not exclusive, as there are many other trends and forces we cannot yet see. But these two are important and timely: globalization and technology.

**Globalization.** Much has been written and said about globalization. Although a lot of this is esoteric and even incomprehensible, deep down one feels that globalization is real. Those of us who go to sea for our pleasure or adventure know that it is a tide of epic dimensions and force. We aren't quite sure where it will lead, but we do know or feel that, if we want to reach our destination, we had better take it into account as we navigate and set course.

No one has written more cogently and comprehensively on this subject than Thomas L. Friedman, the erudite columnist of the *New York Times*. He uses the forces of globalization as a lens through which to examine daily events in politics and economics. In his recent book, *The Lexus and the Olive Tree* (Farrar Straus & Giroux, 1999), he argues that globalization is not just a phenomenon or a passing trend. It integrates capital, technology, and information across national borders in a way that creates a single global market and, to some degree, a global village. He then suggests that you cannot understand the morning news, know where to invest your money, or think about where the world is going—or where your business is going—unless you understand how this new system influences the domestic policies and international relations of virtually every country.

Globalization I took place between the mid-1800s and the late 1920s. If one compares the volume of trade and capital that flows across borders relative to

gross national products, and the flow of labor across borders relative to populations, the period of globalization preceding World War I was similar to the one we are living through today. This first era of globalization was broken apart by the successive blows of World War I, the Russian Revolution, and the Great Depression, which combined to fracture the world both physically and ideologically. The divided globe that emerged after World War II was then frozen in place by the Cold War, which lasted roughly from 1945 to 1989, ending with the fall of the Berlin Wall. Friedman maintains that what we are now living through is really Globalization II. However, today's era of globalization not only differs in degree, but in important ways it also differs in kind. The previous era of globalization was built around falling transportation costs; today's era of globalization is built around falling telecommunications costs. He goes on to say, "If the first era of globalization shrank the world from a size 'large' to a size 'medium' this era of globalization is shrinking the world from a size 'medium' to a size 'small'."

I take comfort in that historical perspective: first, because we have been here before; and, second, because it disposes of the proposition that history is dead and that world economics are now driven by a "new paradigm." History has not been suspended—we shall have plenty of opportunities to make new mistakes—nor have the inexorable economic laws that govern the marketplace and business cycle disappeared. Risk and reward will remain the benchmarks for those of us who have chosen business as a profession. But as we look at risks and rewards in the ordinary course, we must also look at them through the lens of globalization and its impact.

This leads me to the diamond industry. We have all seen and felt the impact of rapid globalization on our business. When I addressed you in 1991, growth and future expansion were perceived to lie outside the U.S. And indeed that is what happened. Diamond production expanded, investments were made, marketing and advertising were refocused, and a lot of us thought that a new era of growing demand in different parts of the world would sustain an uninterrupted expansion. That boom quickly reversed itself with catastrophic impact on many countries and markets, as demand suddenly declined. As the situation slowly stabilizes, the lessons learned are that, yes, we do live in a global village—and, no, we cannot isolate our-

selves across political borders. Nor does globalization lend itself easily to supervision and control.

**Technology.** From the outer limits of our universe, to the deepest recesses of our oceans—from the microscopic world of the atom on which the physical world is built, to the double helix of the DNA chain that is the basis of life itself—human knowledge has advanced with great, bold steps. There are no limits to our curiosity and our vision. Progress and the change it brings cannot be stopped; nor should it be lamented. Technology, in the final analysis, is not an end; rather, it is a means—a tool. How we use it—for good or for evil, to build or to destroy—is a human decision. Technology will challenge our wisdom, our priorities, our ethics, and even our humanity. I am confident that we shall rise to the occasion, because the ben-

*The impact of globalization in the early 20th century is evident in these onyx and jade jabot brooches and carved jade brooch, which derive their inspiration from Asian decorative arts. Dating from around 1925, the jewelry is courtesy of Neil Lane Jewelry, Beverly Hills, California. Photo © GIA and Tino Hammid.*



efits for all of us far exceed the cost—the temporary discomfort that comes with the need to adjust to change.

The gem and jewelry industry is part of all this, as it should be, although to a certain extent the rapid march of technology has had a lesser impact on our industry than on others. Many industries have had more dramatic exposure to technological developments in very short time spans and have had to learn to adjust quickly. However, we have had the luxury of adjusting gradually—and thus the opportunity to think and correct when unavoidable and irreversible changes challenged our industry as well. Tradition is always comforting, particularly in a business where the eternal—art and beauty—intersects with the ephemeral—commerce and change. This industry is fortunate to have so many people who understand the importance of tradition, but who also can accept change and turn it into opportunity. As I said in my opening remarks, ours is a joyful business—and we should do all we can to keep it so—but it is not immune to all the technological change taking place around us and the resulting discomfort. Change is inevitable, and it is up to us to make change our friend.

Let me briefly touch on three areas of the diamond business where new and accelerating technological development will bring change that will affect all of us, as well as those who purchase our products: (1) diamond mining, (2) diamond polishing, and (3) diamond marketing.

*New technology has made it possible to recover diamonds from the Ekati mine, in the bitter cold of Canada's Northwest Territories. Photo © Jiri Hermann; courtesy of BHP Diamonds Inc.*



**Diamond Mining.** Satellite imaging, new breakthroughs in geochemical and geophysical methodology, enhanced recovery methods such as X-ray techniques, underwater mining in deeper and deeper waters, and incremental improvements in standard mining procedures—have all substantially increased diamond production, diamond reserves, and future potential. The new Ekati mine in Canada's frigid Northwest Territories, Namdeb's production offshore of Namibia, the mines in Botswana's harsh desert, and Russia's Alrosa mines close to the North Pole are all tributes to the ingenuity and capacity of the mining companies to develop and economically mine increasingly hard-to-access diamonds. Technology has made that possible. It is irreversible.

**Diamond Polishing.** Laser sawing, automated cutting machines, computerized planning, measuring and polishing machines, deep pressure boiling, and now the newly announced General Electric process to improve the color of a small portion of diamonds suitable to this application, have changed the capacity and economics of transforming rough stones to polished diamonds. Technology has made that possible—and here, too, it is irreversible.

**Diamond Marketing.** About a year and a half ago, John Chambers, the President of Cisco Systems—the company that makes the black boxes that connect the Internet—declared that, although most people did not grasp it yet, the Internet was about to change “everything” about how people work, invest, learn, shop, and communicate (T. L. Friedman, “Foreign Affairs: Are You Ready?” *New York Times*, June 1, 1999). In the future, 1999 will be remembered as the year that the Internet really began to penetrate the consciousness of America. The way people buy everything from cars to airline tickets and, yes, diamonds and jewelry—as well as the way they communicate, invest, work, and learn—is being fundamentally transformed. Technology has made that possible. Again, it is irreversible, and it is just the beginning.

U.S. Federal Reserve Chairman Alan Greenspan, testifying before the Joint Economic Committee, recently said, “Forecasting [the impact of] technology has been a daunting task.” I will not run where angels fear to tread, but let me suggest that the consequence of the technological breakthroughs in diamond mining is the availability of more rough diamonds in a greater variety of shapes, sizes, and qualities. The con-

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sequences of technological changes in diamond polishing are a broader and more diverse supply to the consumer and some adjustments in the relationships among certain diamond grades. The consequences of the Internet are a new way of marketing and, for the consumer, a new way of purchasing diamonds.

Given the conclusion that globalization and technology will increasingly be part of our lives, that these trends are irreversible and will gather greater momentum in the years ahead, and that our industry, like all other industries, will be challenged and surprised again and again, two questions come to mind.

The first is: *How should we as an industry feel about globalization and technology?* The answer to that simple question is crucial: It will determine how we come to grips with the changes that have already occurred, and with others that have yet to come. We can curse or condemn the new and try to roll it back. We can pretend it isn't here or that it will go away if we ignore it. Or we can, with hope and some trepidation, accept it as the unavoidable highlight of the age we live in, and turn it to our benefit and the benefit of our customers. This requires candor, realism, optimism, and adaptability. I have no doubt that our industry has the talent, entrepreneurship, resilience, and integrity to come to grips with this reality and the opportunity it presents.

The second question is: *How should we as an industry deal with the impact of globalization and new technologies?*

We field that question every day. The answer is obvious: adapt and prosper, resist and perish. Maybe the question should be restated: *How should we as an industry deal with these issues in relation to the consumer?* For in the final analysis it is our customers who determine whether we succeed or fail and whether this industry grows and prospers, or declines. The way we position our products and ourselves has an important bearing on the outcome. I have no easy or simple answer, but let me set forth some basic principles for a confident and optimistic outlook:

**First:** Our job is to present the facts. The modern consumer is better informed, better educated, has more access to information, and is better able and more willing to make up his or her own mind when the facts are presented.

**Second:** Our job is to trust their judgment. Our customers are part of the changing world; they are not



*With laser cutting, diamond manufacturers can create shapes that would have been impossible with traditional methods. Both this 12 mm long x 2 mm thick sailboat and the accompanying tennis racket were produced by this new technology. Photo © GIA and Tino Hammid.*

immune to it, and they know how to deal with innovation and change. They deal with that every day.

**Third:** With empowerment comes greater responsibility. What parent or grandparent has not watched with awe and admiration as a young child masters the Internet and is “on line” for his social life, his information, his learning? What parent or grandparent has not realized with trepidation that the Internet is different from radio, television, and newspapers in that it is totally open, interactive technology—without editors, censors, or filters. As you get connected, you have to understand that this is an empowering medium. It gives you millions of new choices, but many of these will not be appropriate.

This industry is fortunate to have institutions like the GIA and the AGS, the brainchildren of Robert Shipley. Their job is to inform and educate in a world that is constantly changing and where new technology affects all sectors of the industry: mining, polishing, and marketing. We who care for, and benefit from, this industry must also face up to the unavoidable changes that globalization and technology bring. Adjustment to some changes may be painful in the short run, but I submit to you, with confidence, that globalization and technology will open new and challenging opportunities for those with the vision to see them and the courage and optimism to grasp them. This industry is too robust and too vibrant to do otherwise.

# Meeting the Millennium *in the* Gem & Jewelry Trade

By William E. Boyajian

President, Gemological Institute of America  
Carlsbad, California

**T**HROUGHOUT HISTORY, humankind has worked with stone and metal to weave the “fabric of passion” referred to in Vince Manson’s opening comments into items of adornment. Just as great designers and craftspeople fashion these items into beautiful jewels, so have these jewels themselves helped fashion humankind.

Once again, we have seen how gems and jewelry bridge the arenas of life itself. They embody beauty. They engender love. They captivate the heart. Gems, like people, have personality. They smile at us. They speak to us. And we watch, and listen.

Over these past several days, we have looked at sources, production, distribution, and identification. We’ve listened to gemologists, designers, manufacturers, and marketers. We’ve addressed challenging issues. We’ve introduced new concepts. We’ve enlightened one another. Indeed, we have all been moved by the role that gems play—in science, in business, in art, and in tradition.

But within this rich history lies an uneasiness about the future of the gem and jewelry industry. This has been a century of revolutionary change: world wars, economic depressions, the advent of computer technology, a man on the moon, and a mission to Mars. It has also been one of radical change in the gem and jewelry industry: shifts in sup-

ply and demand, new retail formats, and sophisticated technological challenges.

The decade of the 1990s has been especially challenging for our industry. The over-retailed ‘80s became the efficiency-minded ‘90s. Mergers, acquisitions, and even bankruptcies dominated the scene. As a result, the number of storefronts has been greatly reduced, and those that survived often lack the trained personnel that are the hallmark of the professional jeweler.

At the wholesale level, we have seen how markets can be shattered by the unknowing—or unthinking—actions of only a few. The emerald industry is a case in point, where the use of unstable fillers without suitable disclosure in the search for short-term profits has devastated demand and left dealers struggling.

But something else changed: New realities set in, and these new realities require new rules.

The thesis I propose as we close this 1999 Symposium is simply this:

***We are an industry in transition,  
and we must adopt new rules to guide us.***

According to Massachusetts Institute of Technology (MIT) economist Lester Thurow (1999, p. 57), “the old foundations of success are gone.” For all

For thousands of years, gems have been fashioned into items of adornment. This magnificent diamond and platinum bracelet is set with the important 69.68 ct Excelsior diamond, the largest of 11 stones cut from the largest diamond (995.20 cts) ever found at the Jagersfontein mine. The bracelet was on view in the Nature of Diamonds exhibit at the San Diego Natural History Museum, March through September 1999.

Courtesy of Mouawad Jewelers, New York. Photo © GIA, by Harold & Erica Van Pelt.



of human history, he says, the source of success has been the control of natural resources. Land and oil are good examples. In our industry, the resources are diamonds, precious metals, colored stones, and pearls. Thurow maintains that the source of success today is knowledge. Knowledge has become the true resource.

This leads us to Rule #1 for an industry in transition:

***Whoever owns the gold  
does not always rule.***

Technology—knowledge, really—has had a profound impact on the “natural” resources of the gem and jewelry industry. It was knowledge that allowed Mikimoto to develop cultured pearls at the turn of this century. It was knowledge that helped Verneuil create synthetic corundum around the same time. It was knowledge that allowed General Electric to produce synthetic diamond in the 1950s. It was knowledge that helped Thai gem traders convert milky white Sri Lankan sapphire to beautiful blue material in the 1970s. And it is knowledge that allows GE to alter the color of certain natural diamonds today.

According to Lester Thurow, the types of changes we are seeing in the world today were last observed a century ago, during the industrial revolution. At that time, birth was given to the corporate research laboratory, as well as to the concept of *systematic* industrial

research and development. Technological advances did not just happen randomly; they could be systematically managed. Technological advances also led to economic and cultural change. Consider electricity: It spawned a whole new set of industries and radically altered the production processes of every existing manufacturer. With the electric light bulb, night became day. Performance and efficiency increased. People’s habits changed. As a result, societies, even entire cultures, were transformed. And technology—again, knowledge—threatens to have a greater global impact in the coming millennium. Here is what a senior executive at GE told me the other day: GE has enormous scientific, technological, and engineering capabilities. General Electric wants its name associated with *natural* diamonds, not synthetic diamonds. GE wants to make an impact—even help revolutionize—the diamond industry, in ways never before imagined. And GE will introduce a steady stream of new technology into the diamond business over the coming decade. This is only part of the new realities of which I speak.

Such change both intrigues and intimidates. Change brings progress, but it also brings increased competition. I’m reminded of a recent advertisement in which the headline read: “Competition is a lot like cod liver oil. First it makes you sick. Then it makes you better.” Change puts pressure on the status quo. It also thins margins for some, and fattens them for



*With knowledge, Japanese entrepreneur Kokichi Mikimoto developed the Akoya cultured pearl into a major industry. Cultured pearl necklace and earrings set with diamonds and blue sapphires are courtesy of Mikimoto Co.*

others. It has a way of bringing out the best, and worst, in people. Principles become bent, skewed in many directions. And the jewelry industry is not immune to change and its many consequences.

How does Thurow's theory of natural resources fit with our industry and Rule #1? Let's relate it to De Beers's natural resources and their current research on branding. Could it be that De Beers's control of the supply of diamonds is not as important today as their name or image? Could it be that De Beers will shift more of its energies from controlling supply to controlling the consumer's mind? For we are in an age, as Al Ries said earlier, when marketing in the new millennium is branding, and winning position in the mind of the consumer is vital (Ries, 1999). As savvy as De Beers is, it probably will try to control both supply and the mind.

Could it be, then, that the next natural resource of our industry—control of knowledge—looks less natural and more resourceful? For what are natural

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resources but products inherent to earth that we exploit for economic gain? Indeed, one of the biggest problems facing leaders in the new millennium will be how to develop our companies, organizations, and associations to maximize intellectual resources—to generate new ideas, new processes, new products, and new services. Knowledge is much more than data. It is a composite of experience and learning, and it constitutes the primary building block for any business entity. Strategic and focused, it is the key that enables one firm to do something significantly better than others. Thus, real knowledge creates real value, for stakeholders and consumers alike.

Today, we must learn how to do business and make money in whole new ways, because simply owning the product is not enough. Using information to create knowledge is the byword of success for the new century.

Rule #2, then, for an industry in transition, is this:

***Whoever controls knowledge rules.***

The 19th century marketplace was dramatically and forever changed by the industrial revolution. Companies that hesitated to embrace mass production failed or were diminished. The 20th century has been changed by the information revolution, and companies that refuse to embrace the technology of today will go the way of their 19th century counterparts.

It is axiomatic that those who fail to remember the past are doomed to repeat it. This must serve as a warning to each of us: Change and adapt, or suffer the consequences . . . as Peter Ueberroth advised in his June 21 opening address.

Unfortunately, the corporate junkyard in our industry is littered with the wreckage of dealers, manufacturers, and retailers who didn't see it coming, proceeded too slowly or too cautiously, or decided to look the other way.

The future has become clearer since our last Symposium in 1991, not just because we are eight years more advanced, but also because the elements of an information society are better developed and understood. Eight years ago we acknowledged the personal computer as a revolutionary product, not unlike the television was 40 years before. But we could hardly have imagined the emergence of the Internet as it exists today, let alone the convergence of these new communication technologies into what

*Education and knowledge provide the foundation and underpinning that allow an individual or a business to create new products and services with intrinsic as well as market value.*  
*Illustration by Peter Johnston.*



can be nothing less than revolutionary in the future.

We have learned that electronic commerce is both a challenge and an opportunity. It is a way for nimble businesses of all types to increase their effectiveness, reach untapped markets, develop new products and services, and boost profits. As Don Tapscott (1999) told us: "More direct selling via the Internet is a certainty." Specialists will do better because they won't try to be all things to all people. They'll do their thing better, and they'll reach more people in search of unusual products and services. They'll also fill niches that consumers demand, now and in the future.

In case you're not convinced about Rules 1 and 2, let me give you a few more industry examples that I'm sure will hit home. How is it that information on a piece of paper—a grading report—can appear to be more important than the gemstone itself? How is it that a man who owns no diamonds, like Martin Rapaport, can govern the price of them? How is it that owning proprietary technology can control the outlook of those who own the product it alters? That is, how can a firm like General Electric—through its new color altering process—have such a profound impact on the future livelihood of every dealer in the diamond pipeline?

Moreover, how is it that a 10-year-old electronic network may do more diamond business than a 100-year-old diamond bourse? How is it that the group owning most of the mines in Colombia cannot control the price of emeralds? How is it that laser inscription can be an impediment in the 1980s and a security measure in the 1990s? How is it that the analysis of cut can lie dormant for decades and regain life in only a few years?

Technology not only changes the way we do business, but it also changes the way we think. Technology adds new dimensions to reality and takes some away. One person's revelation becomes another

person's terror. One person's truth becomes another person's lie. Finding agreement is difficult, but not impossible. When reasonable people speak openly and honestly, rational compromise often prevails. This is a noble goal as we look to the new millennium: that fair-minded people, no matter what the stakes, can work together for the good of all.

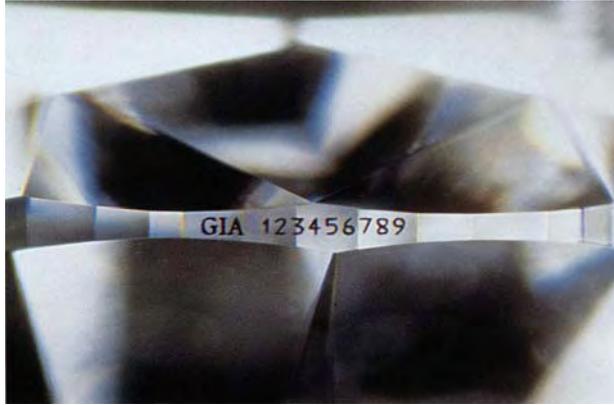
Rule #3 for an industry in transition:

***Continue to live by the Golden Rule:  
"Do unto others, as you would  
have others do unto you."***

The headline of Time magazine read: "What ever happened to ethics?" It is no coincidence that we asked a leading ethicist, Rushworth Kidder (1999), to speak at this event. What we tried to do at Symposium is share principles that can help lead and guide our trade as we work and learn together in the new millennium.

At GIA, our priorities remain the same: Education, Research, and the Gem Trade Laboratory. To be effective, education for professional development has to be grounded in reality. If learning is to be both retained and useful, it must be applied immediately and repeatedly. Our charter is to provide that education efficiently, affordably, and accurately. There is probably no better goal to help us live by the Golden Rule than to be a well-educated, well-trained industry. After all, consumers want to buy from knowledgeable jewelers whom they know and trust, just as jewelers rely on the knowledge and integrity of their suppliers.

At the 1991 Symposium, we revealed that the decade of the '90s would alter our thoughts about research in the future: Post-Cold War military technology would be converted to commercial enterprise,



Once considered an impediment to sales, laser inscription of a laboratory report number or other information on the girdle of a diamond is now a respected security measure. Photo © GIA.

and this new technology would begin to take its toll on the trade. Quoting from my 1991 speech, “. . . the money allocated to research on identification methods in the gem and jewelry community is *miniscule* compared to that allotted to developing synthetics and treatments. The jewelry industry is not prepared for the potential impact of such technology. For the good of the industry, the technology of gemstone identification must keep pace with the technology of gem synthesis and treatments.” (Boyajian, 1992, p. 30)

In the 1990s, we tackled some of the challenges brought on by this new technology: fracture-filled diamonds, synthetic moissanite, new synthetic sapphires and rubies, even synthetic diamonds. In the

Education is a major priority at GIA. Here we see a jewelry manufacturing student master the skills of a bench jeweler. Photo © GIA.



21st century, however, we will see the full effects of commercial exploitation of these technologies. What we are seeing with the new GE process, for example, is just the *tip* of the iceberg.

Gemological laboratories, therefore, are challenged as never before. And if *they* are challenged, imagine the dilemma for dealers, manufacturers, and retailers. No wonder more people are protecting themselves with third-party documentation. No wonder they're searching for additional measures of security. No wonder they question the future.

There are common pitfalls in every industry and in every firm. The strong desire for self-preservation is often coupled with an unwillingness to change and a resistance to fresh ideas. This fosters short-term thinking and, in some people, an overriding obsession with making money that leads them to hoard information and fail to disclose.

Yet mission *must be* more important than money, and doing what is right *must be* more important than determining who is right. Although I am not so naïve as to believe that noble motives are everyone's goal, I do know that *no one of us is as smart as all of us*. Only by working as a community will we prevail.

We are here at Symposium as people who care. We are leaders who can make a difference in this industry. While some things must change, others must not. We must remain true to the basic tenets of our industry, our core values of knowledge, integrity, standards, and quality. Yet these virtues cannot be produced on demand. At some point, we must be able to define what it means to act properly and responsibly. And we must always remember to live by the Golden Rule.

To summarize, then, our industry is in transition. We observe rapid change all around us, and we seek to make sense out of what, at times, appears to be chaos. I shared three Rules that I believe are axioms of the coming millennium. They are:

1. ***Whoever owns the gold does not always rule.***
2. ***Whoever controls knowledge rules.***
3. ***Live by the Golden Rule.***

I have used real-life examples from our industry to make these points. In particular, the models of success in the future are not necessarily those of the past.

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Owning the gold, diamonds, colored stones, and pearls is not enough in an information society. Owning value-added skills of support, service, technology and trading are at least as important. Owning a name, a brand, an image, or a reputation may be of even greater value.

Some people in our industry own a segment of it through sheer knowledge and intelligence. Those people who trade off of their strategic and intellectual capacities often hold an edge over others who are working with an older model. Older models may still apply, but if your profit margin, growth, or market share is declining, consider the benefits of change.

Finally, no matter what your belief system, basic values must prevail. At the end of the day, virtue wins out over greed, and operating by the Golden Rule will be more satisfying and, ultimately, will make you more successful.

So what did we learn at this Symposium?

- That gem and jewelry businesses must embrace change to survive
- That new treatments challenge gemology just as new viruses challenge medicine
- That change itself means progress, not demise
- That new technologies will only increase in the years ahead
- And that ethics and integrity really do matter

In conclusion, this industry's real challenge is to secure the hearts and minds of today's astute consumer. We live in the greatest consumer age in the history of humankind. While this is a great time, it is also a great test for our industry. At GIA, we have attempted to do our part over the years to help secure the future of the industry and to help ensure the pub-



*One of the most important technological challenges of the 1990s is synthetic moissanite, a diamond simulant that reads as diamond on a standard thermal probe. This synthetic moissanite is courtesy of Charles & Colvard (formerly C3, Inc.)*

lic trust in gems and jewelry. I can only hope that this Symposium has made even a small contribution to that effort. But it mustn't stop here. This is not a climax, but a beginning. Not a landing, but a launch.

The key to success in the year 2000 and beyond will be the ability of each of us to anticipate and prepare for the future. We have weathered the challenges of the past quite well, and every indication is that we can adapt and navigate through the rough waters ahead. This is an extremely resourceful and resilient industry, with remarkably agile people.

As we face the coming millennium, let's remember our experience of the Symposium. We saw the future here and—while challenging—that future is bright. Let's work together to make our dreams a vision, and our vision a reality, now and in the years to come.

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## REFERENCES

- Boyajian W.E. (1992) Facing the future in the gem and jewelry industry. In A. S. Keller, Ed., *Proceedings of the International Gemological Symposium, 1991*, Gemological Institute of America, Santa Monica, CA, pp. 27–33.
- Kidder R. (1999) Winning with ethics. Audio recording of lecture by Don Tapscott presented at the Third International Gemological Symposium, San Diego, California, June 24, 1999. *The Sound of Knowledge*, San Diego.
- Ries A. (1999) Marketing in the new millennium. Audio recording of lecture by Al Ries presented at the Third International Gemological Symposium, San Diego, California, June 24, 1999. *The Sound of Knowledge*, San Diego.
- Tapscott D. (1999) Digital technology. Audio recording of lecture by Don Tapscott presented at the Third International Gemological Symposium, San Diego, California, June 24, 1999. *The Sound of Knowledge*, San Diego.
- Thurrow L. (1999) Building wealth. *Atlantic Monthly*, June, pp. 57–69.

# Observations on GE-Processed Diamonds: A Photographic Record

By Thomas M. Moses, James E. Shigley,  
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*Observations made at GIA on 858 GE-processed diamonds revealed several interesting features that may be diagnostic of this kind of diamond. Specifically, a significant percentage exhibited a slightly hazy appearance, noticeable internal graining, and other unusual internal features.*

## Editor's Note

On June 23, at the Third International Gemological Symposium, representatives of GIA and the GIA Gem Trade Laboratory held a special session to provide an update on the situation regarding the diamonds processed by General Electric to improve their color (i.e., closer to colorless). This article follows up on that special session with the statistical results and a photographic record of GIA's examination of a large number of such diamonds.

AS OF AUGUST 1999, GIA STAFF MEMBERS had examined 960 natural diamonds that had undergone a new process, developed by the General Electric Company (GE), that removes some or all of the color of a diamond. Distributed exclusively by Pegasus Overseas Limited (POL), an Antwerp-based subsidiary of Lazare Kaplan International (LKI), the diamonds are referred to as GE POL or Pegasus diamonds in the trade. These GE-processed diamonds look like untreated diamonds; however, careful examination has revealed that some of them exhibit subtle features that usually are not present in natural-color diamonds. This article presents demographic information on 858 (of the 960) GE-processed diamonds that had been incorporated into the GIA Gem Trade Laboratory database as of July 15, 1999, and describes some of the unusual internal features that were seen. As recently stated by GE, the procedure used involves high pressure and high temperature and, to date, is effective only on certain high-purity and high-clarity diamonds (J. Casey, pers. comm., 1999; see Box).

## BACKGROUND

Earlier this year, Pegasus Overseas Limited announced to the jewelry industry that GE scientists had developed a new process to improve the color and other characteristics of a select group of natural diamonds. According to these announcements, the diamonds would be sold only through POL, and every direct purchaser would be informed in writing by POL that they were purchasing a GE-processed diamond. Such sales began in June 1999.

In press releases (e.g., March 1, 1999) and other public statements, POL representatives claimed that this process was designed to improve “the color, brilliance, and brightness” of qualifying diamonds, and that the results were “permanent and irreversible.” They stated that it did not involve any conventional diamond treatment

methods (such as irradiation, laser drilling, surface coating, or fracture filling), but rather it was merely an extension of the manufacturing of rough into polished diamonds. Nor did the processed diamonds require any “special care and handling.” Last, they also reported that these GE POL diamonds would “be indistinguishable” from natural-color diamonds by jewelers and gemologists using standard gem-testing equipment and techniques.

Since the initial announcement, representatives of GE, POL, and GIA have held a series of useful and ongoing discussions to address the concerns of the jewelry trade, and ultimately the consuming public, about this new GE process. These discussions resulted in specific steps taken by GE to laser inscribe the girdle surface of all of their processed diamonds with



Figure 1. The laser-inscribed “GE POL” is readily visible on the girdle surface of this 1.25 ct marquise-shaped diamond. Photomicrograph by John I. Koivula; magnified 40×.

the letters “GE POL” (figure 1), and by POL to then submit these diamonds to the GIA Gem Trade

## RESEARCH ON DIAMONDS AT THE GENERAL ELECTRIC COMPANY

Research at the General Electric Company on the properties of diamond as an industrial material extends back more than 50 years. One result of this ongoing research program was the discovery of a new process that improves the color of a select group of rare natural diamonds. Specifically, exposure of certain high-purity diamonds to high temperature and high pressure removes their extrinsic color centers (i.e., those caused by the external forces that affected the diamonds after they formed in the earth’s mantle), so they display their optimum intrinsic color (i.e., as they originally grew). (For more information on the cause of color in diamonds, see Field [1979] and Fritsch [1998].)

The new process simulates the high pressures

and temperatures to which natural diamonds were subjected while they were deep in the earth’s mantle (see, e.g., Kirkley et al., 1991). The diamonds that respond to this method represent in volume significantly less than 1% of “run of mine” diamonds. After processing, most of the diamonds are in the D through G color range, and most require repolishing.

This discovery evolved through years of scientific and technical work. The General Electric Company is currently working with the jewelry industry to develop practical means of identification and to educate the industry’s members about these processed diamonds.

**Dr. T. Anthony and Dr. J. Casey**  
*The General Electric Company*

### REFERENCES

Field J.E. (1979) *The Properties of Diamond*. Academic Press, London.

Fritsch E. (1998) The nature of color in diamonds. In G. Harlow, Ed., *The Nature of Diamonds*,

Cambridge University Press, New York, pp. 23–47.

Kirkley M.B., Gurney J.J., Levinson A.A. (1991) Age, origin, and emplacement of diamonds: Scientific advances in the last decade. *Gems & Gemology*, Vol. 27, No. 1, pp. 2–25.

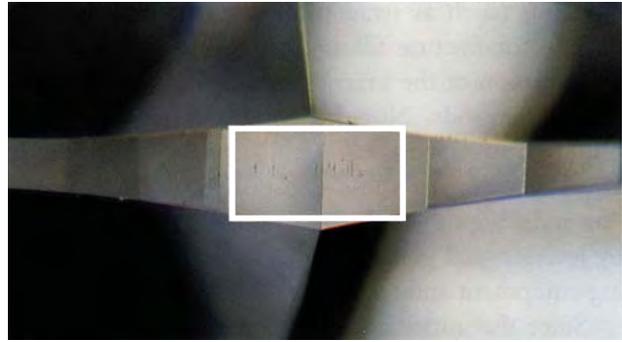
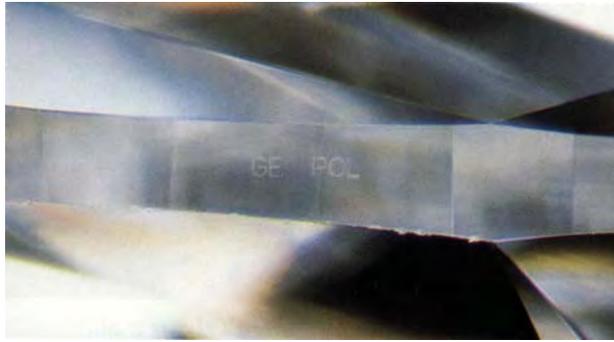


Figure 2. In several instances, GE-processed diamonds have been resubmitted to the GIA Gem Trade Laboratory, by individuals other than Pegasus representatives, with the “GE POL” inscription partially or completely removed. The database of information on the GE-processed diamonds we examined helped us detect these stones. In the photo on the left, the black appearance of the inscription has been removed, so that the “GE POL” is less visible. In the photo on the right, only small portions of the original inscription are still visible. Photomicrographs by Shane F. McClure; magnified 40×.

Laboratory for reports that would identify that these stones had undergone the GE process. This inscription provides an immediate, practical means of recognition throughout the trade. In addition, GIA makes the following comment on grading reports for all such diamonds sent to the GIA Gem Trade Laboratory by POL: “‘GE POL’ is present on the girdle. Pegasus Overseas Limited (POL) states that this diamond has been processed to improve its appearance by General Electric Company (GE).” GE and

POL officials also have expressed support for GIA’s efforts to develop additional means of identifying these diamonds.

During the three-month period from early May through July 1999, POL submitted 960 laser-inscribed diamonds to the GIA Gem Trade Laboratory for reports. They were examined by experienced diamond grading, identification, and research staff at GIA’s offices in New York and Carlsbad. This

Figure 3. As illustrated here, most of the 858 GE POL diamonds examined by the GIA Gem Trade Laboratory weighed less than 2.00 ct.

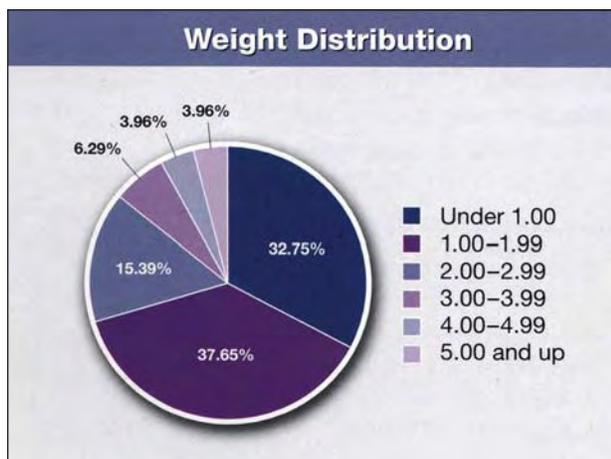
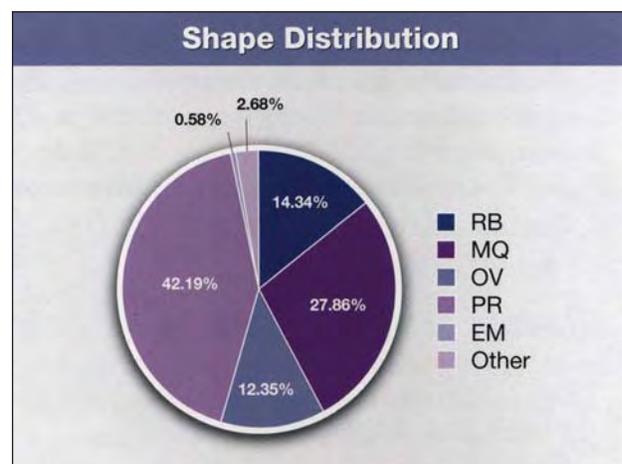


Figure 4. The majority of these diamonds were fashioned in one of several fancy shapes (most frequently marquise or pear shapes). (RB = round brilliant; MQ = marquise; OV = oval; PR = pear shape; EM = emerald)



examination of a large group of known GE-processed diamonds—using both standard identification and grading techniques and, for some of the samples, advanced spectroscopic methods—gave us the unique opportunity to collect data on each diamond. This database has already proved of value by allowing us to recognize several of these diamonds that were subsequently resubmitted to GIA but with the “GE POL” inscription partially or completely removed (figure 2).

We have compiled certain demographic data on this group of GE POL diamonds. These are presented below, together with a description—and illustrations—of the various unusual internal features we observed.

### DEMOGRAPHIC DATA

**Diamond Type.** Diamonds are classified into four major categories—referred to as types Ia, Ib, IIa, and IIb—according to the presence or absence of the trace elements nitrogen or boron in their crystal structure. These four categories of diamonds can be distinguished on the basis of ultraviolet transparency and visible and infrared absorption spectra, among other characteristics.

Whereas most near-colorless diamonds seen in the GIA Gem Trade Laboratory are type Ia, the vast majority (99%) of the 858 GE POL diamonds were type IIa. This was determined by their transparency to short-wave ultraviolet radiation and internal features, such as crosshatched (“tatami”) strain patterns.

**Size.** The 858 diamonds in our sample ranged from 0.18 to 6.66 ct, with an average weight of 1.69 ct. The majority weighed less than 2.00 ct (figure 3). Note, however, that more than two-thirds (577) were 1.00 ct or more.

**Shape.** As illustrated in figure 4, 86% of these diamonds were cut in one of several “fancy” shapes—mainly oval, marquise, and pear; most of the remainder were round brilliants. This is consistent with the recent POL statement that they choose fancy shapes to obtain maximum value from the original rough (“GE/LKI support disclosure . . .,” 1999).

**Color.** A high proportion (80%) of the GE-processed diamonds were described as “colorless” or “near-colorless” (from grades D through G; see figure 5). In

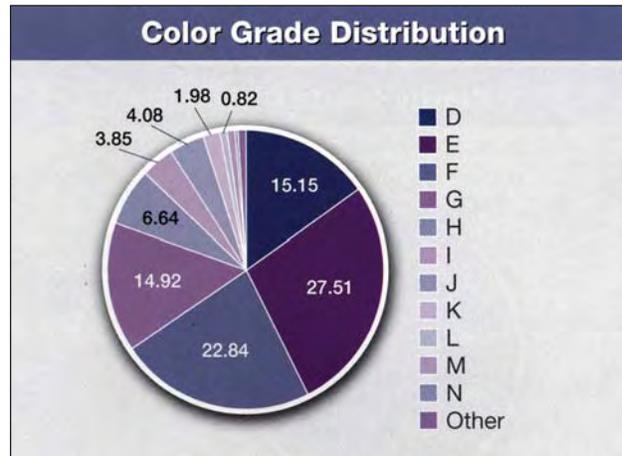


Figure 5. Although the entire range of color grades (from D through Z) were represented by the 858 GE-processed diamonds, most of these diamonds were in the colorless to near-colorless range (D through G). A few were distinctly yellow, and fell in the color grades between O and Z.

28% of the samples, however, members of our grading staff commented that the diamonds had a slightly brownish or grayish color appearance when examined with the GEM Diamondlite™ or a gemological microscope. LKI president Leon Tempelman recently commented that most of the diamonds are “top brown” before the process is applied, “with others generally within the brown family” (Donahue, 1999).

Of the 20% that fell below “near-colorless” on the color-grading scale, the largest portion (16% of the total group) were in the H–K range and 3% of the total group were in the L–N range. The remainder were highly colored: Several were distinctly yellow, two fell in the O–P range, two in the S–T range, two in the U–V range, and one in the Y–Z range.

**Clarity.** Consistent with the recent GE statement that only high-clarity diamonds are chosen for processing, the majority of the GE POL diamonds (61%) were graded as being IF or VVS<sub>1</sub>. Most of the remaining diamonds were distributed over VVS<sub>2</sub>, VS<sub>1</sub>, and VS<sub>2</sub>, with very few in the SI or I categories (see figure 6). GE has confirmed that they select high-quality stones for economic reasons (J. Casey, pers. comm., 1999).

**Ultraviolet Fluorescence.** We found that 79% of the sample diamonds did not fluoresce to either long-

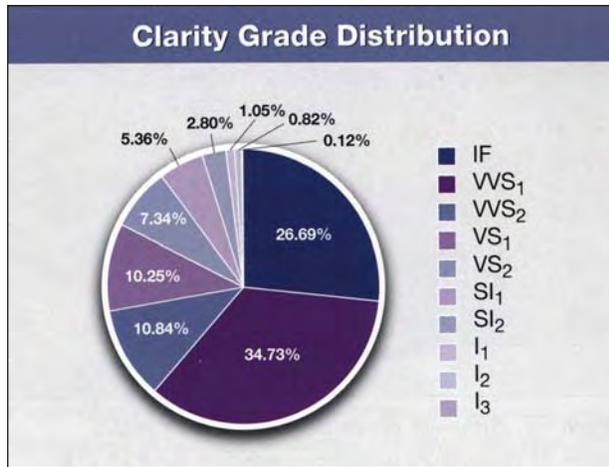


Figure 6. In general, the clarity of the sample diamonds was higher than normally would be expected in a general population of untreated colorless to near-colorless diamonds, with 61% clarity graded as IF or VVS<sub>1</sub>.

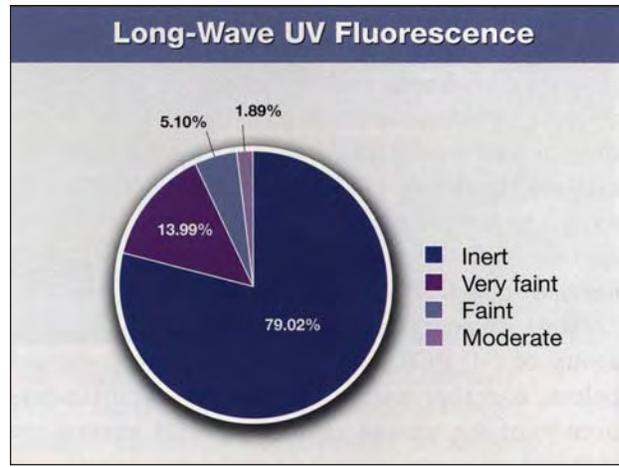


Figure 7. The vast majority of the GE POL diamonds were either inert, or displayed very faint fluorescence, when exposed to long-wave ultraviolet radiation.

or short-wave ultraviolet radiation (figure 7 presents the results for long-wave UV). All of the remaining 21% fluoresced blue, most with an intensity of very faint to faint. This fluorescence reaction corresponds to that of natural-color type IIa diamonds.

Figure 8. Graining was seen in a large number of GE-processed diamonds, and was one of the most prominent internal features of these stones. In some cases, the graining appeared whitish. In those diamonds where the graining was most intense, it seems to have contributed a slightly hazy appearance to the overall stone. Photomicrograph by John I. Koivula; magnified 35 $\times$ .



#### INTERNAL FEATURES

GIA's examination of this large number of GE POL diamonds, in some cases at high (up to 200 $\times$ ) magnification, revealed a variety of unusual internal features, such as graining (figures 8 and 9) and inclusions (figures 10–16). This section expands the photographic record of the visual features we observed in the GE-processed diamonds (see, e.g., Shigley et al., 1999, for an earlier report), to help members of the industry better distinguish such diamonds. Further work is in

Figure 9. Also observed was brown graining, often in a parallel banded pattern. Photomicrograph by Shane F. McClure; magnified 40 $\times$ .



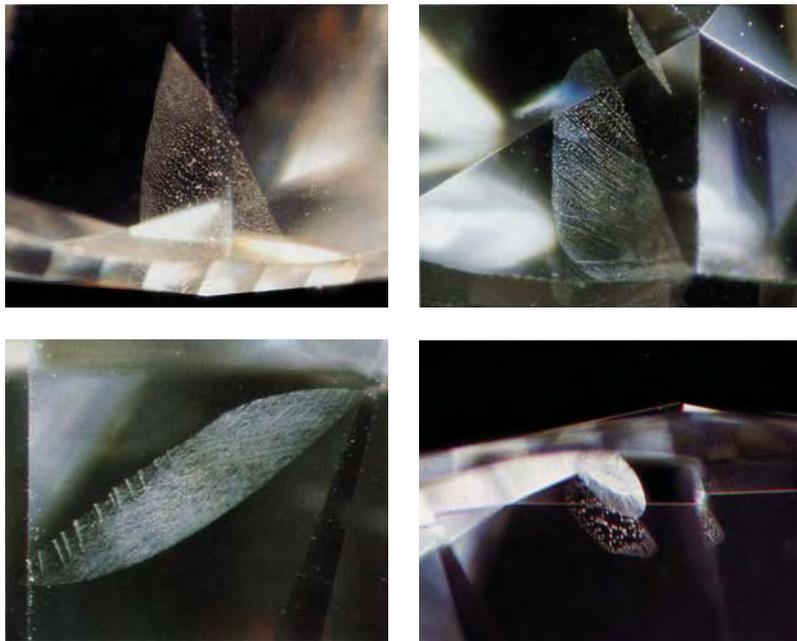


Figure 10. “Partially healed” cleavages were seen in a number of the GE POL samples. Some, as on the top left and right (magnified 13× and 18×, respectively), were similar in appearance to the “fingerprint” inclusions seen in some colored stones. Others had an unusual network-like appearance (bottom left, 18×), and one showed a partially healed cleavage next to a granular/glassy cleavage similar to those described in figure 11 (bottom right, 32×). The first three photomicrographs are by Shane Elen; the last is by Shane F. McClure.

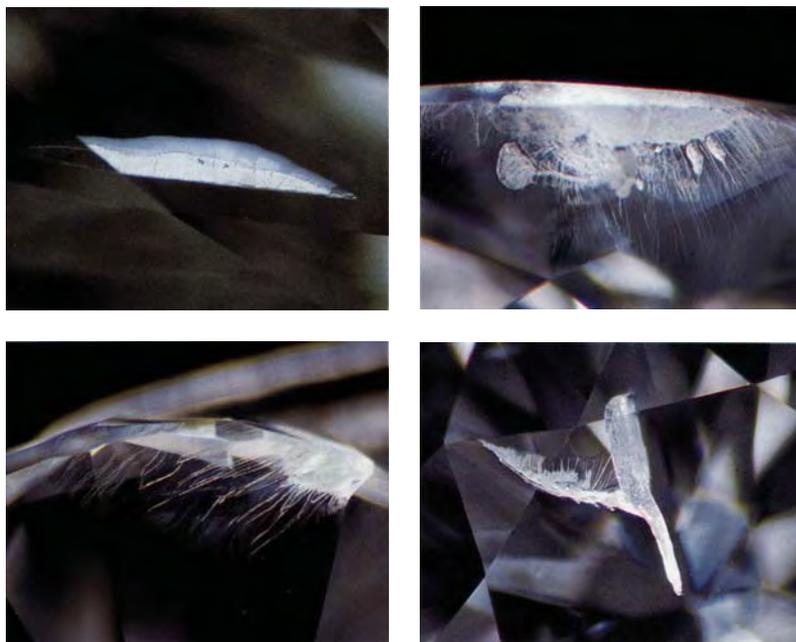
progress to see if any—or a combination—of these visual features will provide conclusive evidence that a diamond has been exposed to GE’s or a similar high pressure/high temperature procedure.

**Graining.** Internal graining was seen in more than 75% of the GE POL diamonds. Our graders described the graining as very subtle to obvious, sometimes with

a “whitish” appearance (figure 8), but occasionally brown (figure 9). Graining also occurs in natural-color type IIa diamonds, though less frequently.

The GIA grading staff noticed that 45% of the diamonds displayed a slightly hazy appearance, especially when viewed with the microscope at 10× magnification. This may be due to graining or to some other light-scattering effect. Some of the diamonds did not

Figure 11. These cleavages appear granular and reflective (i.e., more opaque) where they intersect the surface of the diamond, and are glassier and more translucent deeper within the separation. Top left—photomicrograph by John I. Koivula, magnified 40×; top right and bottom—photomicrographs by Shane F. McClure, magnified 40× (top right and bottom left) and 33× (bottom right).



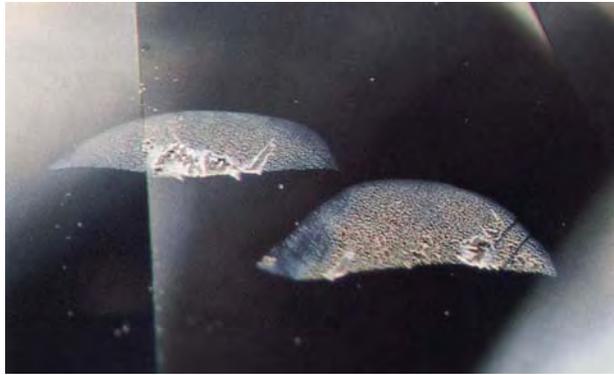


Figure 12. Each of these two partially healed cleavages has a black area similar to one identified as graphite in another sample by Raman analysis. Photomicrograph by Shane Elen; magnified 18 $\times$ .



Figure 13. This small solid inclusion surrounded by a stress crack is an example of a feature seen in 103 of the GE POL diamonds. Photomicrograph by Vincent Cracco; magnified 63 $\times$ .

exhibit the “crisp,” transparent appearance typical of natural untreated diamonds of similar color, clarity, and type.

**Other Features Seen with Magnification.** One or more of the following internal features were observed in more than 30% of the samples: (1) surface-reaching cleavages or feathers; and (2) included crystals, typically with strain cracks or halos.

Many of the surface-reaching cleavages appeared to be “partially healed”; that is, they resembled the “fingerprint” inclusions that are seen in sapphire and ruby (figure 10). In other cleavages, we noticed that close to the surface of the diamond they had a frosted or granular appearance; but deeper within the stone, they became glassier (figure 11). A black area was seen in some of the cleavages (figure 12); laser Raman microspectrometry identified the material in one

feather as graphite. Although cleavages are seen in some natural-color diamonds, we have not observed this distinctive combination of features in surface-reaching cleavages or feathers in untreated near-colorless diamonds.

We noted included crystals that were surrounded by stress cracks (figure 13) in 103 samples. In a number of instances, we observed black patches of what also appeared to be graphite that were surrounded by a translucent halo of tiny cracks radiating outward (figure 14). As is the case with colored gems such as ruby and sapphire, this radial cracking may be due to the differences in thermal expansion of the inclusion and the host diamond during heating to high temperature. A circular cleavage forms around the inclusion along the octahedral plane to relieve the resulting stress within the diamond.

Other inclusions consisted of one or more areas of

Figure 14. In most of the 103 samples that had solid inclusions surrounded by a stress crack, a black inner area (graphite) was surrounded by a brighter halo of outward radiating cracks (left; also evident here is the banded internal graining seen in a number of the GE POL diamonds). In some instances, there were several areas of graphite (right). Photomicrographs by John I. Koivula; magnified 40 $\times$ .





Figure 15. This inclusion contains several areas of what appear to be graphite, which are surrounded by mesh-like zones of tiny cracks. Photomicrograph by John I. Koivula; magnified 40 $\times$ .

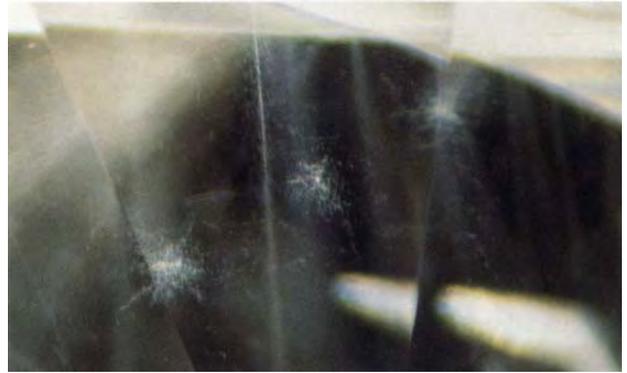


Figure 16. Approximately 2% of the GE POL diamonds exhibited unusual localized clouds and stringer-like clouds. Photomicrograph by Shane F. McClure, magnified 40 $\times$ .

what appeared to be graphite, surrounded by a mesh-like region of small cracks (figure 15). Again, these inclusions are unlike the included crystals or cracks that are typically seen in untreated near-colorless diamonds.

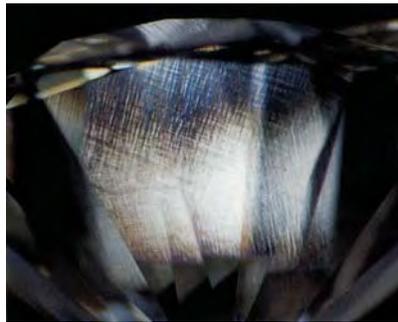
Some solid opaque inclusions did not exhibit these radial cracks, but instead showed a melted or flow structure. These may have been sulfide inclusions, which are seen in some natural diamonds.

Unusual localized clouds or cloud-like formations (which resembled the stringers sometimes seen in ruby) were present in approximately 2% of these diamonds (figure 16).

**Strain.** Most of the GE POL diamonds exhibited moderate-to-strong strain patterns (with crosshatched [“tatami”], banded, and/or mottled arrangements; see figure 17) when examined between crossed polarizing filters with a polariscope or gemological microscope. In the majority of these samples, the strain colors were first- and second-order gray, blue, or orange. In comparison, natural-color type IIa diamonds (which can show similar strain patterns) usually exhibit less-intense gray and brown interference colors (Lang, 1967).

**Discussion.** Although the internal features noted here were usually subtle in appearance, the fact that they

Figure 17. When viewed with cross-polarized light, most of the GE POL diamonds exhibited banded (left) or crosshatched (center and right) strain patterns. Although some stones did reveal low-intensity interference colors (right), for the most part these diamonds showed moderate- to high-intensity interference colors (center and left), notably stronger than what is normally seen in untreated diamonds of similar color. Left and center photomicrographs by Shane F. McClure, magnified 20 $\times$ ; right photomicrograph by John I. Koivula; magnified 20 $\times$ .



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were observed in many of the 858 diamonds reinforced our belief that these features were (1) produced in the diamonds as a result of this process, or (2) pre-existed in the kind of diamond selected for processing. In either case, we have rarely encountered the precise features described here in the colorless to near-colorless type IIa natural-color diamonds submitted over the years to our laboratory for grading reports.

To date, we have not established any definitive identification features in GE POL diamonds that can be detected by instrumental measurement (e.g., an absorption band produced in type IIa diamonds by the GE process, which could be recorded by a spectrophotometer). Thus, visual features (especially the use of a laser inscription on the girdle, as mentioned above) may offer the jeweler or gemologist the best way at this time to recognize a GE POL diamond.

## CONCLUSIONS

For the most part, the 858 GE-processed diamonds that formed the database reported here: (1) were type IIa diamonds, (2) weighed an average of 1.69 ct, (3) were fashioned in fancy shapes, (4) fell in the D-to-G range of color grades, (5) had high clarity grades, and (6) did not fluoresce to UV radiation. In addition, many of these diamonds showed a slightly hazy appearance, often with noticeable internal graining—characteristics that were far more common in this group of diamonds than in a similar population of natural-color diamonds. Other internal features (cleavages, feathers, and solid inclusions) were also somewhat different in appearance from what we have previously observed in untreated near-colorless diamonds. None of the GE-processed diamonds exhibited any evidence of “traditional” diamond treatments (such as irradiation, fracture filling, surface coating, or laser drilling). On the basis of the diamonds we have examined to date, we believe that it is possible to detect at least a portion of these GE POL diamonds using standard gemological observation techniques and equipment.

GIA has undertaken a research program to better understand the techniques used to improve diamond color and also to learn what color changes can be produced and how extensive these modifications may be. Results of these experiments will be published as they become available. If we can reproduce some of the same apparently characteristic features seen in the GE-processed diamonds examined to date, then such features may provide a way to identify that the color of a diamond has been altered by this method.

However, it is also possible that further development work could minimize or eliminate some of the unusual internal features we have noted in these diamonds. It is likely that various organizations will continue to experiment with this type of treatment, and that greater numbers of such diamonds will find their way into the jewelry trade. Although every effort is being made to keep up with these new technologies, we cannot guarantee that practical means will be found to recognize all of these diamonds.

*Acknowledgments: The authors thank Dr. Thomas Anthony and Dr. John Casey of GE Corporate Research & Development, Schenectady, New York, for their assistance. Grading of the GE-processed diamonds was supervised by Bruce Lanzl and Ed Schwartz of the GIA Gem Trade Laboratory.*

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## REFERENCES

- Donahue P.J. (1999) Tempelsman: Consumers mixed on GE POL pricing. Web site <http://www.professional-jeweler.com>, October 14.
- GE/LKI support disclosure and detection (1999) Interview with Leon Tempelsman in *Rapaport Diamond Report*, Vol. 22, No. 36, October 1, p. 23 *et passim*.
- Lang A.R. (1967) Causes of birefringence in diamond. *Nature*, January 21, p. 248 (figure 3 and section V).
- Shigley J., Moses T., McClure S., Van Daele M. (1999) GIA reports on GE POL diamonds. *Rapaport Diamond Report*, Vol. 22, No. 36, October 1, p. 1 *et passim*.



*Special video presentation by De Beers Chairman Nicholas Oppenheimer.*

*GIA President Bill Boyajian delivers his welcoming remarks.*



*"Mr. GIA,"  
Richard T. Liddicoat.*

# PEOPLE PLACES & EVENTS



*Keynote speaker Peter Ueberroth proposes a "two at the top" system for businesses, where two individuals are able to function interchangeably as leaders.*



*Bill Boyajian, Symposium Co-Chair Alice Keller, Richard T. Liddicoat, GIA Executive Chairman Ralph Destino, and Symposium Co-Chair Kathryn Kimmel at the opening ceremony.*



Right: Mark Van Bockstael, Jean-Pierre Chalain, Karl Schmetzer, and Henry Hänni.

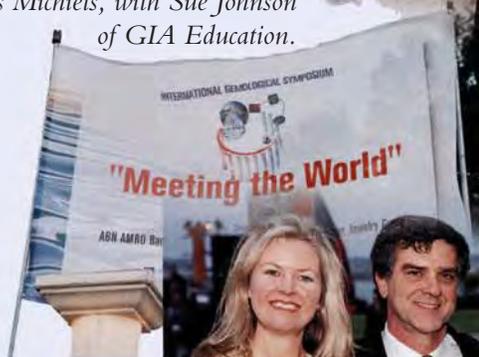
Below: Gina Latendresse, Frank Mastoloni, Renee Latendresse, and Tom Chatham. At the "Meeting the World" Opening Reception.



Right: GIA students Mithun Sacheti, Isabelle Don Carli, Aurelie Gourg, and Jean François Michiels, with Sue Johnson of GIA Education.



Below: George Houston and Al Woodill.



Right: Sheryl Cashmore, Isaac Dekalo, Nir Livnat, and Hadasa Dekalo.



Above: (Standing) Ezriel Rapaport, Martin Rapaport, Eli Izhakoff, Dafna Avigur, Chaim Even-Zohar, and Martin Hochbaum; (Seated) Rivka Rapaport, Norma Haas, Eli Haas, Rachel Rosin, and Lorri Dee Dukes.

Above: Susan Jacques, Howard Herzog, and Lynn Ramsey.

Right: Branding War Room moderator Whitney Sielaff and panelists Al Molina, Sheldon David, Liz Chatelain, Steven Lagos, Esther Fortunoff, Glenn Rothman, Scott Kay, and Eli Haas pose with former Marine Jackie "Spyder" Lockhart.

Below: Garry Holloway argues his point at the Diamond Cut War Room.



Above: A capacity War Room audience listens expressively.

Left (superimposed): Whitney Sielaff.

Left: The Diamond Production panel.

Left: Russell Shor asks a question from the floor.



Michael DeBurgh adds his voice to the Branding War Room, as Daniel Sauer looks on.

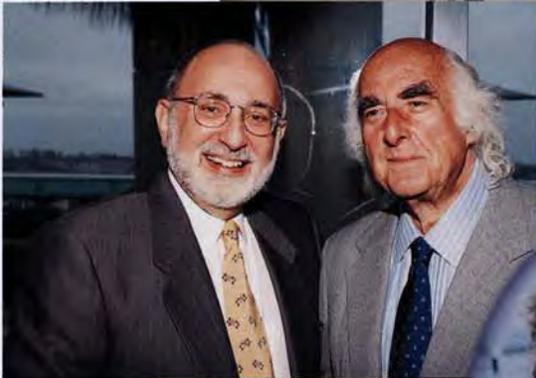


Thomas Gübelin, during the Leadership Role of Fine Jewelry panel.



Left: The San Diego Natural History Museum, site of the “Nature of Diamonds” exhibit and the “Diamonds—The New Millennium” gala event.

Below: Ben Janowski and William Goldberg.



Below: Sheryl Cashmore, Elise Misorowski, Hertz Hasenfeld, Sally Ehmke, and Al Levinson.



Above: James Rothwell, president of BHP Diamonds; Chuck Fipke, chairman and founder of Dia Met Minerals; and Jim Eccott, president of Dia Met Minerals.

Center: Symposium Manager Carol Moffatt; Directly above: Jim Eccott extends his welcome to “Diamonds—The New Millennium.”

Performance by the Delta Drummers, a native dance troupe from the Northwest Territories.



*The Platinum Dancers.*

*Below: Zlata and Jules Sauer;  
Dona Dirlam and John Sinkankas;  
and Kurt and Julia Nassau with  
Eric Wong.*



*Above: Laurie Hudson welcomes attendees to the Platinum Breakfast;  
Henry Kennedy presents his poster on "Publicity and Profits."*

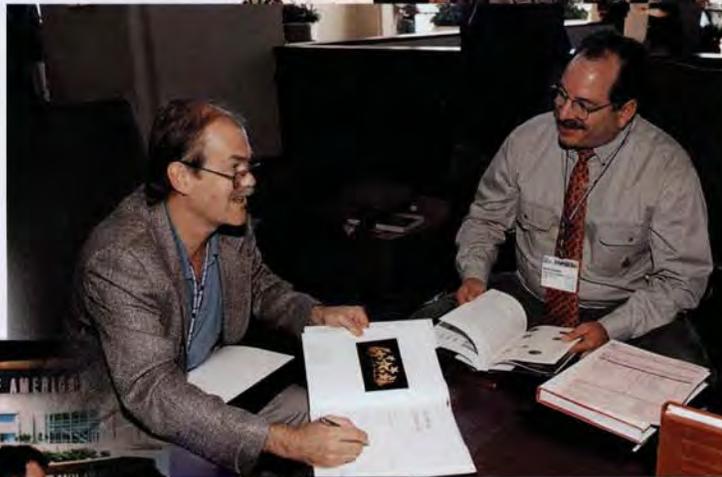
*Directly above: "White Hot Platinum: The Metal of the Millennium."*





*Bill Boyajian and Tom Yonelunas update the trade on GE-processed diamonds.*

*Disclosure War Room: Mary Johnson, Cheryl Kremkow, George Rossman, Nanette Forester, Francesco Roberto, Roland Naftule, Cecilia Gardner, Esther Fortunoff, and Jeffrey Fischer.*



*George Harlow signs a copy of Nature of Diamonds for Kevin Castro.*



*The Alumni Internet Café was a popular attraction.*

*Carole Johnson and Cassidy Kennedy at the Gems & Gemology booth.*



*Akoya, Tahitian, and South Sea pearl fashions were on display at "Of Future Days: A Pearl Fashion Preview."*

*Below: Cuixia Mi and Robert Wan.*

*GIA students Holly Rice, Michelle Orlik, Fumiyo Ishida, and Jessica Bole at the Pearl Reception.*



*Above: Kathryn Kimmel, Gabriël Mattice, Cindy Edelstein, and Cheryl Kremkow.*

*Directly above: Runway models display the elegance of pearls at the "Pearl Fashion Preview."*

*Above: Fran Mastoloni and Frank Mastoloni.*

*Directly above: Elvira Cornell and Varujan Arslanyan.*

*“Arte in Oro,” Symposium’s final social event, showcased jewelry by Italy’s leading designers.*



*Top left: Wendy Davis and Terri Ottaway at the “Arte in Oro” reception.*



*Contemporary Italian jewelry designers weave time-honored artistic traditions with innovative techniques to create the classics of tomorrow.*





*Italy's rich artistic heritage—extending from the Middle Ages through the Renaissance and the Baroque era—came to life at "Arte in Oro."*

*Above: Richard T. Liddicoat and E-Mae Bradbury enjoy the show.*

*Below: Bill Boyajian, Vicenza Trade Fair Board President Giovanni Lasagna, Ralph Destino, Vicenza Trade Fair Board Executive Director Andrea Turcato, and soprano Pamela Hicks.*



*Lower Left: Lynn Ramsey, Gary Gordon, and Italian Jewelry Guild President Robyn Lewis.*





*Top left: Bill Boyajian with Maurice Tempelsman at the Closing Ceremony.*

*Top right: Bert Krashes and Glenn Nord during the "Gemology Greats" session.*



*Rushworth Kidder urges gem and jewelry professionals to support ethics: "The question is: Will we self-regulate, or have regulation imposed on us?"*



*Noted economist Arthur Laffer presents his economic forecast for the new century.*

*Clockwise from middle left: Gemology greets Richard T. Liddicoat and Robert Crowningshield; Donald Tapscott describes how the Internet will change the way the jewelry industry does business; according to marketing expert Al Ries, "If you want to build a powerful brand in the mind of consumers, you need to contract your brand, not expand it." Center: Maurice Tempelsman delivers the valedictory presentation.*

# Abstracts of Feature Presentations

## Sessions

- 34** **DIAMOND SOURCES**  
Moderator: John I. Koivula  
Coordinators: Thomas Gelb and Maha DeMaggio
- 44** **DIAMOND MANUFACTURING AND DISTRIBUTION**  
Moderator: Thomas C. Yonelunas  
Coordinators: Kelly Shanley and Mark Van Daele
- 50** **DIAMOND ECONOMICS**  
Moderator: John M. King  
Coordinators: Scott Guhin and Jonathan Cohen
- 55** **PERSPECTIVES ON THE DIAMOND MARKET**  
Moderator: Alice S. Keller  
Coordinators: Marla Belbel and Daniel Gillen
- 60** **COLORED STONE SOURCES**  
Moderator: Brendan M. Laurs  
Coordinator: Jana Miyahira-Smith and Michael Wobby
- 68** **COLORED STONE DISTRIBUTION AND MARKETING**  
Moderator: Wendi M. Mayerson  
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- 73** **PEARLS—THE SOURCES**  
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Coordinators: Karin Hurwit and Clara Zink
- 80** **GEM IDENTIFICATION**  
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Coordinators: Dino DeGhionno and Troy Blodgett
- 88** **TREATMENTS**  
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Coordinators: Ronnie Geurts and Stuart Overlin
- 97** **TIMELESSNESS OF ANTIQUE AND ESTATE JEWELRY**  
Moderator: Veronica Clark-Hudson  
Coordinators: Rebekah Nichols and Laura Small
- 103** **ORIGINAL AND TREND-SETTING JEWELRY DESIGN**  
Moderator: Susan B. Johnson  
Coordinators: Steve Workman and Corrine Perez-Garcia
- 107** **RETAILING IN THE NEW MILLENNIUM**  
Moderator: Harry W. Stubbert  
Coordinators: William Herberts and Roxana Lucas

## Changes and New Developments in Africa

John J. Gurney

*University of Cape Town*

Rondebosch, South Africa

**A**NALYSIS OF HISTORICAL RECORDS (e.g., Levinson et al., 1992) reveals that Africa has been the source of about 70% by weight of the global total of about 3.5 billion carats (700 metric tons) of diamonds produced since antiquity, chiefly from primary kimberlite deposits but also with substantial high-value contributions from secondary sources, mainly alluvials. All the significant kimberlite mines have been found within the stable Archean (>2.5 By [billion years]) cratonic nuclei of the continent (Janse, 1996). The major alluvial fields are on, or adjacent to, these geologic structures; are derived from them by secondary surficial processes; and have been a declining influence in recent times. Moving away into peripheral Early Proterozoic rocks (between 1.6 and 2.5 By), there is much less chance of finding an economic primary diamond source. Current knowledge of diamond formation processes in the earth's mantle predicts that the likelihood of finding economic kimberlite pipes off cratons is extremely low. This rules out large areas of the African continent from hosting an as-yet-undiscovered primary diamond source, as can be seen from the figure shown here (reprinted from Janse, 1996).

Some geologically favorable terrain for primary diamond sources occurs within countries that are, to varying degrees, unsafe places to operate and particularly unsafe to explore. Two of these, Angola and Zaire, are currently producing diamonds under conditions of civil war. Nevertheless, they have been important diamond producers from secondary deposits for many decades, and they have high potential for further discoveries of new primary deposits. Indeed, De Beers announced four new discoveries in Lunda Norte Province, Angola, during 1998. Extensive exploration in certain other cratonic sources, such as North Lesotho, indicates that the discovery of a major kimberlite pipe is unlikely.

### Current Production

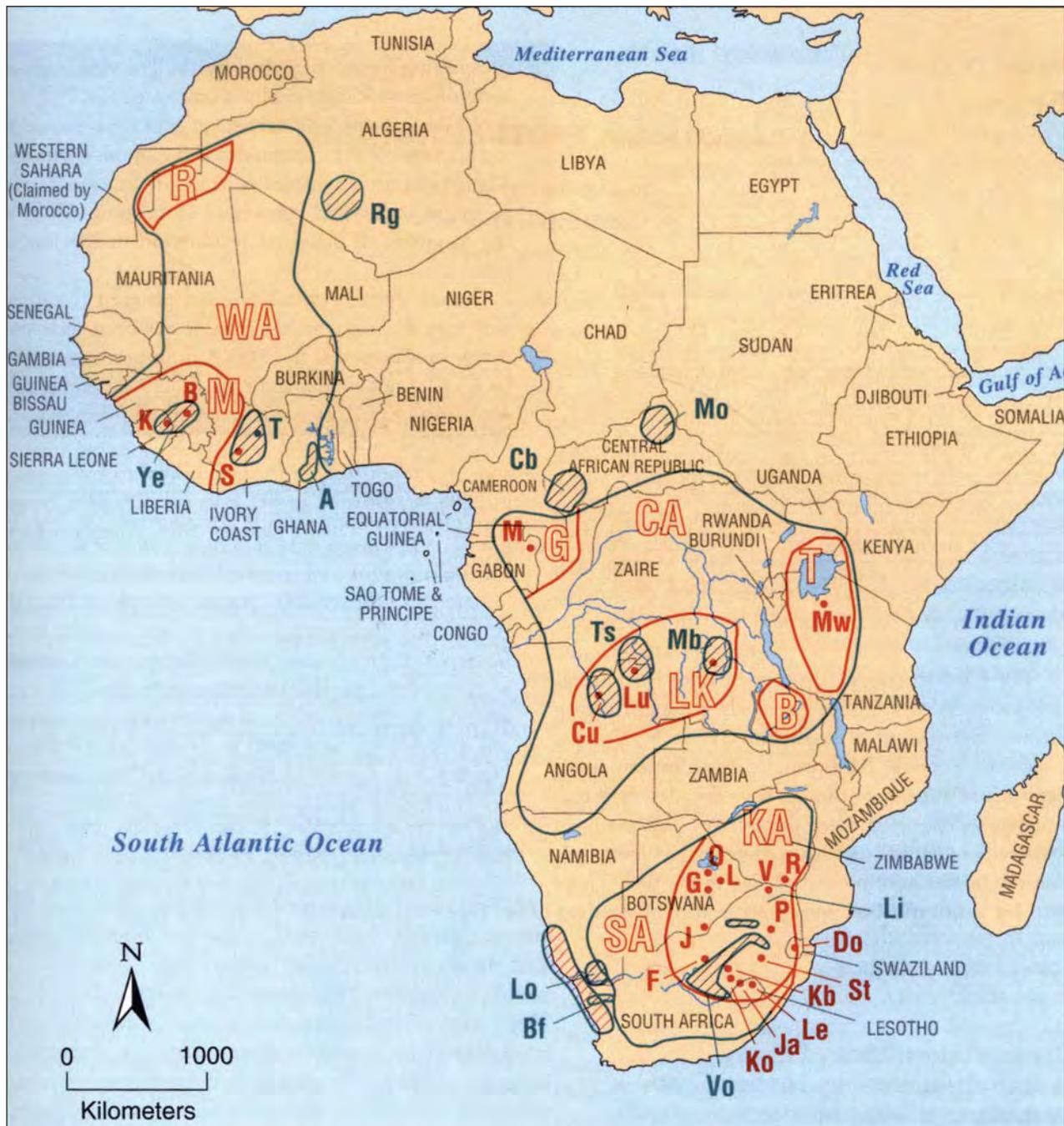
Africa currently produces 51.8 Mct (million carats) of rough diamonds annually, or 46% of the world total by weight, which rises to at least 72% by value. The jewel in the crown is Jwaneng (in Botswana), the most profitable mine in the world; Jwaneng's 1997 production of 12.7 Mct represented 21% of world diamond production by value (Picton and Newton, 1998).

All the major De Beers mines, which produced 31.3 Mct in 1998, have projected lives of more than 10 years, and the most important of these—Jwaneng, Orapa, Venetia, Premier, and Finsch—are expected to produce for more than 20 years. Orapa is scheduled to double production by year 2000 to about 12.5 Mct, and improved mining and recovery operations are being implemented at Jwaneng, Venetia, Finsch, and in the Kimberley mines, as well as on the west coast of southern Africa.

In the South Atlantic Ocean, De Beers Marine and Namdeb have a well-established, profitable mining operation that produces more than 500,000 high-value carats per year at present. Continuing exploration, coupled with high-technology improvements to their mining operations, suggests increasing production and a long life for this operation. Spectacular recent successes for the NamSSol underwater crawler of Namco in Namibia, and the prospecting results of Diamond Fields International, further expand the evidence for the existence of a major resource of gem diamonds in the sea off western southern Africa, particularly Namibia. This will more than offset the depletion of high-level beach deposits and river alluvials on land.

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E-mail address: John.Gurney@minserv.co.za



To date, economic kimberlites have been found only on those parts of cratons known as archons. This map of Africa shows the distribution of cratons (outlined in green) and archons (outlined in red). Solid red dots and red letters are pipes and dikes, green striped areas and green letters are alluvial deposits (note that some areas contain both green stripes and red dots), and the red-striped area marks the beach and off-shore deposits in Namibia and Namaqualand. **Key to large, open red letters:** B—Bangweulo archon; CA—Central African craton; G—Gabon archon; KA—Kalahari archon; LK—Lunda-Kasai archon; M—Man archon; R—Reguibat archon; SA—South African craton; T—Tanzania archon; WA—West African craton. **Key to solid red and green letters:** A—Akwatia/Birim alluvials; B—Banankoro alluvials and pipes; Bf—Buffels River alluvials; Cb—Carnot/Berberati alluvials; Cu—Cuango alluvials and pipes; Do—Dokolwayo pipe; F—Finsch pipe; G—Gope pipe; J—Jwaneng pipe; Ja—Jagersfontein pipe; K—Koidu pipes and dikes; Kb—Kimberley pipes (5); Ko—Koffiefontein pipe; L—Lethakane pipe; Le—Letseng pipe; Li—Lichtenburg alluvials; Lo—Lower Orange River alluvials; Lu—Lunda pipes and alluvials; M—Mitzic kimberlites; Mb—Mbuji-Mayi pipes, eluvials and alluvials; Mo—Mouka Ouadda alluvials; Mw—Mwadui pipe; O—Orapa pipe; P—Premier pipe; R—River Ranch pipe; Rg—Reggane alluvials; S—Séguéla alluvials and dikes; St—star fissure; T—Tortiya alluvials; Ts—Tshikapa alluvials; V—Venetia pipe; Vo—Vaal/Orange Rivers alluvials; Ye—Yengema alluvials. (Reprinted with permission from Janse, 1996.)

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## Future Production

Reviewing this situation, it appears that African diamond production will increase to more than 60 Mct per year in the foreseeable future.

In the medium term (5–12 years), additional production may come from the development of mining operations on some of the many known kimberlites in Angola, following the model of Catoca (66 ha, with 1.17 ct/tonne; Gordon, 1997). Camafuca-Camazambo (160 ha) and Camatue (12 ha) are two good examples among many. Gope 25 in Botswana may be developed by De Beers/Falconbridge. A number of small potential mines are in the feasibility stage at present (e.g., Klipspringer, The Oaks, Palmietgat, Crown mine, and Voorspoed in South Africa; and Tshwapong in Botswana). These reflect a growing interest in the mining of smaller deposits, especially where—as with Marsfontein (SouthernEra/De Beers)—they have high ore grades. Marsfontein (0.4 ha) produced 1 Mct in its first year of operation.

The Kalahari craton (again, see figure) is an excellent example of a comprehensively explored craton where significant discoveries (Finsch, Orapa, Jwaneng, Venetia, Klipspringer, Marsfontein) have been made in each of the last four decades. It is reasonable to expect further discoveries, especially in areas with extensive recent geologic cover where hidden ore bodies have proved elusive in the past. These will be accomplished by creative use of modern

prospecting methods applied by the growing body of technologically astute exploration companies.

In this context, the early-stage grass roots prospecting activities of Rex Diamonds and Ashton/Diamet in Mauritania are examples of the sort of exploration programs that could contribute to keeping Africa at the forefront of diamond production in the longer term.

In any event, Africa's premier position is assured well into the next millennium. It has been independently estimated that by 2005 African production will be 63 Mct out of a world total of 119 million carats, representing 66% of world value at an average price of US\$97/ct and a total value of \$6.1 billion (Picton and Newton, 1998). African production by country in 2005 is estimated to be: Botswana 26 Mct, South Africa 14 Mct, DR Congo 14 Mct, Angola 5 Mct, Namibia 2 Mct, rest of Africa 2 Mct.

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## REFERENCES

- Gordon C. (1997) Angola's first kimberlite mine. *Diamond International*, No. 47 (May/June), pp. 67, 68, 71, 72.
- Janse A.J.A. (1996) A history of diamond sources in Africa: Part II. *Gems & Gemology*, Vol. 32, No. 1, pp. 2–30.
- Levinson A.A., Gurney J.J., Kirkley M.B. (1992) Diamond sources and production: Past, present and future. *Gems & Gemology*, Vol. 28, No. 4, pp. 234–254.
- Picton J., Newton C. (1998). *De Beers/Centenary and the Global Diamond Industry*. Standard Equities, 104 pp. [www.equities.co.za].

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# Diamonds from Australia

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THE DISCOVERY of the Argyle diamond deposit in 1979, and its exploitation since 1986, brought extensive changes to the diamond industry from four key perspectives: geological, mineralogical, gemological, and commercial. In 1980, for the first time in the known history of diamond mining, economic quantities of diamonds were found in an Early Proterozoic mobile belt instead of, as for all previous discoveries, the Archean core of a craton. Until 1980, it was thought that diamondiferous kimberlites (and, by inference, any other primary host rock for diamonds) occurred only in the interior of old cratons—that is, parts of the earth's crust older than 1,600 million years (My) that are stable, rigid, and have not been deformed (known as Clifford's Rule; Clifford, 1966). Janse (1994) elaborated on Clifford's Rule by stating that economic kimberlites occurred only on an Archon—that part of a craton that is underlain by basement rock of Archean age, older than 2,500 My. In the Kimberley region of Western Australia (see figure), the economic Argyle lamproite and the near-economic lamproites at Ellendale occur not in a stable Archean block, but rather in the Early Proterozoic Halls Creek and King Leopold mobile belts, which are older than 1,800 My, and surround the stable Archean Kimberley Plateau block.

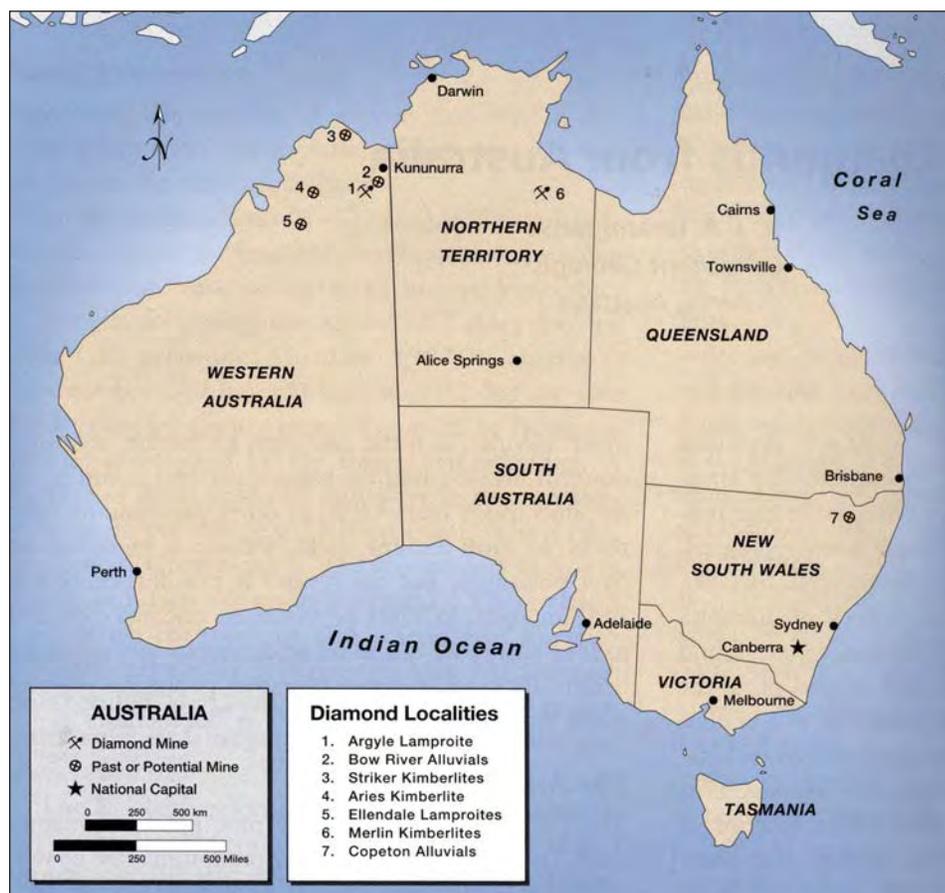
For more than 100 years, up until 1980, it was thought that the only primary host rock for diamonds was kimberlite (excluding a few diamonds of meteoritic origin and their problematic occurrence in some rocks of dubious origin). However, the diamonds at Argyle occur in lamproite, a rare rock that had been known as an academic curiosity since it was named by Swiss Professor Paul Niggli in 1923. Like kimberlite, lamproite forms breccias that range from bluish green to pale yellow. These breccias are also ultrabasic-to-basic rocks (i.e., poor in silica and thus containing

much olivine); as is the case with kimberlite, they also contain alkalis, mainly potassium and sodium, in amounts much higher than in other ultrabasic-to-basic rocks. In most alkaline rocks, sodium is predominant over potassium, but the reverse is true for kimberlite and lamproite. In 1980, however, no one had expected to find economic quantities of diamonds in a nonkimberlitic rock, so at first exploration geologists referred to the Argyle diamond host rock as "kimberlitic."

## The Argyle Deposit

The 50 ha (124 acres) Argyle pipe produces mainly small (average size 12 points), predominantly brown diamonds of irregular shape; only 5% are true gem quality. Mining began in 1985, with almost 30 Mct (million carats) produced the following year (see table). The great commercial problem of how to absorb this large volume of diamonds into the world markets was the reason the majority owners of the Argyle Diamond Mines Joint Venture (CRA [now Rio Tinto] about 57% and Ashton Mining 38%) negotiated two five-year sales contracts with the De Beers CSO that covered mid-1986 to mid-1996. From the beginning of production, the 5% minority owner, Northern Mining (later the Western Australian Diamond Trust, which was absorbed into Argyle Diamond Mines in early 1989) sold its share directly to the market. Since mid-1996, all Argyle diamonds have been sold to the market outside of the CSO.

Eventually it was discovered that about 40% of the 95% non-gem diamonds at Argyle could be cut economically in India into inexpensive, low-quality stones. Thus, the production from the Argyle mine became 5% gem, 40% near-gem, and 55% industrial grade. Approximately 700,000 people, about 25% of whom work full time, are currently involved in the Indian cutting industry and cut most of the Argyle mine production (Sevdermish et al., 1998).



*Diamonds have been discovered in several areas of Australia—in lamproites, kimberlites, and alluvial deposits. Most of the deposits, including the highly productive Argyle mine, are located in Western Australia, in what is known as the Kimberley region.*

Argyle, with its associated alluvials, is the only major Australian diamond producer. For eight years, from 1988 to 1995, Bow River Diamond Mines (owned by Normany-Poseidon) mined a small alluvial deposit in Lower Limestone Creek, 20 km downstream from the Argyle pipe, and produced roughly 7 Mct (again, see table) of a quality three times higher than that of the Argyle diamonds: \$25 per carat compared to \$8 per carat. Thus, the great majority of Australian diamonds are produced by Argyle. Present ore reserves will last until the end of 2003. Deepening of the open pit now in progress has assured that the mine will remain active until the end of 2005, while a planned additional underground operation may extend life until 2009.

### Other Deposits in Western Australia

Diamonds have been found in stream sediments of the Ord River as far as Kununurra, up to 150 km downstream from Argyle, and some have reached the sea. However, it is not clear where the paleo-Ord River that would have drained the Argyle pipe during the Tertiary period had its outlet. Compared to the

straight and periodically stable coast of South Africa and Namibia, the coast of the Kimberley region and adjoining Northern Territory is flat and indented from ever-changing river courses. Consequently, it is unlikely that large concentrations of diamonds exist offshore along Australia's northwest coast.

In contrast to the large Argyle lamproite, which is located in the Early Proterozoic Halls Creek mobile belt, small kimberlite dikes and pipes have been found in the northern part of the Archean Kimberley Plateau. Striker Resources is presently evaluating the 4-km-long Bulgurri kimberlite dike system and the four small Ashmore pipes. Both of these properties contain sharp-edged, flat-faced, colorless, inclusion-free octahedra and have promising economic potential.

The 20 ha (49 acres) Aries kimberlite pipe, the largest kimberlite pipe discovered in Australia so far, was found in the more interior part of the Kimberley Plateau. (Although the pipe is large and the diamonds found to date have been good quality—mainly colorless dodecahedra, reportedly valued at \$150 per carat—the ore grade is too low to make it an economic deposit.)

Annual diamond production of Australia, 1983–1998.

Year	Argyle <sup>a</sup>					Bow River <sup>a</sup>		Total Australian production (Mct)	Australia, as a % of world production	
	Alluvial production (Mct) <sup>b</sup>	Alluvial grade (ct/tonne)	Pipe production (Mct)	Pipe grade (ct/tonne)	Total production (Mct)	Alluvial production (Mct)	Alluvial grade (ct/tonne)		By weight	By value
1983	6.2	5.8	NP <sup>c</sup>	NP	6.2	NP	NP	6.2	11	2
1984	5.7	3.9	NP	NP	5.7	NP	NP	5.7	9	2
1985	5.4	4.7	1.7 <sup>d</sup>	5.0	7.1	NP	NP	7.1	11	2
1986	NP	NP	29.2	9.1	29.2	NP	NP	29.2	32	6
1987	NP	NP	30.3	8.7	30.3	NP	NP	30.3	33	6
1988	NP	NP	34.6	7.3	34.6	0.5	0.3	35.1	35	7
1989	1.6	1.4	32.8	6.7	34.4	0.7	0.3	35.1	33	6
1990	2.1	1.1	31.7	6.1	33.8	0.9	0.3	34.7	32	6
1991	1.6	1.2	33.4	5.6	35.0	1.0	0.3	36.0	35	7
1992	2.4	0.7	36.6	5.4	39.0	1.2	0.3	40.2	40	6
1993	2.5	0.7	38.4	5.8	40.9	1.0	0.3	41.9	41	6
1994	3.1	0.7	39.7	5.0	42.8	1.0	0.2	43.8	41	6
1995	2.4	0.5	37.5	4.2	39.9	0.5	0.2	40.4	37	5
1996	2.6	0.4	39.4	3.9	42.0	NP	NP	42.0	35	5
1997	1.6	0.3	38.6	3.7	40.2	NP	NP	40.2	35	4
1998	1.9	0.3	40.0	3.5	40.9	NP	NP	40.9	35	4

<sup>a</sup>Data from annual reports of Ashton Mining Ltd. and from Bow River Mines management.

<sup>b</sup>Mct = Millions of carats.

<sup>c</sup>NP = No production reported for the year from this source.

<sup>d</sup>Production at the Argyle pipe began in December 1985; 1.7 Mct was one month's production.

### Other Diamond Producing Areas of Australia

Alluvial diamonds were found as early as 1851 in southeastern Australia in a region that is far outside any cratonic parts of the crust. In fact, it is in a Paleozoic orogenic belt. The origin of these diamonds is still an enigma. The largest concentration of diamonds was found near Copeton in New South Wales. Attempts to establish an economic production from this and other smaller deposits in the region were made in the last century, and again in the 1990s, but without commercial success. The Copeton diamond crystals are often complexly twinned; the resulting “naats” (seams) are often difficult to see and cause problems in cutting. Consequently, the term *cannifare* (“cannot make”) is often applied to the Copeton stones. Total alluvial production from the 1860s to the 1920s amounted to about 300,000 carats. Small deposits of alluvial diamonds, and kimberlites with a trace of diamonds, have been found in many other places throughout Australia, but none has proved economically significant.

At present, the only producing diamond mine other than Argyle is Merlin, located in the Northern Territory. It was discovered by Ashton Mining in

1994, and brought into production in February 1999. As is the case with the Ekati mine in Canada's Northwest Territories, Merlin draws ore from four to seven small kimberlite pipes and produces diamonds of very good quality, reportedly \$130 per carat. In the first batch produced, a good-quality diamond of 14.76 ct was recovered, and several stones of this size and quality have been found since.

### REFERENCES

- Clifford T.N. (1966) Tectono-metallogenic units and metallogenic provinces of Africa. *Earth and Planetary Science Letters*, Vol. 1, pp. 421–434.
- Janse A.J.A. (1994) *Is Clifford's Rule still valid? Affirmative examples from around the world.* In H.O.A. Meyer and O. Leonardos, Eds., *Diamonds: Characterization, Genesis and Exploration*, Vol. 2, Proceedings of the Fifth International Kimberlite Conference, Araxá, Brazil, 1991, Companhia de Pesquisa de Recursos Minerais (CPRM), Special Publication 1/B, Rio de Janeiro, pp. 215–235.
- Sevdermish M., Miciak A.R., Levinson A.A. (1998) The rise to prominence of the modern diamond cutting industry in India. *Gems & Gemology*, Vol. 34, No. 1, pp. 4–23.

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# Canadian Diamond Production: A Government Perspective

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THE ANNOUNCEMENT earlier this decade that diamonds had been found in the Northwest Territories presented a whole new challenge to the Canadian government. For the most part, provincial governments have jurisdiction over natural resources in Canada. However, the three northern territorial governments—the Yukon, the Northwest Territories, and the new territory of Nunavut—do not. Consequently, the government of Canada has been deeply immersed in the development of this country's first diamond mine and its new diamond industry. Early research revealed important issues—such as the need for environmental reviews, the political climate in the north, and the structure of the northern mining industry—that were different from those in other diamond-producing countries. Therefore, the government had few precedents to follow in its mandate to ensure the smooth development of this complex industry.

Since fall 1998, however, the first Canadian diamond mine—the Ekati mine—has been in production, and it is likely that additional mines will be developed. As a result, Canada could soon be producing more than 10% of the world's diamonds by value. This review looks at the Canadian government's response to this new industry, including government attempts to attract value-added operations to the Northwest Territories.

## **Canada's North and Its Diamond Mines**

Canada's Arctic region is an enigma to most people—including the majority of Canadians. It makes up one-third of the country's landmass, but it has only a tiny fraction (<100,000 people, or 0.003%) of its population. Only 800 km south of the North Pole at its northernmost point, it stretches across three time zones and touches two oceans (see map). Consequently, it is a difficult and expensive area both to reach and to work.

Few took Canadian geologist Charles Fipke very seriously in the early 1980s, when he first started prospecting for diamonds in this cold, barren region. But like the adventurers who opened up the Klondike a century before and became millionaires, Fipke eventually became very very wealthy following his 1991 discovery of a number of kimberlite pipes in the area near Lac de Gras.

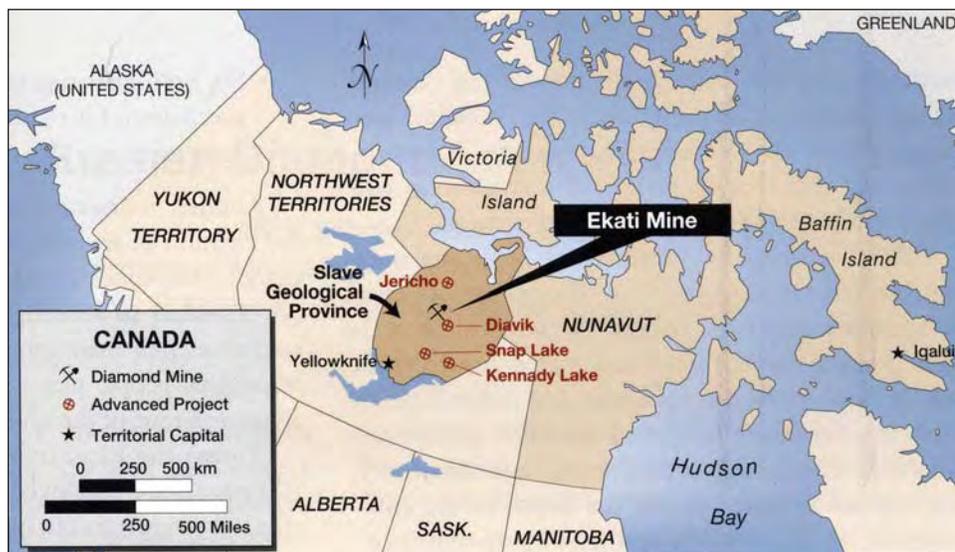
It is not the purpose of this presentation to dwell on the history of the discovery of diamond deposits in Canada, as this topic has been discussed in great detail elsewhere. Suffice it to say that during the period 1991–1998, more than 250 kimberlite occurrences were discovered in the Slave Geological Province in the Northwest Territories, and exploration for additional diamond deposits continues unabated. Although diamond-bearing kimberlite pipes have been found in several other provinces and territories (i.e., Quebec, Ontario, Saskatchewan, Alberta, British Columbia, and Nunavut), the principal cluster of economically viable pipes found to date occurs in the Lac de Gras area, the site of the Ekati diamond mine, which is owned by BHP Diamonds Inc. (51%), Dia Met Minerals Ltd. (29%), Charles E. Fipke (10%), and Stewart L. Blusson (10%).

The Ekati mine alone has a resource of 66 million tonnes at 1.07 ct/t, with an average value of US\$100 per carat (see “Diamond production starts at Canada's Ekati mine,” *Gem News*, Winter 1998 *Gems & Gemology*, pp. 290–292, for further details). From October 1998 to June 1999, the mine produced in excess of 1 Mct (million carats). It is expected to produce about 3 to 4 Mct a year for at least 17 years. And, as they say in the Arctic, that's only the tip of the iceberg. Other diamond projects in the evaluation or development stage include Diavik, Snap Lake, and

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*This map shows the provinces and territories (Yukon, Northwest Territories, and Nunavut) of Canada. The Ekati diamond mine, as well as most of the potentially economic kimberlites found to this point, are in the Slave Geological Province.*



Kennady Lake in the Northwest Territories, and Jericho in Nunavut. At least six different companies are involved.

### Exploration and Mining Differences

Diamond exploration and mining in Canada are very different from most other countries. Not only is the climate harsh (winter temperatures of  $-40^{\circ}\text{C}$  are common), but there is also very little infrastructure, so all materials are moved to the projects via winter ice roads. In addition, glaciers have resulted in diamond indicator minerals being dispersed for great distances, the kimberlites being covered with glacial deposits (e.g., till) in some places, and in most cases the occurrence of kimberlites under lakes (because the glaciers preferentially eroded the kimberlite pipes, resulting in depressions that are now filled with water). Last, most of the pipes found to date in the Northwest Territories have a small surface expression—typically less than 2 ha ( $\sim 5$  acres)—which makes them more difficult to locate (thus requiring modern geophysical exploration methods). By comparison, for example, the Orapa mine in Botswana extends over 100 ha. If Canadian diamonds are more difficult to reach, they are definitely worth the effort because of their high quality, with up to 30% gems in the pipes slated for production thus far.

### Business Climate

Doing business in Canada's North is also different from anywhere else in the country, and perhaps the world. A large proportion of the population in the

Arctic region is aboriginal. Many of the First Nations located in the Northwest Territories are actively involved in land claim settlements and self-government agreements, which give them decision-making powers over land use and resource development.

The three northern territories enjoy a special relationship with the government of Canada, a relationship managed by the Department of Indian Affairs and Northern Development (DIAND). DIAND is a key player in the North. Three of its key objectives are to:

- Foster the political development of the North
- Promote sustainable development
- Strengthen Canada's international presence among circumpolar nations

Although these complex issues will not be discussed here, one recent event—the establishment of the territory of Nunavut—deserves mention. It demonstrates the approach Canada is taking with respect to the political and economic development of the North.

### Nunavut

On April 1, 1999, the map of Canada was redrawn with the creation of Nunavut—a vast new territory in the Eastern Arctic (again, see figure), which is populated by about 25,000 people of whom 85% are Inuit. In partnership with their non-aboriginal neighbors, they will run a public government for all of the Nunavut

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residents, one that will clearly reflect the cultural makeup of the territory. Inuktitut, the aboriginal language, will be the working language of the government, and many of its programs and policies will reflect their traditional knowledge and customs.

Like all Canadians, Northerners want and need jobs and business opportunities. They want and need an economy that will support them and their children. They want and need sustainable development that addresses both the economic and cultural health of aboriginal communities, where the population growth is double the Canadian average. However, they are not prepared to risk the health of the environment, their own physical health, or their centuries-old traditions for the sake of a mine that may not last longer than 20 years. This notion of sustainable, responsible development is more and more shaping the government's view of mineral development in the North.

### **Environmental Assessment and the Engagement of First Nations**

The proposal to develop the Ekati diamond mine triggered the most rigorous environmental assessment of a mining project ever in Canada. Working together as partners, the governments, mining industry, aboriginal communities, and public built on the findings of a public panel to negotiate a mine-specific regulatory regime and benefits package that meets the needs of Northerners in general, and aboriginal people in particular. The final arrangement included:

- An environmental agreement between BHP Diamonds Inc. and both the federal and territorial governments
- Impact and benefit agreements that commit BHP Diamonds Inc. to provide jobs, business opportunities, training, and annual cash payments to the communities over the life of the mine
- A socioeconomic agreement, to ensure that the benefits of diamond development extend to all residents of Canada's North
- A water license, an action that is common to every mine

- Six land leases that provide an enforcement mechanism for certain obligations in the agreement

Another innovative aspect of this agreement was the creation of an independent monitoring agency to ensure compliance by Ekati Diamond Mines and the governments in meeting their obligations related to environmental management and reporting activities. Aboriginal people play a key role in the agency, and appointed four of the seven members.

Today, the Ekati mine is up and running. About 700 people are employed, and a stream of social benefits is flowing into the North at an increasing pace.

### **Diamond Manufacturing**

Through an agreement between Ekati Diamond Mines and the government of the Northwest Territories, roughly 3% by weight, but 10% by value, of rough diamonds from the Ekati mine are available for local manufacturing in the North. The territorial government, backed by the federal government, is finding ways to establish local cutting and polishing operations. For example, the government of the Northwest Territories has attracted Sirius Diamonds Ltd. of Victoria, British Columbia, by providing testing equipment and other assistance. Other manufacturers are expected to follow. Jewelry making is the next logical step in the development of value-added diamond industries in Canada's North, and ways to create other such opportunities are being examined.

### **Conclusion**

This snapshot of Canada's diamond industry is, admittedly, intended to stimulate interest in mining opportunities in Canada. When you consider the North's immense diamond potential, Canada's mineral rights disposition and tenure system (which promotes exploration and mineral development), a reasonable tax regime, as well as the technical expertise available, you cannot help but conclude that Canada's North is a good place to do business. With this excellent exploration and mining environment, it is inevitable that Canada will play a major role in the diamond industry in the next millennium.

# Russian Diamond Sources

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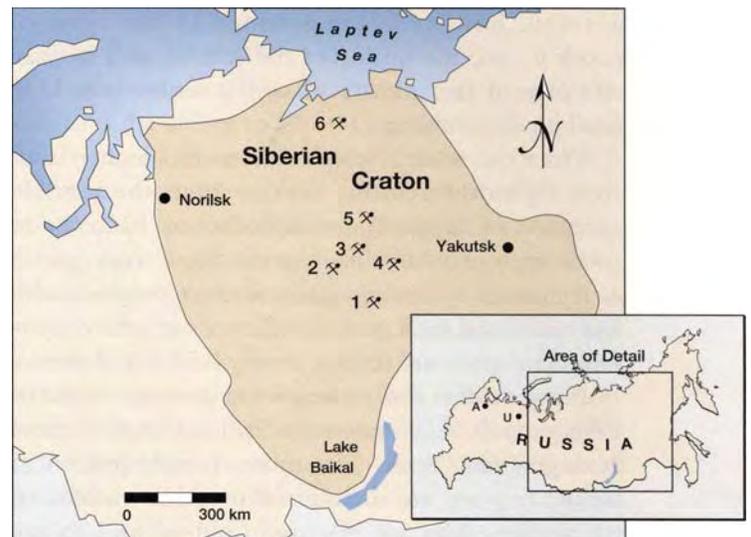
**T**HE HISTORY OF DIAMOND production in Russia began in 1829 with the discovery of alluvial diamond deposits in the northern Ural Mountains (see location "U" on the inset map). However, it was not until 1954 that the first kimberlites were discovered, in the Siberian craton of the Republic of Sakha (formerly Yakutia), as predicted by Professor Vladimir S. Sobolev in the late 1930s. Professor Sobolev's prediction was based on the many geologic similarities between the South African and the Siberian cratons, including past magmatic activities.

The vast Siberian craton, in which more than 800 kimberlite bodies have been identified to date, covers more than 2,000,000 km<sup>2</sup>. The boundaries of the Siberian craton are shown on the main map, as are major kimberlite fields 1, 2, and 3, in which at least 10 high-grade kimberlite pipes are currently being mined. Also indicated on the map (as no. 4) is the new Nakyn kimberlite field, which contains the recently discovered (in 1994) Botuobinskaya kimberlite.

Approximately 98% of all diamonds mined in Russia come from Sakha, with the remaining 2% recovered from placers in the Ural Mountains. Within Sakha, 90% of the diamonds are mined from several Devonian age (345–362 My) kimberlite pipes. The main ones are Mir, Internationalaya, Aikhal, Sytykansкая, Udachnaya, Jubileynaya, and Botuobinskaya. Ten percent of the production is from the Anabar placers at the Ebelyakh River. Several pipes in the Muna field (no. 5 in the figure) are being prepared for mining early in the next millennium. Whereas open-pit mining has been the mainstay of the Russian diamond industry since its inception, plans are being made for the first underground mine, at the Internationalaya pipe, and another later at the Mir pipe; both are in the Malaya Botuobiya craton (see map).

In the northern part of European Russia, the Arkhangelsk diamondiferous province on the East European (Russian) craton is being evaluated for its economic potential (see location "A" on the inset map). Since this province was discovered in the late 1970s, several high-grade kimberlite pipes have been identified. It is likely that the Lomonosov kimberlite pipe will be the first to be developed, with production planned to begin early in the next century.

*On the inset map of Russia, the "U" represents the location of the first discovery of alluvial diamonds in the Ural Mountains and "A" represents the Arkhangelsk kimberlite field, which was first discovered in the 1970s and is expected to begin production early in the next century. The most important diamond-producing areas in the Sakha region of Siberia are shown on the larger map. In Sakha, the Siberian craton hosts the following diamondiferous kimberlite fields: (1) Malaya Botuobiya, (2) Alakit, (3) Daldyn, (4) Nakyn, and (5) Muna. The location of the Anabar placers of the Ebelyakh River is also shown (6).*



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## The New York Diamond Market

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### New York's Position in the Current World Diamond Market

From its beginnings in the late 1800s, New York's diamond industry has continued to grow and prosper as one of the most important of the world's cutting centers. Supported by skilled craftsmen trained in Europe, augmented by a well-apprenticed labor force, compelled by high wage and labor standards in the New World, and fueled by aggressive product marketing, New York gained its foothold by supplying larger, well-made diamonds to the growing American—and international—consumer market. Today, with some 400 skilled cutters and approximately 2,000 diamond merchants—concentrated in a single square mile in midtown Manhattan—New York continues in a dominant international role. Yet it faces critical decisions as to how it will maintain that role in the future.

New York shares the title of “World Cutting Center” with Belgium, Israel, Asia (including the emerging China), and, of course, India. When these five centers are measured in terms of number of cutters, New York is by far the smallest. New York's position, however, is maintained by the types of goods it cuts, the quality of the cutting, and the significance of the primary market it serves—the U.S. retail jewelry industry.

From the onset, New York has had higher labor costs than other cutting centers (with the possible exception of Belgium), so its production *had* to be in goods appropriate to this situation. New York gained its reputation by cutting medium-to-larger goods with fine make, and such goods remain its strength today—well-cut rounds and fancies, usually 0.50 ct and above.

New York is also an important trading center. In 1998, over 97% of American diamond imports came through New York. The more than \$6 billion in annual imports are distributed to other cutters, to wholesalers who are not sightholders, and to the

largest concentration of retail jewelers in the world—numbering some 40,000—from major chain stores to high-end specialty retailers. New York also distributes to wholesalers and retailers worldwide.

Having reached more than \$22 billion in retail jewelry sales in 1998, the U.S. jewelry market anchors New York as a significant player. With over 60% of the typical retailer's annual sales being in diamonds or diamond jewelry, the U.S. retail market represented 36% of world diamond sales by value (see figure) and at least half of the world's total diamond consumption by weight. The types of diamond goods produced in New York accounted for over half of U.S. total consumption by weight.

Because of the significance of the U.S. retail market, the U.S. consumer drives diamond production trends. Today's consumer seeks higher-quality center stones, and there is an increasing awareness and demand for “Ideal” and premium-cut diamonds. The use of laboratory certificates in retail selling is increasing, with more emphasis being placed on cut quality.

### Challenges Facing the New York Diamond Market

To maintain its current status in the world diamond market, New York must address the following challenges:

1. Spot shortages
2. Labor costs
3. Globalization
4. Competition for high-end cutting

*Spot Shortages.* The polished diamond market of 1999 has proved to be an interesting conundrum. Weakness in demand for small sizes (i.e., up to 1 ct) is counterbalanced by extreme shortages in the 1.25+ ct

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categories. Certain sizes, such as 1.70s and 2.50s, have virtually vanished.

The underlying reason for this situation is that the supply line for much of the “outside” rough in recent years, which originated in Russia and Angola, has virtually disappeared. Most of the rough in today’s market comes from traditional (and legal) channels. De Beers has regained firm control of the rough markets, especially in the larger sizes. In fact, at the most recent sights, premiums on boxes of larger-size rough were 8%–15, numbers that were unheard of in recent years. New York, as the first line of defense for the retail jeweler, must continue to procure the difficult sizes. Otherwise, jewelers will turn to Antwerp and Israel in hopes of finding such goods.

**Labor Costs.** Over the past three decades, Israel and India have emerged as important cutting centers. At the same time, we have seen centers such as Hong Kong and Thailand fade almost as quickly as they emerged. While the cheapest goods will continue to be cut in various developing nations around the globe, New York must focus its industry on cutting goods worthy of the talent and expertise of its labor force.

New York is also augmenting human labor with automation. Automatic diamond cutting has evolved dramatically since the first machines were used in Israel in the 1970s. Today, a machine is capable of cutting a diamond—with the exception of the star facets—with perfect polish and symmetry and with no additional weight loss, compared to human labor. Automation ensures better consistency, an attribute demanded in branded diamonds. It also helps address some of the consumer issues regarding diamond cut, the last quality factor to become quantifiable.

**Globalization.** With today’s telecommunications, overnight deliveries, and international travel facilities, New York is no longer insulated by the Atlantic. Not only are diamonds supplied to the American market by other cutting centers, but New York also services other international markets. New York has established strategic international links for the American retailer through brokers and partnerships in overseas centers. Diamond trading in the U.S. now requires memo service and next-day delivery. To overcome time zones, progressive retailers look for electronic access to existing inventories, including on-line pricing



*The U.S. dominates world diamond sales. For 1998, it represented 36% by value.*

ing and ordering. U.S. retailers also require credit. Fortunately, the New York Diamond Market is in a strong financial position.

**Competition for High-End Cutting.** The diamond manufacturing technology available to New York is also available to the rest of the world. As skill and experience increase in other cutting centers, New York has seen increasing competition from those centers for the larger, better rough. In response, New York must conscientiously protect its role in fine make by providing more premium-cut goods for the American market, along with the diamond-grading reports that authenticate their cutting quality.

### **Concluding Remarks**

As a relatively small and tight center, New York maintains the ability to adjust to consumer trends and service special requests. Because of their depth of skill and experience, New York cutters can shift production to different shapes, sizes, and features as the market demands. In addition, New York can respond to custom orders and recutting requests. Although it is impossible to curtail the developing skills and resources of other centers, a keen awareness and sensitivity to the needs of the American retailer will help protect New York’s position as the diamond supplier to this important constituency. New York is indeed poised for the new millennium.

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# The Antwerp Diamond Sector

Marcel Pruwer

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Antwerp, Belgium

With a yearly turnover of around \$20 billion, Antwerp handles more than 80% of the world's rough diamonds, and half of its polished diamonds. It is the undeniable capital of the world's diamond trade, continuing a tradition of cutting, trading, and financing that started in Bruges over 500 years ago. Antwerp's diamond volume is a reflection of its key role in the diamond pipeline. There are well over 1,000 active diamond manufacturing and trading companies in Antwerp, some of which are the largest in the world. The Antwerp sector accommodates a global business comprising 70 million pieces of diamond jewelry at an average of \$750 per piece. This amounts to a total retail value of \$50 billion and a wholesale polished diamond value of \$12 billion.

For centuries, diamonds and the diamond industry were clouded in mystery, myth, and the magic released by artisan gem cutters. Today, the diamond trade is driven by computers, lasers, leading-edge science and technology, and the Internet. While Antwerp's cutting tradition has felt the impact of competition from low-cost cutting centers, such competition has raised the local standards of skills and technology with tremendous increases in the efficiency of all operations.

For years, the international diamond trade operated in an environment largely protected by De Beers. Recent experience and De Beers's new commercial stance reveal the weakness of a production-based, rather than market-driven, strategy. The vicious impact of the "reverse ripple effect" (i.e., downstream market conditions—whether good or bad—are inevitably exaggerated in the cutting centers) can be devastating. More positively, contending with critical change and challenge is illuminating. A self-examination analysis (SWOT—Strengths, Weaknesses, Opportunities, and Threats) defines several issues that merit attention, including commoditization, erosion

of profit margins, treatment and disclosure, branding, unprofessional conduct and ethical standards, corporate transparency, the discount syndrome, credit and memo excesses, and far too little creativity in style, design, and merchandising. Antwerp is very aware of current threats to the global diamond industry. Accordingly, Antwerp is now re-inventing itself with vitality, gaining new insight, vision, and clients, and developing new business strategies.

Today, Antwerp is positioned perfectly to be the partner of choice for diamond dealers, distributors, manufacturing jewelers, retailers, other cutting centers, and downstream stakeholders around the world. The city benefits from the presence of the financial pillars of the diamond industry, Antwerp Diamond Bank and ABN-AMRO. Indicative of Antwerp's strength and position, as well as the quality of its infrastructure, is the fact that it is headquarters to the World Federation of Diamond Bourses and the International Diamond Manufacturers Association. The HRD (Diamond High Council) is being revamped through a process of modernization under its new director-general, Peter Meeus. Antwerp's four diamond bourses, the oldest in the world, lead the global industry in developing dispute resolution and arbitration procedures.

In July 2000, the city will host the Antwerp World Diamond Congress, a major platform for addressing the challenges that face the global diamond industry. With the implementation of forward-thinking and constructive development strategies, Antwerp diamantaires believe there is no reason why diamond jewelry could not be a \$100-\$150 billion world market given the right design, merchandising, and promotional approach. Antwerp is picking up the pace.

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# The Indian Perspective: Challenges and New Developments

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EARLIER THIS YEAR, ARGYLE DIAMONDS celebrated its 10th year of operating in India. I have, in fact, been going to India for the last 20 years, visiting factories, meeting with diamond industry representatives and, of course, selling diamonds. The last 20 years have been a period of great challenge, opportunity, and growth in the Indian diamond industry, a period during which Indian manufacturers reached a position of dominance. Let me remind you of how far the Indian diamond and jewelry manufacturing industry has come and what has been accomplished.

- Today, more than 100 Mct (million carats) per annum of rough diamonds are processed in India.
- Approximately one million people are directly employed in the Indian diamond industry, and many more support their activities.
- The first laser machines were introduced into India in the late 1980s. Today, there are more than 400 lasers in operation.
- 19 out of 20 diamond polishers in the world reside in India.
- Indian polished exports have more than doubled in the last five years, to over US\$5 billion.
- India is now the leading exporter of polished diamonds in terms of *both* value and volume.
- Today, exports of diamond jewelry from India are approaching \$1 billion, up from \$155 million in 1990.

Whichever way you look at it, the growth in the Indian diamond and jewelry manufacturing industry has been one of modern India's great success stories.

## Elements of India's Success

Let us now look at the elements of this success and what they might mean for the new millennium.

***Purchasing and Financial Strength.*** Security of supply has always been critical in the diamond industry. The Indian manufacturing industry has excelled by establishing an efficient infrastructure to ensure a stable and growing supply of rough diamonds, accompanied by the financial capacity to fund these purchases.

Today, Indian diamond manufacturers have purchasing offices in the world's major trading centers—Tel Aviv, Mumbai (Bombay), and Antwerp. The Indians also regularly visit Russia and Africa to secure supplies. Whether they are buying through CSO sights (and there are 40 Indian sight holders) or on the open market, the Indians are well organized and have the business acumen to ensure continuity of supply under any scenario.

***Ability to Process a Wide Range of Product.*** The Indian manufacturing industry has the skills and capability to process any type of rough diamond. For a long time, India manufactured rough rejections that were both labor-intensive and extremely difficult to process. Cutting and polishing these "rejections" provided a sound basis for learning how to get the most out of a rough diamond. It also positioned the Indian diamond industry for manufacturing the difficult large-scale Argyle production that commenced in the early 1980s. Cutting and polishing the Argyle product pro-

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vided further skills development and product understanding.

In the early days when I visited Indian factories, they were essentially part of a cottage industry. In a relatively short time, traditional Indian diamond-cutting skills have been enhanced enormously by the rapid adoption of technology such as diamond-impregnated cutting wheels and automated polishing, in addition to laser sawing. As a result, the Indian manufacturing industry is now in a position where it can process the full range of rough, from very small, low-quality stones to the more expensive and larger products. In fact, many diamantaires in other cutting centers are increasingly subcontracting their cutting and polishing activities to the Indian industry. I anticipate that we will see the Indian industry increasingly dominate manufacturing across the full range of diamonds and diamond jewelry.

*Global Marketing and Distribution Systems.* The Indian diamond industry has excelled in the worldwide marketing and distribution of both loose polished stones and, more recently, diamond jewelry. Now, not only can they effectively acquire a wide range of rough and manufacture it competitively, but they also can sell it successfully on a global scale. Family members in Indian companies are mobilized to provide an unprecedented level of vertical integration and super-efficient communications. To give you an example, one of our key customers buys Australian rough from our Antwerp office, cuts and polishes it in Mumbai, has a jewelry factory in Surat, and distributes both loose polished stones and diamond jewelry in New York.

These three success factors combine to produce a typical Indian product that represents high quality and low cost. For retailers, this translates into better margins. For the end consumer, it means more value for the money. This is the only formula for success in an increasingly competitive environment.

### **The Millennium Challenge**

The strong growth over the past 25 years has secured a great future for the Indian diamond industry. India is likely to see an even larger market share, as it continues to dominate diamonds and diamond jewelry. The global environment in which the Indian diamond manufacturing and jewelry industries now operate is unlikely to change in the foreseeable future. That is:

- Low inflation
- Increasing competition
- Shrinking margins
- A shortened distribution chain

There is no room in the chain unless you can add value. The search for improved value and profitability is relentless.

In this environment, I see the challenges as two-fold: (1) the possibility of new players entering the retail market, and (2) the possibility that large-scale manufacturers of diamonds and diamond jewelry will distribute directly to consumers through the Internet.

As the Indian powerhouse searches for further growth opportunities, we may see a greater number of Indian companies in the retail business; after all, they are already financing a large part of the stock in the retail and jewelry manufacturing pipeline. Alternatively, the move to Internet marketing is a logical next step to complete integration. If retailers are to meet the challenge of this sort of competition, then they need to look at new ways in which they can differentiate themselves and add value for their customers.

These are exciting times. Argyle Diamonds (the world's largest diamond mine), India (the world's largest diamond manufacturing industry), and the United States (the world's largest consumer market for diamond jewelry) have come a long way together. The journey is not yet complete, and we look forward to working together to meet the challenges of the new millennium.

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# Diamond Manufacturing and Distribution: The Israeli Perspective

Shmuel Schnitzer

Israel Diamond Exchange and M. Schnitzer & Co. Diamonds  
Ramat-Gan, Israel

AT PRESENT, THE ISRAELI DIAMOND industry is enjoying an upswing period, and I have good reason to believe that this momentum will continue well into the year 2000.

Last year (1998), De Beers reduced its worldwide rough supplies by 28%. As Israel's annual consumption of rough diamonds is equivalent to more than 70% of the CSO's annual sales, it is clear that CSO policies affect the Israeli industry each and every day. However, in 1998, Israel's exports of polished diamonds declined by only 11.5%, to \$3.65 billion. Actually, we have no complaints about the reduction in volume of rough because, as partners to our rough suppliers, we realize that we also had to make a contribution to the welfare of the entire industry.

This year, we believe that polished exports will approach \$4 billion. The success of De Beers's policies should cause prices of polished diamonds to firm, especially in the latter part of the year. Today, 62.8% of all our direct polished exports are destined for the United States. We estimate that an additional 15% of our exports to other countries eventually end up in the U.S. In the first half of 1999, we saw our exports to Hong Kong, which is a virtual barometer, increase by 11%. We also see encouraging buying activity from Japan. Fueled by a stronger yen, Japan's polished imports rose by 21% in the first quarter of this year. This suggests that the Japanese market remains very important, and the purchase of diamond jewelry remains an integral part of that country's consumer behavior.

As a result of this improved situation, 25 new diamond factories have opened in Israel over the past few months. That is the other part of the so-called ripple effect: When the pendulum swings back—and we have already felt the effect of a shortage of

goods—the improvement is fast and decisive.

We have every reason to believe that we should be truly optimistic about the future. Even with new sources in Canada, and with the expansion of production in Botswana, it is clear that demand for quality diamonds will greatly surpass the growth in new rough supply. New markets will fuel the expansion of the diamond business. The greatest hope lies, I believe, in the Chinese market, which is likely to be the world's most attractive market at the onset of the new millennium. We also anticipate other promising new markets, such as Eastern Europe, India, and South America.

*The Israel Diamond Exchange, in Ramat-Gan, is an important hub for the Israeli diamond market. It is estimated that polished exports from Israel could reach almost \$4 billion in 1999.*



## The Effect of International Economic Developments on the Diamond Market

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**T**HE DIAMOND MARKET, like many other markets, is confronted with a rapidly changing competitive landscape (see figure). Profound shifts in the international business environment during the 1990s have had (and no doubt will continue to have) far-reaching effects on the diamond industry. In particular, globalization and rapid technological change are transforming the world economy. The old models of doing business are having to adjust to new realities. In the new economy, there are no friends or enemies, just competitors.

In the 1980s, companies began to apply principles of sustainable competitive cost advantage on a global scale. In diamonds and jewelry, firms moved to set up and utilize manufacturing capacity in Asia and, to a lesser extent, Latin America. In the 1990s, global

*Powerful and diverse forces will mold the diamond market of the future.*



competition in the diamond business has intensified, exacerbated by overcapacity and a slowdown in retail demand worldwide. Focused marketing and access to diverse and competitive supply sources have become the main considerations in maintaining profit margins.

Also, the market dynamic has shifted from Asia to America. The dependence of the diamond industry on the U.S. is striking. The U.S. has not had such a big share of the world retail market for 30 years or more. Whereas America suffered from the strong yen in the 1980s, the Japanese and Asian markets have suffered from the strong dollar in the 1990s.

After the ups and downs of the past few years, supply and demand are in better balance and there is undoubtedly room for growth in the world diamond market, with considerable untapped potential. Margin pressures will no doubt remain, but globalization and new technologies will bring opportunities, as well as challenges, for both small and large firms.

In a changing world, the diamond business is fortunate to have strong and vigilant global institutions, such as GIA. New technologies and new treatments bring new threats to the market. Anything that harms the integrity of the industry has to be resisted. Supporting GIA, therefore, has to remain a priority for everyone.

Finally, spare a thought for De Beers. They, too, are having to come to terms with globalization, competition, and the changing supply-demand balance. At the 1991 Symposium in Los Angeles, I noted that the diamond business depends on confidence—confidence in the product and confidence in the system of marketing. Despite all the changes in the world since then, I have no reason to alter my opinion.

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# Diamond Economics: A Dynamic Analysis

Martin Rapaport

*Rapaport Diamond Report*

New York

**T**HE DIAMOND INDUSTRY is undergoing unprecedented change and development. New information technologies will revolutionize the distribution system and play havoc with traditional profit margins and marketing strategies. The rough-diamond markets and De Beers Central Selling Organisation (CSO) will be forced to reinvent themselves, as global economic forces play a greater role in dictating polished diamond prices. The fundamental economics of the diamond industry will change, as firms look for new ways to generate profits in an increasingly complex global marketplace. Firms will have to adopt new strategies and new ways of doing business if they are to succeed in the diamond markets of the future.

Some people still complain that certificates and price lists have destroyed profit margins in the diamond industry. Pray tell, how will these same firms adapt to the information revolution now taking place on the Internet? The availability of specific pricing and inventory information to consumers is growing exponentially. The old days when you could make money because consumers did not know diamond prices or quality are over, kaput, gone.

**The Importance of Adding Value.** The only way a firm can make money in the diamond business is by adding value to the diamond product. Jewelers who think they can make “traditional margins” by simply placing a diamond into a four-prong setting are dreaming of the past instead of planning for the future. Firms can and must add value to the diamonds they sell—through better design, customer support, education, branding, and hundreds of other ways. We must recognize that the cost of selling and shipping diamonds to consumers via the Internet is significantly below the cost of traditional retailing, so Internet sellers can move diamonds at margins well below those that any in-store retailer can afford. While jewelers can compete *on* the Internet, they cannot compete *with* the Internet. Traditional jewelers must define exactly how they are adding value to the diamonds they sell.

**Diamond Pricing Will Change.** The diamond industry is unique. Rough diamond prices are now controlled by the De Beers CSO, while polished diamond prices are established in a free market. The diamond trade often finds itself in an untenable position because rough prices are not adjusted downward when polished demand declines. Consequently, rough prices are sometimes higher than polished prices. In this scenario, diamond manufacturing is unprofitable and cutters put tremendous pressure on retailers for higher prices, even though there is insufficient demand to justify them.

The imbalance between rough and polished prices and the resultant lack of profitability for diamond cutters is a primary CSO problem: When cutters do not make money, they cannot buy rough and the CSO stockpile increases. The CSO is currently undergoing a strategic review that will undoubtedly conclude that they should maintain a profitable relationship between rough and polished prices. If they follow this course, polished prices will drive rough prices, and diamond pricing will be beyond their control.

It is reasonable to expect that the CSO will modify their powerful role in diamond pricing over the next few years. They will give higher priority to limiting the size of their stockpile than to controlling prices. More than ever before, the industry will have to self-regulate prices and deal directly with problems that result from increased diamond price volatility.

In conclusion, the diamond trade is entering a period of great transition. We should expect significant change in all sectors—from the mining and wholesale distribution of rough to the retail distribution of polished. Our challenge is to confront these changes head-on. To turn adversity into opportunity. To find new ways to participate in the exciting markets of the future.

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# The Diamond Distribution System

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THE DIAMOND INDUSTRY has undergone wrenching changes in the past decade—from the way rough diamonds are mined and marketed, to the way they are polished and eventually sold to consumers by retailers. The only thing we can predict with any certainty is that changes will continue to occur, but they will arrive much more rapidly and they will require enormous adaptability at every level of the industry.

Currently, the diamond industry is shaped like a funnel. Diamond production comes from all over the world, then funnels down into the narrow distribution channels of rough diamonds that eventually reach the cutting centers. Today, something close to 70%—and probably nobody outside of the Central Selling Organisation knows the exact figure—of the world's rough diamonds are distributed through De Beers. Most recently, we saw Russia sign an agreement with De Beers. Only a few months ago, De Beers also signed an agreement to sell 35% of the production of Canada's Ekati mine. As much as we would like to avoid a well-worn subject, De Beers is still the funnel through which diamonds reach the rest of the industry, and it would be foolhardy to ignore that fact. De Beers influences everything that happens in the diamond industry, all the way down to the retail level.

Although the current arrangement is monopolistic, it does provide stability. First, our industry benefits from the well-funded De Beers marketing campaign. Then consider the steadying influence of the single-channel marketing system for rough diamonds, as we saw after the Asian economy collapsed in October 1997. In a normal competitive environment, diamond prices (both rough and retail) would have fallen 30%–40%. Korea was hit especially hard, yet Korean consumers were still able to convert their diamond jewelry into money at a reasonable approximation of what they paid for it. Other valuable commodities—real estate, cars, furs, artwork—fell to

one-half, one-third, and sometimes one-fifth of their original value. Over and over, those consumers said that the first thing they'd replace when the economy turned around would be their diamonds. We can take some comfort from that.

It sounds like a rosy picture, but will it actually remain this way? Can we count on the *status quo* to continue? De Beers is undergoing a massive management review of its entire structure, and its leaders are considering the fundamental question of whether they want to, or even have the ability to, continue the single-channel marketing system into the 21st century. The answer to that question will determine how most of us in the industry will fare in the future.

It has been said that "Change is the great equalizer," but I have to disagree in this case. If De Beers decides to give up the single-channel distribution system, this change will not equalize the playing ground—it will rewrite the rules of the game. Some people will benefit from it, but others undoubtedly will lose. De Beers, no longer a monopoly but a competitor, would be a *dominant* competitor, with extensive resources and an enormous advertising budget. De Beers would have the ability to integrate vertically into every retail niche that's been carved. Supply channels for polished diamonds would narrow dramatically. Polished diamond distribution would become every bit as controlled as today's rough diamond distribution is. If such a scenario unfolds, many retailers will be left out of the picture altogether.

Nevertheless, the general outlook in the U.S. is very positive. As long as the economy remains strong, we can expect vigorous and healthy diamond and jewelry sales.

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# Retail Markets and the Growing Global Significance of Branding

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**From the 4 Cs to Commoditization**

For centuries, buyers and owners of diamonds valued them strictly for their beauty as measured by the 4Cs, the pleasure they brought the wearer, and the awe and envy they inspired from those around the wearer. That situation reached its peak about 20 years ago, until the great commodity boom of 1980, when newspapers were full of talk about \$800 gold and “diamond investments”: A one carat D-flawless sold for \$62,000, and pundits said it was cheap at twice the price. The investment boom didn’t last very long, but its legacy—in the form of an increasing dependence on laboratory grading reports and price lists—changed the diamond market forever. Publisher Martin Rapaport got his start in 1978, when prices were rising faster than he could put them into print. On the supply side, diamond production more than doubled in the 1980s; at the same time, worldwide demand tripled, thanks to the economic boom in Japan and, eventually, throughout the rest of Asia.

But what should have been a diamond manufacturers’ paradise was tempered by cutthroat price competition, discounting, and that dreaded word—*commoditization*—that is, the selling of diamonds by certificate and price list at much lower margins, as little as 20% in some cases. Retailers played one supplier off against another, with the result that margins and cash flow fell into a downward spiral that only recently appears to be bottoming out.

Now the Internet can complete the process by making the purchase of diamonds almost automatic. A recent check of the eBay on-line auction company, for example, listed 1,432 diamond items, ranging from \$19.95 to \$7,000. GemKey lists more than \$150 million worth of diamonds and gemstones each day on its trading network. And that’s just to the trade.

## And Quality Cuts

Quality retailers and their key diamond suppliers, being resourceful businesspeople, evolved a strategy to fight back: They offered quality cuts such as “ultra-Ideals,” which weren’t governed by certificates. Cutters created new and proprietary cuts such as the Gabrielle, the Radiant, and many others that could not be checked easily against a lab report or in the *Rapaport Report*. Their aim, besides raising profit margins and reintroducing “distinctiveness,” was to reestablish the diamond as a symbol of romance and prestige in an age where Wal-Mart sells them alongside garden hoses and plastic dishware.

## And Now: Branding

The industry is just entering the next phase—*branding*—which is becoming a lot more controversial than the new cuts. It’s controversial because of the De Beers initiative (the “Millennium Diamond”), which many people in both retail and wholesale believe is an attempt by the “diamond giant” to seize control over the so-called downstream diamond market.

De Beers claims that their research and that of others clearly demonstrates that consumers want branded diamonds and branded jewelry—whether it is by De Beers or another reputable company. And most will pay more to get a brand that means prestige and instills confidence that the buyer made the right decision.

About four or five years ago, De Beers conducted an extensive consumer study about synthetic diamonds. After the interviewer had explained what synthetic diamonds were—that is, actual diamonds made by man, as opposed to simulants such as CZ—most of the survey participants felt that a reputable jeweler could spot synthetic diamonds and would not pass

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them off as natural stones. But that was *most* of the consumers surveyed—not all of them. A minority did not have such confidence, and they said they felt like “red meat” to a jeweler who possessed all of the knowledge. Also, De Beers found that many consumers would pass over diamonds for something else if they felt a jeweler could not spot the differences between synthetic and natural stones. It was this study that launched the initiative to develop synthetic diamond detectors and the branding program.

Further, De Beers surveys found that consumer feelings about the “inviolability” of diamonds actually worked against branding at first. While jewelry buyers readily accept cultured pearls that have been tumbled and bleached and colored gems that have been heat-treated or irradiated, diamonds have to be pure and untouched. Consumers were worried that the mark would compromise the diamond’s quality.

Since no company had undertaken such consumer research about diamonds before, almost all of this project was a trip into the unknown. Focus groups and questionnaires gave De Beers some clues, but by last year it was clear that most of these concepts had to be proved in the marketplace before further decisions could be made. This is what led De Beers to launch the trial marketing program of its branded diamonds at Boodle & Dunthorne, a British retail chain.

The key questions were: (1) Will consumers accept a “marked” diamond, and (2) How much more are they willing to pay for one? Other questions addressed whether or not consumers wanted the “extra” reassurance of a serial number on their diamond and a De Beers in-house certificate that said the diamond was natural and untreated.

The next step was to develop a sales training program for the Boodle & Dunthorne staff so they could properly explain what the brand meant and that the marking on the diamond was meant to enhance value, not compromise it. De Beers and Boodle & Dunthorne began the program in July 1998 with a 10% premium over comparable unmarked diamonds. Since then, they have been steadily pushing that premium past 15%. According to De Beers, not one consumer has refused to buy a branded diamond because it costs more. In fact, Boodle & Dunthorne have decided to convert their entire inventory of diamonds over 30 points to De Beers-branded goods—even complicated pieces such as multi-stone rings.

Ultimately, De Beers hopes branding will increase



*As part of De Beers’s marketing for the new millennium, the Mikimoto diamond feather brooch (with an 11.10 ct diamond as the centerpiece) was part of a collection featured at the “Diamonds Are Forever: The Millennium Celebration” gala event held in London June 9, 1999. Photo by Albert Watson.*

the size of the diamond market, not carve a bigger slice for retailers and sightholders selling its own branded diamonds. De Beers already sees this happening in other luxury markets. For example, many consumers will pay \$5,000 for a new Louis Vuitton flight bag even if they already have a flight bag, because it’s something new and exciting. In short, the brand drives the demand for the product as much as it does for the brand itself, according to De Beers.

Last, some retailers, such as Cartier, have successfully built a store brand of their own. However, “third party brands” such as that offered by De Beers, other diamond houses, or respected industry groups (e.g., the American Gem Society or World Federation of Diamond Bourses) can be the global equalizer—ensuring quality standards and helping retailers who do not have great resources compete in the “branded” world.

## A Manufacturer's Perspective

Sean Cohen

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THE ENTIRE DIAMOND INDUSTRY is changing, and the rate of change is increasing. Notable within this changing industry is the evolving role of the diamond manufacturer. Whereas in the past the manufacturer's role was clearly defined as one of polishing diamonds and selling them at wholesale, now the manufacturer is entering an era of vertical integration. This involves purchasing the rough diamonds as close to the source as possible and then selling the polished stones as close to the ultimate consumer as possible. The era of vertical integration for diamond manufacturing will change the "mix" of manufacturers involved in the business and, concomitantly, it will have a large impact on the role of dealers and possibly retailers.

The role of diamond manufacturers started to change back in the late 1970s, as the GIA Gem Trade Laboratory grading reports and Rapaport price lists gradually became accepted worldwide. Standardized grading and pricing allowed rough to be priced more tightly in relation to polished. At that time, many in the industry did not understand the effect that these reports and lists would have during an era of seemingly endless price increases for polished goods. However, with rough being priced ever closer to realizable polished value, manufacturers were forced to increase their yields to combat low margins.

By necessity, this environment created significantly greater manufacturing efficiency. Yet, the cost savings generated were constantly being eroded by the ever-increasing prices for rough. To further combat the lack of profitability, manufacturers sought to increase turnover while maintaining their overhead. Increased turnover led to a glut of polished diamonds, as the greater capacity that had been achieved drove their demand for rough. This glut led to competition for sales, which resulted in the need for ever-longer credit terms and greater bank financing. This situation has eroded many of the gains made by increased turnover and led to moribund prices for polished diamonds. In addition, it has resulted in diamond

manufacturers' funding other sectors of the industry, in particular, the retail jewelry business.

The economic crisis in Asia actually saved the diamond industry by injecting it with a strong dose of reality. As a result of the Asian crisis, companies and institutions related to the industry realized that the system by which the industry operated was unstable and unsustainable.

As we look to the future, we see that the information age, which dominates commerce today, will bring many positive benefits. Not only has it already moved diamond manufacturers in the direction of vertical integration, but it also has produced a number of broad trends that will usher in a new era of profitability.

First, enhancing efficiency by outsourcing services can create highly dynamic small firms. Like fish in the ocean, small firms need to react quickly if they are to survive. With the manufacturing efficiencies inherent in outsourcing and the nimbleness of small firms, we may see a significant change in the dynamics of all manufacturing firms.

Second, branding is here to stay. In the future, due to public demand and the widespread availability of diamonds on the Internet, there will be a plethora of brands. As a result, there will be at least 20 different versions of a "G-VS<sub>2</sub>", each with its own price point. The prices for polished goods will not be nearly as definable as they are now. If polished prices are variable, then the price gap between polished and rough will be greater, and there will be more opportunity for better profitability. The information age will, with the correct usage, bring profitability back to the industry.

Last, diamonds have intrinsic value. Humans have been captivated by them for thousands of years. As long as there are human beings and luxury products, diamonds will be bought and there will be diamond manufacturers. With new marketing methods, diamond manufacturers will absorb an ever-increasing and profitable role within the diamond industry as a whole.

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# The U.S. Diamond Industry

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THE U.S. DIAMOND INDUSTRY enters the 21st century with several history-making trends in full force. Most importantly, the U.S. has evolved from a manufacturing society to a service-based society, and now we are emerging as a communication- and information-based society. Soon, the consumer will have the ability to be fully informed on any subject, to reach multiple global sources with a speed and ease that will fundamentally alter any conceptions we now have about the way the world works. There will be no future for companies with business models and profits that rely on geographic isolation, limited communication, or the ignorance or laziness of the consumer.

The industry's evolution has accelerated to a point where entire segments are at risk. Catalog showrooms have essentially disappeared, as have jewelry distributors. The number of diamond importers and dealers has declined rapidly, while jewelry imports have grown just as fast. Suppliers of loose diamonds feel compelled to be in jewelry manufacturing, and they are finding the transition daunting because of the vast differences between the two businesses. At the same time, television shopping networks and wholesale clubs, once disparaged, are now sizable businesses. The Internet is causing distress mostly because it is an "invisible" opponent—there is no real estate to inspect. And this one has the power to dwarf anything we have seen.

The supply side remains fragmented and faces difficult times in a market that will value marketing and distributing power far more than purely manufacturing skills. Heavy competition, informed consumers, and excess capacity at all levels of the industry have caused shrinking margins for some years, and it is finally sinking in that margins are not going to improve within the present structure of the trade.

To address the many new challenges facing the U.S. diamond industry, companies are pursuing any

device that raises visibility—especially *consolidation*, *branding*, and *technology*, but particularly the *Internet*. The aim is to dominate their market segment, and to increase productivity to the point where turnover—the sale of larger volumes—overcomes the lack of gross margin.

## Consolidation

*Consolidation*, especially at retail, has reached a final stage. Television, like the wholesale clubs, has only four meaningful companies in jewelry. The mall jewelry sector has seen some 40 operations disappear in the last seven to eight years. Only 10 or so chains will exist in the mall jewelry sector by 2005. Only suppliers with significant capacity in production, systems, and support will be able to service this sector.

The days when any credit-worthy diamond company could buy goods from prime sources appear to be ending. Prime goods are going to be channeled through a preferred value chain of distributors, manufacturers, and retailers, and there will be a distinct effort to cut off competition. Nevertheless, small, innovative companies, who sense the public's needs and who respond accordingly, will outperform large rivals, and may even undo them.

## Branding

The fundamental nature of diamonds makes true *branding* particularly difficult, since a brand name cannot be ostentatious or visible on the principal product. Nevertheless, branding is going to have central importance for Internet sales, and that guarantees that considerable effort will be exerted to create successful brands.

The De Beers brand has great potential, but we can be certain that many others will make efforts in this area. Although there will be few successful bran-

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ders, we can expect a great deal of jockeying for position around those who do succeed. Cutters, jewelry manufacturers, importers, wholesalers, and retailers all will want strong alliances with the brander. Branding stands out as a singularly powerful tool for attaining size and profits, and it will be futile to fight the trend.

### **Technology: The Internet**

The enormous capacity of the *Internet* will provide a quantum leap in the ability to communicate and to project image and personality. It is a mistake to imagine the Internet of the future as a faster, upgraded version of what we have now. We will have the “experience” of buying jewelry delivered to us in a manner that surpasses almost any in-store experience we know.

By 2005, 10%–15% of the country’s jewelry business, or about US\$6 billion, may be generated by the Internet, directly or indirectly. A new retail format that captures 15% of the business while still in its infancy will have an enormous impact on the status quo. Some are already saying that the diamond business as we know it is finished. Indeed, it is likely that, with regard to pricing, the Internet will produce the equivalent of a public bourse. Even the Rapaport list could fade out, as the Internet becomes the great equalizer.

This new dynamic will require a new set of marketing skills, most critical of which will be producing sales velocity. Small family businesses, which historically nurture their stocks and rely on relationships, may no longer be viable. Even now, with diamond lists available to retailers on Web sites, dealers have found that there is little loyalty, only a search for value.

Jewelers need to view such an environment as an opportunity. If they succeed, we will see a revitalized and energized independent sector.

### **What Are the Possible Scenarios We Face?**

**Scenario 1. Supply Domination.** The hope is that De Beers will be able to continue single-channel marketing, and rebuild a situation in which inventories make money by sitting on the shelf. De Beers will not relent in its pursuit of control, at least in better and larger goods, and it will seek success by funneling stocks through a limited number of favored sightholders.

However, this will be a multi-polar world, and unless there is a remarkable turnaround in producer sentiment, De Beers control of a high percentage of

world diamond production is unlikely.

Other major producers will build comparable networks of large customers. In this scenario, a company’s position in the value chain will mean a great deal. All others will have inordinate difficulty finding the goods they need at a price that is affordable.

**Scenario 2. Retail Domination.** The continuance of the present situation, in which retailers foster competition among suppliers in order to extract the lowest possible price, could continue for years. Major retailers will connect directly with major sightholders (both within De Beers’s domain and outside it), and large-scale disintermediation will result as consolidation intensifies. Independent retailers will join the fray, with many of the stronger operations establishing similar associations with the dominant suppliers. There would still be room here for relationships between retailers and mid-sized, established diamond companies. However, the Internet could radically change the balance of retail power.

**Scenario 3. Distributive Domination.** A number of wholesale suppliers establish powerful brands and find both manufacturers and retailers at their door. The Internet takes another piece, flattening the hierarchy and making distribution the most important and valuable asset. In this scenario, verticalization and alliances attain any number of variations, and the distinctions between suppliers and retailers really blur.

**Scenario 4. No Domination.** Everything happens, and doesn’t happen. There are enough sources of polished goods to satisfy any diligent buyer. Major chains continue to consolidate, absorb weaker ones. Independents maintain the high ground in the guild business. Branding brings credibility and stability to the trade, and the threats of synthetics and treatments are disarmed. The Internet grabs a large slice of business, but in its democratization it generates as much new business as it takes away.

### **Watchwords**

The watchwords for the future will be *efficiency, speed, innovation, and anticipation*; not necessarily *size, longevity* or *deep inventories*. Product will count less than marketing, and inventory might well be treated like a hot potato.

Which scenario is the likely one? Take your pick!

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# Today and Tomorrow in the Japanese Jewelry Market

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THE JAPANESE JEWELRY MARKET has experienced great changes in the past decade, including the shift from a seller's to a buyer's market. As a result, we need more skills to market our products. The present situation is a consequence of the economic slowdown that started in 1991 and has grown progressively worse.

After extremely rapid growth in the 1980s, the Japanese retail jewelry market reached record sales of ¥3.015 billion (US\$22.8 billion at the average exchange rate for that year) in 1991, but by 1998 it had declined by almost half, to ¥1.595 billion (US\$13.3 billion at the average exchange rate). This slowdown is also reflected in changes in Japan's proportion of world diamond sales. Whereas in 1991 Japan accounted for about 30% of the world's diamond sales by value, this had fallen to 25% in 1997 and probably reached its low point in 1998, at a mere 18%; by comparison, the United States accounted for upwards of 40% of the world's diamond sales last year. This decline was reflected in all sectors of the Japanese market. Furthermore, partly because of the increasing popularity of a new concept, the "simple wedding," the acquisition rate for diamond engagement rings shrank from 76% in 1994 to 68% in 1998 for first marriages.

However, improvement is on the horizon. During the first quarter of this year (1999), diamond imports increased by 20% compared to the same period in 1998. This bodes well for continued recovery for the remainder of the year.

During this long recession in Japan, companies have tried to find ways to survive. Some have taken extreme measures, such as restructuring, reducing costs, closing

under-performing retail outlets or excess facilities, and withdrawing from non-core or unprofitable segments of the jewelry business. Notwithstanding these efforts, some companies were forced to declare bankruptcy, including a few so-called top-ranked companies.

In due course, the jewelry market in Japan will recover and thrive. However, I feel that it will never expand as rapidly as it did in the past, and that the retail jewelry market will become far more competitive. For all practical purposes, the Japanese jewelry market is mature and soon will be saturated. To be successful in such a market, major improvements will be required in retailing, merchandising, and presentation skills, in addition to developing beautiful jewelry.

Although most of these aspects of the retail jewelry industry can be evaluated quantitatively, the issue of "emotion" is particularly important in Japan. We are seeing a trend in purchases away from those items that people buy for their usefulness and can replace easily, to those that they buy for some important reason and which have no substitute. It may represent a valuable memory, or it may be a symbol of some emotion. One such emotion is affection, which immediately conjures up the image of a diamond. Although this concept is well established in our market, its importance will continue to grow. We know that we are selling not only a diamond, or a piece of jewelry—but also a dream.

Nevertheless, we in Japan are always alert to, and prepared to respond to, changes in consumer tastes, trends, and customs in our society, as well as changes to business practices and the distribution system. Such changes are inevitable, and they are transforming the Japanese jewelry industry.

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# The Developing Market in China

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THE DIAMOND SCENE in the People's Republic of China has altered considerably in the course of the last 20 years. Following the liberalization policies adopted by Deng Xiao Ping, there have been fundamental changes—mostly in the main commercial centers, coastal areas, and border provinces adjoining Hong Kong and Macao—which have affected every sphere of life. Today, numerous centrally and locally funded infrastructure projects are taking place. Much overseas investment by ethnic Chinese individuals and companies, and by governments and foreign organizations, has flowed into the country. A consumer society has started to develop that includes Western-style shops, some of international standing. Advertising on television, in magazines, and in newspapers—both locally and nationally—has played a role in creating consumer interest and awareness. There is disposable income in the hands of more people, with a growing middle class that is backing its preferences with purchasing power.

Social changes are also in process. Some of the traditions that governed life for generations are being forced to adapt to new ways of thinking and action. There is a sense of relief that the drab uniformity of Mao days has changed in favor of a more interesting, exciting, and colorful way of life—affecting especially those members of the younger generation who live in big cities and who have access, through language awareness, to outside influences.

These changes have substantially influenced diamond developments in China. Prior to the 1990s, there was a distinct lack of a diamond culture compared to the high acquisition rates among expatriate Chinese in neighboring countries and throughout the world. During the present decade, many diamond factories were opened with government (central and

provincial) assistance. The Chinese authorities in Beijing and Shanghai are working on measures to encourage diamond and jewelry manufacturing in China—including reorganizing the tax system to allow local industries to compete with imports, official and unofficial, from overseas. At the same time, overseas diamond companies have invested in manufacturing opportunities in China, both to take advantage of the lower production costs and to establish a base for the market possibilities that are anticipated to develop in the years ahead.

In recent years, De Beers has undertaken educational programs to increase and improve consumer awareness. Encouraging results have been achieved—supported by estimates of growth in total sales, and of the rise in the average price of jewelry items sold. By way of example, the Chinese market for diamond jewelry grew during the 1990s from insignificant to \$500 million in 1998. Current De Beers marketing programs are attempting to introduce the concept of the diamond wedding ring and to promote diamond acquisition among men.

Much work remains to be done, and care has to be exercised, to find the right partner with whom to work in China. However, there are opportunities for growth and development in which both local companies and foreign enterprises can take part. The size of China's population, the increase in wealth and income, and the growing awareness of Western styles and fashions—including jewelry—promise a bright future for the diamond market in this rapidly developing nation.

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## Ruby and Sapphire Occurrences Around the World

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**A**FTER DIAMOND AND EMERALD, sapphires and rubies are the most sought-after of fine gemstones. Widespread use and acceptance of heat treatment in the 1980s, and significant discoveries such as the vast ruby reserves in the Mong Hsu region of Myanmar in the early 1990s, have made rubies much more available and affordable than ever before. With the exception of Antarctica, gem-quality ruby and sapphire are mined on every continent. This abstract reviews the status of the active deposits on each continent, and concludes by addressing the question: Will supplies be able to meet market demand in the next millennium?

Although still debated by geologists, with few exceptions rubies and sapphires can generally be classified as coming from: (1) alkali basalts; (2) marble-type deposits; or (3) metasomatic deposits and ultrabasic bodies, such as those associated with pegmatites, schists, gneisses, skarns, and amphibolites (see, e.g., Levinson and Cook, 1994; Muhlmeister et al., 1998; Schwarz, 1998). This distinction has significant commercial importance because rubies and sapphires recovered from alkali basalt deposits often are less pure in hue, and typically are much darker in tone and saturation (and thus frequently command substantially lower prices) than their counterparts from other geologic origins.

**Asia.** Historically, Asia has been the predominant source of ruby and sapphire, and significant quantities continue to come from Myanmar and Sri Lanka. By the early 1990s, many of Thailand's important basalt-type deposits of ruby and sapphire were nearly exhausted, and today mining activity is greatly decreased. India continues to supply major quantities of low-priced ruby beads, cabochons, and star rubies. Several locations in Orissa State in eastern India currently yield fine-quality facet-grade ruby.

Sapphire mining at the historic Kashmir deposit is currently limited to sporadic alluvial workings along the hill slides and old mine tailings. Limited geologic studies indicate that further deposits of sapphire may await discovery in Kashmir. In 1979, a major deposit of fine-quality ruby was discovered in Azad Kashmir, about 350 km from the blue sapphire area

The last decade has seen the discovery of, or increased mining activity at, deposits in Vietnam, Laos, and Cambodia. Ruby continues to be recovered from deposits in Nepal, Tajikistan, Afghanistan, and Pakistan. In addition to economic considerations, the viability of mining some of these regions is influenced by difficult terrain, as well as by political considerations. Important alkali basalt sapphire deposits are mined in at least three different areas of China. Ruby is also known from several different regions there; the Yunnan and Guangxi provinces—which border Myanmar, Laos, and Vietnam—are promising. Asia will continue to be a major supplier of ruby and sapphire during the 21st century.

**Europe.** There are several countries in Europe where gem-quality corundum is known to occur; however, most are not producing commercially at present. Russia has the greatest potential in Europe for economic ruby and sapphire deposits, but currently there is only minor production. Gem corundum has been discovered at numerous places in the Ural Mountains. Given the right conditions and incentives, this region could become a significant producer of gem-quality ruby and sapphire.

**North America.** Montana remains North America's most significant source of gem corundum. Huge sapphire reserves are known to exist within four major

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areas of Montana. Although limited production continues today from several different areas, the success or failure of these or future mining ventures depends on the ability to mine, heat treat, and cut the stones at a cost that will enable the unusual colors and generally small sizes to be sold at competitive prices on the world market.

**South America.** Opaque and low-quality sapphire and ruby have been known in Brazil for many years. In the 1990s, however, a potentially economic deposit of facet-grade sapphire was systematically explored in the Indaia Creek region of Minas Gerais. This deposit has yet to be mined commercially. Sapphires have been known in the Mercaderes-Rio Mayo area of Colombia since 1907. Small-scale mining continues to produce various colors, including light to medium blue, and an unusually high percentage of color-change sapphires. Rubies also have been reported. The future of these deposits will depend largely on economic and political factors.

**Australia.** Australia remains a major player in the international sapphire market. Gem sapphire occurs in association with alkali basalt at numerous localities in eastern Australia. Large-scale commercial mining has been successful only at the Anakie and New England fields. Geologic surveys indicate that Australia is very likely to remain a major supplier of commercial sapphire well into the next century.

**Africa.** Africa undoubtedly will be the source of many exciting future discoveries of ruby and sapphire. Gem corundum continues to be commercially exploited (to varying degrees) in Burundi, Kenya, Malawi, Mozambique, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Tanzania, Uganda, the Democratic Republic of the Congo (formerly Zaire), and Zimbabwe, as well as in the nearby island nation of Madagascar. As the latter half of this century has already witnessed, East Africa has extraordinary gem potential. This is particularly true throughout the Mozambique Orogenic Belt, the 200–300-km-wide geologic feature that runs from Mozambique in the south, through Tanzania, Kenya, and Ethiopia, to the Sudan in the north; it is one of the richest gem-bearing regions in the world. In Tanzania alone, more than 200 different occurrences of various gem minerals have been identified (Dirlam et al., 1992), most of

which are in the Mozambique Belt. The Tunduru region of southern Tanzania is so rich in gems, including sapphire and ruby, that it has been described as the “new Sri Lanka.” Future discoveries of gem-quality ruby and sapphire are likely all along this belt.

Many other countries in Africa will continue to provide exciting deposits of ruby and sapphire. For example, Uganda recently produced some unusually large ruby crystals. Last, Madagascar, which has many geologic similarities to East Africa, continues to reveal its extraordinary sapphire wealth. Most recently, the alluvial deposits in the Ilakaka region of southern Madagascar have yielded impressive quantities of attractive pink sapphire, as well as important quantities of blue sapphire.

**Ruby and Sapphire in the New Millennium.** As exploration techniques move beyond the simple washing of gravels and placing of explosives toward the use of sophisticated geophysical technology (such as seismic reflection and radar imaging for high-resolution mapping of near-surface deposits; see, e.g., Cook, 1997), even more gem corundum deposits will be discovered. When these advanced technologies are combined with favorable political and economic conditions in less-developed countries, where mining costs are relatively low, we will see the greatest results.

Current information indicates that not only will market demand for ruby and sapphire be met in the 21st century, but a full range of qualities and price-points will also be available.

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#### REFERENCES

- Cook F.A. (1997) Applications of geophysics in gemstone exploration. *Gems & Gemology*, Vol. 33, No. 1, pp. 4–23.
- Dirlam D.M., Misiorowski E.B., Tozer R., Stark K.B., Bassett A.M. (1992) Gem wealth of Tanzania. *Gems & Gemology*, Vol. 28, No. 2, pp. 80–102.
- Levinson A.A., Cook F.A. (1994) Gem corundum in alkali basalt: Origin and occurrence. *Gems & Gemology*, Vol. 30, No. 4, pp. 253–262.
- Muhlmeister S., Fritsch E., Shigley J.E., Devouard B., Laurs B.M. (1998) Separating natural and synthetic rubies on the basis of trace-element chemistry. *Gems & Gemology*, Vol. 34, No. 2, pp. 80–101.
- Schwarz D. (1998) Aus Basalten, Marmoren und Pegmatiten. *Rubin, Saphir, Korund: Schön, hart, selten, kostbar — extraLapis* No. 15, pp. 5–9.

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# Emeralds—Recent Developments and Projected Changes in Supply

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**I**N GENERAL, the most important factors affecting gem production are: (1) socio-political, (2) logistical, (3) technical, (4) financial-commercial, and (5) geological-mineralogical. The importance of each of these factors on production varies in each mining area. In some emerald-producing countries (e.g., Zambia and Brazil), the dominant factors controlling the gem output are geological-mineralogical and technical (e.g., the lack of modern mining technology). In other countries, emerald production is controlled primarily by current socio-political factors (e.g., Russia and Pakistan), and even by recurrent military operations (e.g., Afghanistan). The status of current emerald production and the future potential of the major producing countries are reviewed.

## Colombia

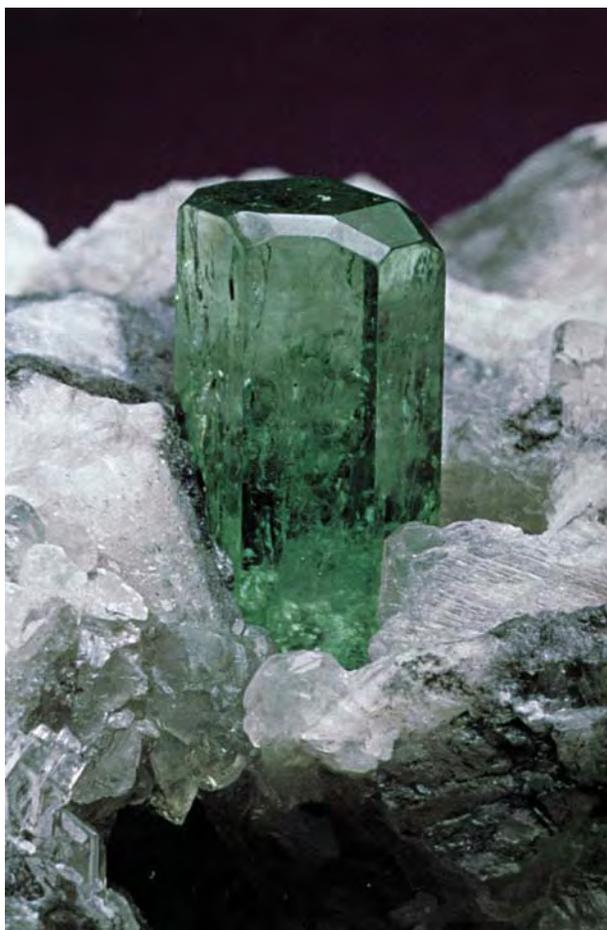
Colombia, the world's most important emerald-producing country, is reorganizing its emerald industry, including the mining sector. Foreign companies have been invited to participate in joint-venture mining projects (e.g., Canadian companies at Chivor). Currently, there is only minor production at Chivor and Muzo. Coscuez is the most important mining area at present; it produces about three-quarters of Colombia's emeralds (see figure). In the past few years, underground mining has begun to replace the historic open-cast mining operations.

## Brazil

The major problem facing most Brazilian emerald deposits is the complex geological conditions (e.g., extensive faulting, dislocations, or disrupted layers) in the mining areas, which requires the use of capital-intensive mining methods to follow the emerald mineralization (Lau, 1998). The potential reserves of most

Brazilian emerald deposits are impressive. However, the high production costs result in inflated prices for the emeralds (Roditi and Cassedanne, 1998). Future prospects depend primarily on whether the mines can get sufficient capital to develop modern underground operations.

*This fine emerald crystal from Coscuez in Colombia measures 1.3 cm high. Courtesy of Mel Gortatowski; photo © Jeff Scovil.*



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## Zambia

For the past few decades, the Zambian government has attempted to control practically all aspects of the emerald industry. This has made it impossible to exploit the enormous potential of the emerald fields in the Ndola Rural District (see, e.g., Milisenda et al., 1999). Optimistic predictions, which project annual production of about US\$100 million (a value previously attained in the 1980s), have been voiced by some individuals with intimate knowledge of the Zambian emerald industry. If such goals are to be realized, efficient underground mining operations must be introduced. This will require government support and guarantees, before private mining companies will make the substantial investments necessary to modernize emerald exploration and mining, as well as other phases (e.g., marketing) of the emerald industry. The geological-mineralogical and economic potential of the Zambian emerald fields is sufficient to justify such a commitment.

## Zimbabwe

Steady production of at least 60 kg of mixed-grade rough emeralds per month has been achieved since the mid-1990s (Zwaan and Kanis, 1997). Although it is difficult to give a precise estimate of reserves, ongoing exploration in the Sandawana area indicates that current production can be maintained for many years.

## Madagascar

In general, emerald mining in the Mananjary region is very costly, due to the lack of a stable infrastructure, poor telecommunications, and expensive technical maintenance. Systematic mining is also impeded by the lack of capital and technical expertise. Nevertheless, the emerald potential of this region is enormous (Petsch and Kanis, 1998).

## Pakistan

The Pakistani government, which has controlled the emerald industry for decades, has prevented the development of modern and effective mines and marketing strategies. Increased production can only be achieved when the following are achieved: reduction of government interference, large investments of capital, and acquisition of sufficient technical expertise for the operation of modern large-scale mines.

## Afghanistan

Mining activity in Afghanistan, including emerald

production, has always been more dependent on political-military conditions than on mineralogical-geological factors. Currently, emeralds are being mined in the Panjshir Valley, although there is no steady production, at least "officially" (Giard, 1998). Comprehensive studies by Russian geologists indicate that the region has significant gemological potential, but precise data on the emerald reserves are lacking.

## Russia (Ural Mountains)

Although no new emerald deposits have been discovered in the Urals since 1945 (Laskovenkov and Zhernakov, 1995), geological studies suggest that only about 30%–35% of the known reserves have been worked to date. Future prospects depend mainly on the implementation of cost-effective mining operations along with a realistic marketing concept for the production.

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## REFERENCES

- Giard D. (1998) Les émeraudes de la vallée du Panjshir. In D. Giard, G. Giuliani, A. Cheilietz, E. Fritsch, and E. Gonthier, Eds., *L'émeraude*, Association Française de Gemmologie, Paris, pp. 177–184.
- Laskovenkov A.F., Zhernakov V.I. (1995) An update on the Ural emerald mines. *Gems & Gemology*, Vol. 31, No. 2, pp. 106–113.
- Lau W. (1998) New finds in Brazil boost production. *Jewellery News Asia*, No. 169, September, pp. 160, 162, 164.
- Milisenda C.C., Malango V., Taupitz K.C. (1999) Edelsteine aus Sambia – Teil 1: Smaragd. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 48, No. 1, pp. 9–28.
- Petsch E.J., Kanis J. (1998) Gisements d'émeraudes de Madagascar, région de Mananjary. In D. Giard, G. Giuliani, A. Cheilietz, E. Fritsch, and E. Gonthier, Eds., *L'émeraude*, Association Française de Gemmologie, Paris, pp. 1173–1176.
- Roditi M., Cassedanne J.P. (1998) L'exploitation des mines d'émeraude et leur context socio-économique au Brésil. In D. Giard, G. Giuliani, A. Cheilietz, E. Fritsch, and E. Gonthier, Eds., *L'émeraude*, Association Française de Gemmologie, Paris, pp. 157–163.
- Zwaan J.C., Kanis J. (1997) Update on emeralds from the Sandawana mines, Zimbabwe. *Gems & Gemology*, Vol. 33, No. 2, pp. 80–99.

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# Review of Gem Localities in North America, Russia, and Southeast Asia

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**N**ORTH AMERICA. Gem mining in North America has never been extensive, and typically has accounted for less than 1% of the global gem production. Nevertheless, over the years the U.S. has produced more than 60 different colored gemstones, mostly from relatively small, short-lived deposits. Some U.S. colored gem areas and deposits have been known for more than a century. Mining at these deposits generally has been intermittent, however, as new economic zones are found or older zones are reworked. For example, the pegmatite district in San Diego County, California, has been famous for its tourmalines since the 1890s (figure 1). Mines such as the Himalaya, Stewart, and Tourmaline Queen have enjoyed revitalization and supplied fine gem material over the past three decades. Since 1976 at the Himalaya mine alone, 10,000 feet (3,075 m) of underground tunnels have been driven, with about 2 tons of tourmaline recovered to date. The Little Three pegmatites, also in San Diego County, have produced spectacular spessartine and blue topaz. The historic pegmatites in Maine (e.g., at Plumbago and Mt. Mica) have been mined sporadically in the same time frame and also have produced some fine tourmaline.

Arizona produces several important gem minerals. Significant deposits of peridot are located on the San Carlos Indian Reservation, where magnificent gem rough up to 40 ct have been recovered, although most of the pieces are small. Nearby, fine andradite and “ruby”-colored chrome pyrope garnets occur. The Four Peaks deposit, located in the rugged Mazatzal Mountains near Phoenix, has recently been reopened and is producing high-quality amethyst. Although the faceted stones are typically small, the

amethyst is known for its extraordinary “red flash” effect to strong light.

The southwestern U.S. is one of the world’s largest sources of turquoise. Numerous deposits in Arizona, Nevada, and New Mexico produce turquoise, some

*Figure 1. Fine-quality tourmaline is still produced occasionally from pegmatites in Southern California. These pink, bicolored, and green stones from the Himalaya mine weigh 5.15 ct, 5.83 ct, and 3.77 ct, respectively. Photo © Tino Hammid.*



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Figure 2. Primitive mining techniques are still employed at the world-famous ruby mines of Mogok, Myanmar. Photo by William Larson.



of it magnificent but most of it of lower quality (porous, chalky but amenable to enhancement). Some of the copper mines (e.g., at Morenci) still produce malachite and azurite. Chrysocolla is obtained from the Globe-Miami district. These copper minerals are continually being exposed during mining operations. Other important gems presently being mined in the U.S. include sunstone (feldspar) from Oregon; sapphire from two areas in Montana (the *in situ* Yogo Gulch deposit and several alluvial sources in the western part of the state); and emerald from Hiddenite, North Carolina. Although recent emerald finds at Hiddenite have been encouraging, it remains to be seen whether this deposit can be mined economically.

Much scientific and media attention has been given to two rare gem materials that are unique to the United States: red beryl from Utah and benitoite from California. Extensive (and expensive) development work by organized mining companies is currently in progress at both of these deposits.

Elsewhere in North America, Mexico has been the source of fine amethyst and iridescent andradite, but it is probably best known for beautiful opal from Querétaro. In the last few years, some extremely fine opal has been produced, but in small quantities. Although only a limited number of colored gems have been mined in Canada, British Columbia has been the world's principal supplier of nephrite for several decades. Alberta is the world's only source of "ammonite," the nacreous outer shell layer of fossil ammonites that can exhibit remarkable iridescence.

**Russia.** Since the dissolution of the Soviet Union in 1991, exploration for, and mining of, colored gems in Russia has undergone tremendous changes. Most of the major activity has been in the Ural Mountains where the mining of emerald and alexandrite (from mine dumps at Malysheva and Takovaya), as well as demantoid (at Karkodino mine) has resumed, in most cases with mixed results. Jadeite has been found at three locations: the Polar Urals, Kazakhstan, and Siberia. In the Lake Baikal area, pegmatites locally contain abundant tourmaline. Only time will tell if these various deposits can be mined economically and whether their production will be significant to the gem trade.

**Southeast Asia.** The production of ruby, sapphire, spinel, and jadeite from historic areas in Myanmar—especially Mogok (figure 2)—is legendary. However, the new production of rubies from Mong Hsu, in northeastern Myanmar, is likely the major gemological event of the decade in Southeast Asia, as it has greatly increased the availability of rubies on the world market. Concomitantly, there has been a significant decrease in the production of sapphire from the Kanchanaburi district in Thailand, and production from Laos and Cambodia is still affected by political turmoil. Vietnam has exciting potential. Its rubies are fabulous. The full significance of Vietnam's spinel, aquamarine, topaz, and other gems has yet to be determined.

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# Colored Stone Sources in Africa and Madagascar

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ARGUABLY, THE GREATEST SOURCE of excitement in the world of colored gemstones for the past half-century has been Africa. This continent consists of 50 nations; 20 of these, as well as the nearby island nation of Madagascar, produce gemstones. Much of Africa's land mass is composed of Precambrian rocks, the most

*Figure 1. Tanzanite is one of the most important gem materials discovered in the 20th century. This crystal measures 4.4 cm high, and the oval brilliant weighs 10.08 ct. Courtesy of Barker & Co.; photo © Jeff Scovil.*



geologically significant of which, from the viewpoint of colored gemstones, are found in the Mozambique Orogenic Belt. This belt extends almost the entire length of the eastern part of Africa, from Madagascar and Mozambique in the south to Ethiopia and Sudan in the north. Most of the colored gemstone deposits are related to the Pan-African orogeny (i.e., a series of metamorphic events and associated mineralizations that occurred between 800 and 450 million years ago, which were superimposed on the Mozambique Belt).

As diverse and vast as the continent is, so too is the colored gem potential. In order to predict this potential, as judged by the number of new gemstone discoveries, it is worthwhile to examine Africa's recent gemological past. This continent, with all its inherent difficulties, has yielded amazing finds of: tanzanite in Tanzania (figure 1); tourmaline from Mozambique and Namibia; very fine aquamarine from Mozambique; and tsavorite from Kenya, Tanzania, and Mali. Further, the Southeast Asian dominance in ruby and sapphire is being challenged by Tanzania, Kenya, and Malawi. Alexandrite, cat's-eye chrysoberyl, and sapphire—in qualities that rival those from Sri Lanka—were recently discovered in the Tunduru area of southern Tanzania (figures 2 and 3). Mozambique has yielded spessartine garnet that is comparable to the “Mandarin” garnet from Namibia. Nigeria also has produced fine spessartine, as well as large amounts of pink, red, and bicolored tourmaline. Zambia and Zimbabwe are regarded as very important sources of fine emerald.

More than ever, Madagascar demands close scrutiny due to the sheer frequency with which new deposits are being discovered and the quality of the gems found. Sapphire in colors comparable to those from Kashmir are now mined near Ilakaka, in south-

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ern Madagascar. Madagascar is also the source of tourmaline, sphene, apatite, and various garnets. Emerald deposits have been found near Mananjary, and extensive deposits of dark blue sapphire have been mined near Diego Suarez. In the next decade, Madagascar will likely emerge as one of the most important colored gemstone sources in the world.

However, Africa's streets (or mountains) are not lined with gemstones. Africa is an example of extremes. The inherent difficulties, in most of the mining areas, defy the imagination. These include anarchy, inadequate communications, difficult climatic conditions, poor infrastructure, insufficient finances, government red tape and arbitrary judgments, lack of technology and appropriate machinery, prevalence of malaria and other diseases, and in some areas warfare. As a result, the foreign investments that are sorely needed throughout Africa are difficult to obtain for colored gemstone mining. After discovery has been made, the systematic extraction of the gems presents another set of problems. Once the easily accessible surface areas have been worked, hand mining becomes difficult, tenuous, and eventually uneconomical, at which time the area is abandoned. Restarting mining in a locality that has been desecrated by small-scale miners, even if modern machinery and mining methods are used, is usually economically unattractive.

Africa will almost certainly yield more compelling treasures in the new millennium, but the extent of its



*Figure 2. This miner is digging for gem-bearing gravels at Libafu in the Tunduru region of southern Tanzania. Photo by Horst Krupp.*

future gemstone wealth will depend on improvements in exploration and mining. And, although Africa is rich in colored gems, it is not likely that there will be an oversupply for extended periods of time. New discoveries that yield superb stones are generally worked feverishly for a relatively short period of time and soon are exhausted. Thus, Africa will be a reliable source of significant quantities of colored gemstones, but the supply will be erratic.



*Figure 3. A stunning variety of gems have been recovered from the vast alluvial deposits in the Tunduru region of southern Tanzania. The gemstones shown here consist of sapphires, spinel, chrysoberyl, and garnet (approximately 0.5–2 ct). Courtesy of Horst Krupp; photo by Shane F. McClure.*

## Will There Be Another Chance For Business in the Asian Colored Stone Jewelry Market?

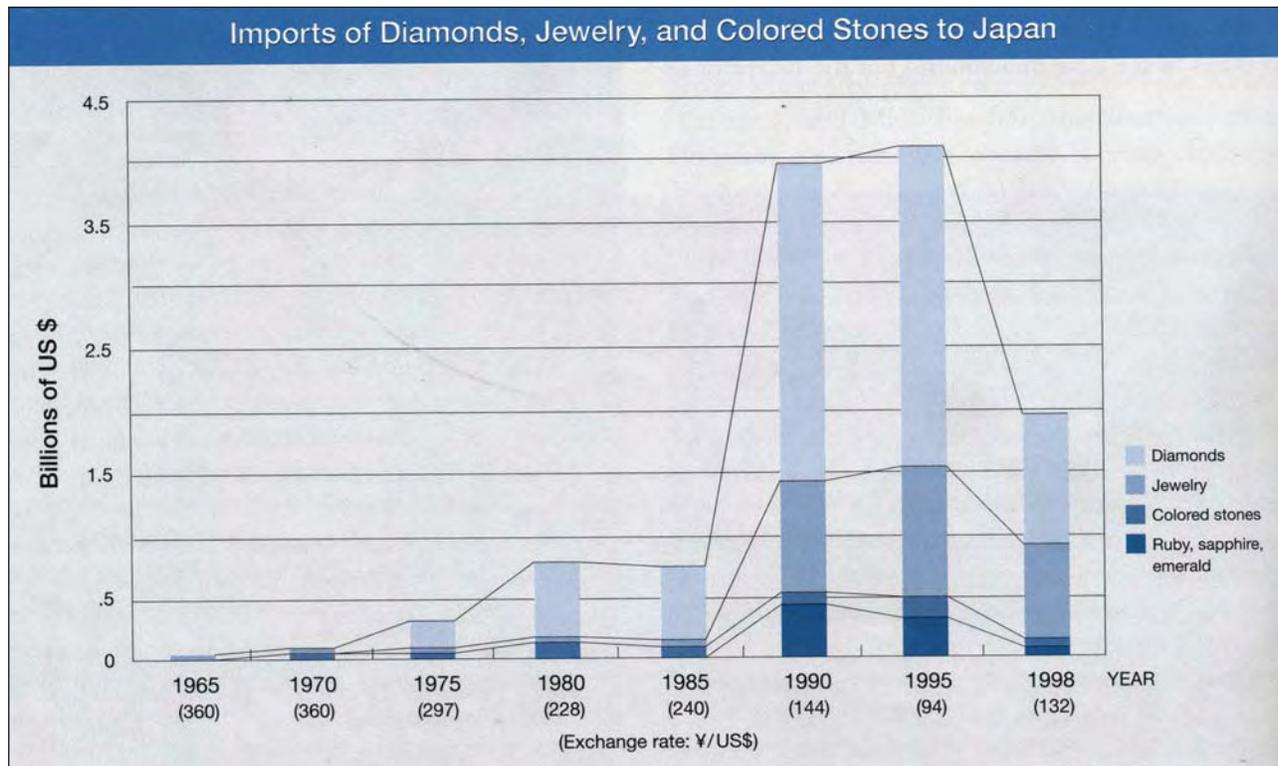
Yasukazu Suwa  
Suwa & Son, Inc.  
Tokyo

SINCE THE ASIAN COLORED STONE markets peaked in 1990, poor economic conditions have caused them to stagnate. In particular, the currency crisis that originated in Thailand in 1997 has severely damaged the economies of the area. This abstract will investigate past and present market conditions, particularly in Japan, and present ideas for reviving the market from a global viewpoint.

### Recent History: Gradual Growth, Drastic Decline

Figure 1 shows Japan's gem and jewelry imports between 1965 and 1998. Total imports of US\$35 million in 1965 increased by over 100 times to just under \$4 billion by 1990. It is noteworthy that the Japanese market, which 30 years earlier had accounted for just a few percentage points of world jewelry

Figure 1. The Japanese jewelry industry experienced extraordinary growth from 1985 to 1990. Since 1995, however, the economic crisis in Japan has resulted in drastic declines in imports of jewelry and especially loose diamonds and colored stones.



consumption, surpassed one-third of the world total by the early 1990s. During this same 25-year period, the exchange rate went from 360 to 144 yen per dollar, and per-capita gross domestic product increased from \$993 to \$24,164. These statistics illustrate how jewelry purchases rise as a society becomes more affluent.

The increase in gem and jewelry imports between 1985 and 1990 shows the effect of the expansion of the Japanese market during the “bubble” economy—a period of low capital costs and an extraordinary appreciation of asset prices that lasted from 1986 to 1991. The exchange rate dropped from 144 yen per dollar in 1990 to 94 yen per dollar in 1995. Although Japan’s economy had already collapsed by 1995, overall imports did not decrease up to that year because of this stronger yen. Between 1990 and 1998, imports of ruby, sapphire, and emerald had decreased drastically, by 80%. Jewelry imports dropped only 27% between 1995 and 1998, compared to decreases of over 60% for diamonds and 70% for colored stones (other than ruby, sapphire, and emerald) during that period. This was a result of sustained sales of branded jewelry by companies such as Cartier, Tiffany and Co., and Bulgari.

### Future Prospects

The future of the Asian market for gems and jewelry depends on the success with which these countries change to a global-minded social structure. We need to keep abreast of changes in the politics, economies, and societies of Japan, China, and other Asian countries. Since jewelry is a long-term, big-ticket purchase, consumer confidence is especially important

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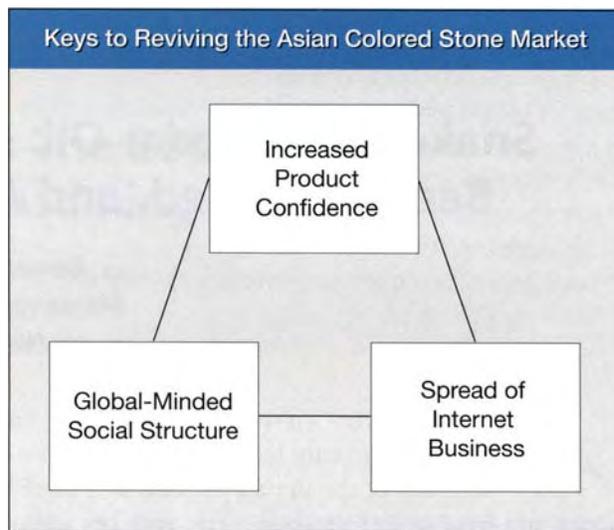


Figure 2. A three-fold solution could help revive the demand for colored stone jewelry in Asia and worldwide.

for reviving the market, not only in Asia but also on a global scale. Thus, treated gemstones must be clearly disclosed as such when they are sold. It is of paramount importance that we as an industry work to increase confidence in our products. The Internet will undoubtedly be a major force in the transformation of the colored stone jewelry market. The Internet will facilitate the immediate, efficient, and accurate transfer of information. As a result, the value of jewelry as an asset will become even clearer, which will greatly enhance the appeal of these products. Since Internet business is not conducted face-to-face, product confidence is especially important on-line. Increased product reliability will allow for smoother Internet transactions.

In summary, a global-minded social structure, greater consumer confidence in gems, and the spread of Internet business are key to the revival of the colored stone jewelry market worldwide (figure 2).

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# Snake Oil or Cedar Oil: Have Your Colored Stones Been Enhanced, and Are You Telling the Tale?

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Manning International  
New York

*M*ARKETING COLORED GEMSTONES in the United States requires a proper understanding of the impact of consumer confidence and trust in our products. The two key questions we must ask are: How do we foster and maintain that trust? How do we promote a positive image to the consumer? Efforts made to answer these questions will yield a positive response from the consumer. Action in the following areas can go a long way toward addressing these concerns.

**First: Participate in consumer education.** Responsible use of terminology regarding product content and its effect on pricing is essential. Use “friendly” language (see, e.g., AGTA’s [1999] brochure “Gemstone Enhancements: What You Should Know”).

**Second: Don’t underestimate the power of negative press.** The Diane Sawyer exposé “All that Glitters” in her *Prime Time Live* segment (February 1998) highlighted fraud in the jewelry industry: “Buyer beware!” This negative press caused serious ripples in consumer confidence, resulting in a fall-off in sales of emeralds, Native American jewelry, and other colored stones (both natural and synthetic).

**Third: Use the trade associations.**

- *American Gem Trade Association:* Fosters responsible promotion of colored gemstones, and provides information for the retailer to share with the consumer. Also maintains a code of ethics, with mandatory member compliance.

- *American Gem Society:* Provides marketing support for the retailer and information for the consumer; maintains high membership/vendor standards.

- *Jewelers of America:* Provides extensive market cooperation with other trade groups; furnishes marketing support for retailers and consumer education, with an emphasis on retail jeweler issues.

- *Jewelers Vigilance Committee:* Fosters ethics and integrity in the jewelry industry. The JVC is the jewelry industry watchdog. Violation of FTC guidelines for consumer protection is a key concern for JVC.

**Fourth: Use gemological laboratories.** Value cannot exist without trust. The laboratory commitment to accuracy is, in many cases, the basis of trust—and, therefore, a building block of “value.”

**Fifth: Avoid risky marketing strategies.** Mass marketers and other large (and small) retailers often ignore nature’s limited ability to produce gem materials in the quality/clarity/color and *quantity* they seek. Mass marketing requires product uniformity—often in defiance of nature’s production limits. Some products sold by mass marketers—on television and other media—are susceptible to fraudulent substitution of synthetics or imitations for natural stones.

**Sixth: Follow the *FTC Guidelines*.** These are available through the trade organizations or can be downloaded directly from the Internet ([www.ftc.gov](http://www.ftc.gov)). The *Guidelines* specify the important differences between *natural*, *synthetic*, and *imitation*. Know the accepted alternative language for these and other terms, as permitted by the FTC. For example, use *pearl* alone only if it’s a *natural* pearl. If it’s not natural, it’s a *cultured* pearl, a *simulated* pearl, or an *imitation* pearl (again, see the *Guidelines*). Be aware of these potential abuses and be prepared to act when you see likely violations. Report them to the JVC.

Consumers thrive on well-presented information about colored stones and their enhancements. If you market colored stones in the United States, learn the disclosure requirements and make them your own. There is no avoiding responsibility if you fail to “disclose.” There is significant liability for failure to do so, and it can be very costly.

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## South America: The Birth of a New Jewelry-Consuming Market

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**W**ITHIN SOUTH AMERICA, the major suppliers of gems are Brazil and Colombia, whereas the largest jewelry manufacturing and consuming markets are Brazil and Argentina, followed by Venezuela, Chile, Colombia, Peru, and Bolivia.

### Mining, Marketing, and Manufacturing in Brazil

For years, Brazil has stood as the world's major producer of colored gems (in terms of gem varieties), leading the production of Imperial topaz (figure 1), aquamarine (figure 2), tourmaline, amethyst, and chalcedony, among others. However, a combination of factors has drastically reduced the country's gem-mining activity in the last five years. The traditional *garimpeiro* (i.e., the folkloric independent miner, who is driven by dreams of hitting the jackpot) has guaranteed the supply of most of Brazil's gems for the last six decades. The Brazilian government has introduced new regulations for the working conditions of the *garimpeiros*, and the new constitution requires that the independent miners form cooperatives with strict environmental controls—and, thus, additional investments for infrastructure.

Today, most of the mining properties are controlled by mining companies or individual landowners. At this time, the landowners are giving priority to agricultural and cattle breeding activities over gem mining. Perhaps most importantly, gem prices have not kept pace with the rapidly increasing mining costs, so many mines have been forced to shut down.

And because of the high investment risk involved in gem mining, especially for colored gemstones, few private domestic or foreign companies are now getting involved in such ventures. With the exception of diamond, emerald, alexandrite, and Imperial topaz, which hold a higher intrinsic value, there are current-

*Figure 1. Imperial topaz has been mined in Ouro Preto, Brazil, for more than 200 years. The pink topaz in the top ring weighs 5.35 ct, and the deep "salmon"-colored topaz in the bottom ring is 7.08 ct; both are set with diamonds in 18K gold. Courtesy of Amsterdam Sauer Jewelers—Brazil.*



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*Figure 2. Brazil is noted for the fine aquamarine produced there. These “rough” aquamarine beads (approximately 15 mm in diameter) provide a novel compliment to the baroque pearls and the 19.5 ct Nigerian tourmaline enhancer. Courtesy of Susan Sadler Fine Jewelry Design.*

ly no organized gem-mining operations in Brazil. The reduction in Brazil’s gem output is expected to last indefinitely, unless new incentives are created or new important discoveries are made—usually by accident, as has historically been the case for most Brazilian gems.

On the brighter side, the Brazilian jewelry industry has been experiencing tremendous growth since July 1994, when a new economic stabilization plan began. The drastic reduction of inflation was reflected immediately in the greater buying power of the pop-

ulation. Brazilian consumers have been buying durable goods as never before. The result was a growth in jewelry consumption of no less than 100%, in a four-year period, with Brazil’s jewelry market worth an estimated US\$1 billion (including informal activities) in 1998. At the same time, modernization, increased productivity, quality-control programs and, most importantly, creativity, have transformed Brazil’s jewelry-manufacturing industry in less than five years. By 1998, the jewelry industry employed about one million people and consumed around 40 tons of gold. Most of the jewelry was manufactured by the 1,200 small and middle-size local domestic industries, but imported jewelry, mainly from Italy and Asia, also supplied the market.

According to the World Gold Council, Brazil ranks as the world’s 12th-largest gold consuming country. Provided Brazil sustains its economic strength, the jewelry market will certainly continue to grow there and in South America as a whole.

### **Colombia**

Colombia stands out as the world’s major producer of emeralds, with an estimated market value of \$500 million per year. Although the country lives in a constant struggle to overcome its internal problems, the emerald market has been an important economic and social activity for centuries. The historic mine at Muzo is still the most important one for the quality of emeralds produced, but Coscuez is the most productive one. New investments have been directed toward the Chivor mining complex. During the World Emerald Congress in Bogotá in 1998, important issues such as methods of clarity enhancement, grading standards, and certification were discussed, but these have yet to be resolved. The industry urgently awaits the establishment of new universally accepted procedures to address these issues. It is the obligation of our trade to restore credibility to this important gemstone.

## The Present and Future of Akoya Cultured Pearls

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K. Mikimoto & Co. Ltd.

Tokyo, Japan

FOR MOST OF THE 20TH CENTURY, Japanese Akoya cultured pearls dominated the pearl market. For decades, a strand of Akoya cultured pearls (figure 1) has been a staple of the jewelry wardrobe.

### The Present

Pearl production in Japan has been declining since 1992, because Akoya oysters have been dying in great numbers. In 1997, massive Akoya oyster deaths escalated to become a nationwide problem, as the production of cultured pearls dropped to less than one-third the usual 70 ton harvest. This has been compounded by a reduction in the quality of these pearls.

There appear to be three main causes for the Akoya oyster mortality: red tide, formalin, and disease.

**Red Tide.** In 1992, a unique “red tide”—a sudden color change of the seawater, usually to red—killed many Akoya oysters in Ago Bay. Subsequent research brought the following facts to light:

- The red tide was caused by a new phytoplankton called *Heterocapsa circulariscarma*.
- In several minutes, the plankton kills bivalves, such as Akoya oysters.
- Agitating mud on the sea floor, where red tide plankton reside, can carry the plankton toward the ocean’s surface where they may multiply and cause the red tide.
- At present we cannot prevent red tides, but we can predict them at least a week in advance and evacuate the oysters to safer areas.

**Formalin.** Formalin is a formaldehyde solution. This

toxic substance is widely used to cure disease at blow-fish culturing farms, which are located within about 300 m of the Akoya farms. Although it is difficult to prove a link between formalin and the Akoya oyster

Figure 1. Japanese Akoya cultured pearls are renowned for their attractive appearance and high luster. Photo courtesy of Mikimoto.



deaths, pearl farmers strongly oppose the use of formalin from an environmental and food-safety standpoint, as well as for its possible effects on oysters. As a remedy, Japan's Fishery Agency has recommended the use of a formalin substitute at the fish farms. The fish farmers have complied, and the situation is improving.

**Disease.** Research eventually showed that a virus was a contributing factor in the Akoya oyster deaths. To counteract the virus, we are now taking the following measures:

- Only healthy oysters are being bred.
- Healthy oysters are kept in virus-free culturing tanks, and/or their sperm is preserved in liquid nitrogen.
- Infected oysters are eliminated whenever and wherever they are found.
- Every effort is made to avoid excessive stress to the oysters.

### **Chinese Akoya Pearl Cultivation**

Full-scale production of Akoya cultured pearls started in China around 1983. Now, Chinese Akoya cultured pearls hold a solid position in the world pearl market. At about 25 tons per year, China's volume today is about the same as Japan's. Although Chinese Akoya cultured pearls do not fully match the quality of their Japanese counterparts, they are widely exported as commercial merchandise. If Japan does not make the utmost effort to produce good-quality Akoya pearls, Chinese Akoyas will probably drive Japanese Akoyas out of the world market.



*Figure 2. Japanese Akoya pearl farms such as this are struggling to maintain production despite widespread oyster mortality. Photo courtesy of Mikimoto.*

### **The Future**

Above all, Japan urgently needs to revive Akoya cultured pearl production (figure 2). New ideas and techniques must be implemented. If farmers continue to use the same techniques as they have in the past, they cannot expect improvement.

In addition, to maintain the pearl industry's prosperity, we have to educate consumers so they can make intelligent choices. Globalization of the pearl industry is imminent. Therefore, establishing a universal standard for cultured pearls is critical. The time is right for the pearl industry to come together to discuss pearl nomenclature, manufacturing, and quality. As president of the CIBJO (International Jewellery Confederation) Pearl Commission, I propose to hold such a conference next year in Kobe during the CIBJO congress.

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## Freshwater Pearls: New Millennium — New Pearl Order

James L. Peach Sr.

*American Shell Company and U.S. Pearl Company*

Camden, Tennessee

AS WE APPROACH the new millennium, we find the world of pearls even more exciting than at the turn of the 20th century, when Kokichi Mikimoto of Japan started culturing saltwater shell-section Akoya pearls. During the 20th century, we have seen the development of South Sea white and “gold” saltwater shell-section cultured pearls, the advent and demise of Japanese freshwater mantle-section cultured pearls, and the rise of both Polynesian saltwater shell-sectioned cultured pearls and, most recently, Chinese mantle-section freshwater cultured pearls. (The term *mantle section* refers to the mantle tissue used for pearl nucleation; such cultured pearls are commonly referred to as “tissue nucleated.” The term *shell section* refers to the shell bead that is commonly used to nucleate cultured pearls, commonly referred to as “bead nucleated.”)

Freshwater cultured pearls, grown by both shell-section and mantle-section techniques, are currently very important in world markets and are expected to play an even greater role in the new millennium. Today, freshwater shell-section pearl culturing is occurring in China, Japan, and the U.S., although only the Chinese product is significant in the world market. Commercially available shapes are primarily coin, rectangular, and square, but there is expectation of considerable production of round shell-section pearls from China during the next 18 to 24 months.

Freshwater mantle-section cultured pearls now hold the largest share in the world pearl market, with the advent of high-grade mantle-section

Chinese freshwater pearls causing a lot of excitement. These cultured pearls are often called “pure pearls,” because typically there is no detectable nucleus, and concentric layers are evident throughout the pearl (see figure).

As we prepare to enter the 21st century, the Chinese pearl farmers are dominating the world pearl market. Production of both mantle-section and shell-section cultured pearls in 1999 is expected to be between 800 and 900 metric tons, in sizes from 1 to 15 mm, with a wide variety of shapes and a broad range of colors; this output is expected to increase to 1,500 metric tons by 2005. Saltwater pearl farmers are being challenged by the lower production costs and enormous production capacity accomplished by the Chinese pearl farmers.

The new millennium will hold fantastic opportunities for the consumer, as a larger variety of high-quality freshwater cultured pearls become available at competitive prices.

*This mantle-section Chinese freshwater cultured pearl (12 mm in diameter) has been sawn in half to reveal multiple concentric layers and no evidence of a nucleus.*



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## The Tahitian Cultured Pearl: Past, Present, and Future

Robert Wan

*Tahiti Perles*

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**A**ROUND THE TIME that Westerners discovered Tahiti in 1767, the black pearl had already earned a reputation in Europe and elsewhere as the “pearl of queens” and the “queen of pearls.” It took some 120 years before the talents of people were combined with those of nature to produce what today is known as the Tahitian cultured pearl (see figure). However, the first successes did not occur regularly until the late 1960s to early 1970s. Fortunately for Tahiti and the nearly 400 pearl farms that operate there today, cultivation, harvesting, selection, and promotion efforts have improved over the past 26 years. That is why exports of Tahitian cultured pearls reached a record of more than 6 tons in 1998, with a collective value of \$134.5 million.

My personal opinion is that, ultimately, Tahitian cultured pearl production should be limited to a maximum of 8 tons yearly. It will probably reach that level in another four to five years. When it does, Tahiti’s

*New government regulations ensure that only high-quality Tahitian cultured pearls, such as those shown here, enter the world pearl market. Courtesy of GIE Perles de Tahiti; photo by M. Roudnitska.*



government has targeted a value of some \$300 million for those 8 tons of cultured pearls. Why such a big change in price per ton? Simply because a new and increasingly concerted effort is being made by the government and the pearl-producing industry to cultivate and export only the finest-quality Tahitian cultured pearls. On January 1, 1999, the government imposed new export classifications and regulations aimed at ensuring that only a high-quality product enters the world pearl market. They effectively ban the export of rejects and non-nacreous “pearls,” such as calcite “pearls” and organic “pearls.” According to the government’s official definition, the *Tahitian cultured pearl* is one produced only from the black-lipped oyster *Pinctada margaritifera*, variety *cumingi*, which is the official oyster used on pearl farms in French Polynesia. The new export regulations stipulate that there are only four products of Tahiti’s official pearl oyster that qualify for the label “Made in Tahiti.” They are the Tahitian cultured pearl, the Tahitian mabé, the Tahitian keshi and the Tahitian mother-of-pearl. Note that the new regulations have not changed the export tax on loose Tahitian cultured pearls. Half of that tax still goes to the government, and the other half goes to Perles de Tahiti, a nonprofit economic interest group that has done much to popularize the Tahitian cultured pearl in the gem, jewelry, fashion, media, and entertainment industries.

Japan is our number one export market, followed by the U.S. and Hong Kong. However, the promotional efforts by Perles de Tahiti have opened new markets for Tahitianan pearl exports, such as Latin America, Spain, England, Austria, Germany, Belgium, Eastern European countries, and even Russia. The trade association also has increased activity in existing markets, such as France, Italy, Switzerland, Canada, and the U.S. The producers and government alike are optimistic that demand will continue to grow for the fine-quality cultured pearl exported from Tahiti.

# Cultured South Sea Pearls

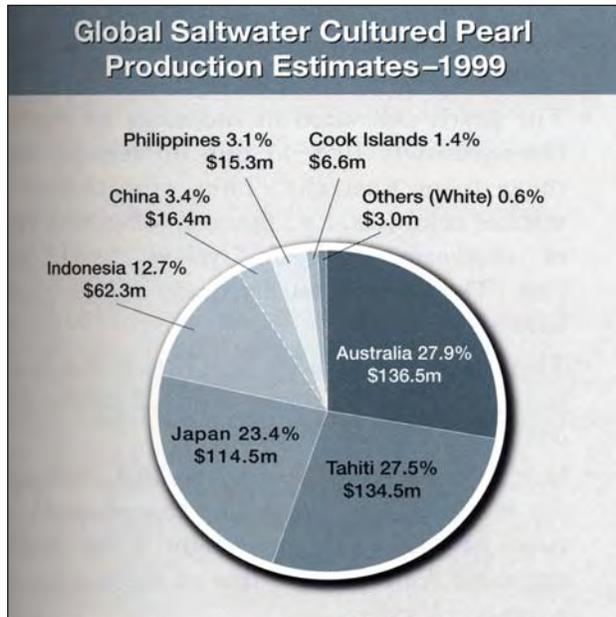
Andy Muller  
Golay Buchel  
Kobe, Japan

## Brief Historical Background

In 1928, a team of Japanese, led by Dr. Sukeo Fujita, harvested the first cultured South Sea pearls at Buton, Celebes (now called Sulawesi), in Indonesia. The team was financed by Baron Iwasaki of Mitsubishi Goshi-Gaisha of Tokyo (better known today as Mitsubishi Corp.).

From 1928 until the outbreak of World War II in 1941, the project produced, on average, 8,000 to 10,000 cultured pearls per year. The majority of the pearls cultivated at Buton were 8–10 mm in diameter, with 12 mm being the rare exception. If we recall that during the same period Akoya pearls cultivated in Japan had an average diameter of 3–4 mm, there is little wonder that these first South Sea pearls created quite a sensation.

Figure 1. South Sea pearls from Australia, Indonesia, and the Philippines represent almost half of the world saltwater cultured pearl production estimated for 1999.



For the period during World War II and immediately after, from 1941 to 1956, we found no recorded production of any significance. In 1954, however, Kichiro Takashima established a South Sea pearl culture project in Burma (now Myanmar), and the first regular harvests started in 1957. In 1956, another Japanese pearling pioneer, Tokuichi Kuribayashi, started farming in Australia and harvested his first crop in 1958. During the 1960s and 1970s, various farms opened in Australia, Indonesia, the Philippines, Malaysia, and Thailand. Nevertheless, we estimate that in the early 1980s, the total marketable part of these productions was around 95 kan, or a maximum of 100 kan (1 kan=3.75 kg). Since then, however, development has been truly phenomenal.

## Current Production Estimates

How large is our industry today? We estimate that in 1999, the entire saltwater cultured pearl industry (i.e., organized pearl farms) will produce pearls worth approximately US\$490 million (figure 1). White South Sea cultured pearls are estimated to represent \$217 million of this value, which translates into a market share of 44.4%; the major producers are Australia, Indonesia, and the Philippines (see table).

## Main Characteristics by Country

### Australia

- Australia produces almost half of the world's white South Sea cultured pearls by weight, and almost two-thirds by value (\$136 million).

### Leading producers of cultured South Sea pearls (1999 estimates).

Country	By weight (kan)	By value (US\$)
Australia	47.2% (450)	62.9% (\$136.5 million)
Indonesia	39.8% (380)	28.7% (\$62.3 million)
Philippines	10.9% (104)	7% (\$15.3 million)

- Approximately 90% are cultivated along the northern coastal areas of Western Australia.
- The Western Australian Pearling industry is well organized and efficient. Sixteen license holders share a total annual oyster quota of 572,000 (*Pinctada maxima*) shells fished from the wild, plus 350,000 propagated in hatcheries.
- So far, these “hatchery options” have not been fully utilized. The first pearls cultivated from hatchery shells in Australia were harvested in 1998, but they represented less than 3% of the total. However, farmers have now begun to use these hatchery options, so they should start to have an impact in the market after the year 2000.
- The official policy in Australia of limiting output by quota control, to keep the supply of cultured South Sea pearls from exceeding demand, is now under review and may change in the not-too-distant future.
- South Sea pearls cultured in Australia are, on average (at about 13 mm), the largest in the world. Their colors are more “silver,” white, and blue when compared to their counterparts from Indonesia and the Philippines.
- Pearl growth usually takes 24 months, with initial seeding operations and harvests taking place during the cooler months of June, July, and August.

#### Indonesia

- Unlike Australia, where production is concentrated in one particular coastal area, the farms in Indonesia are spread over the entire archipelago, with the main concentration in the islands east of Bali to Irian Jaya.
- The entire South Sea pearling industry relies entirely on *Pinctada maxima* oysters propagated in hatcheries. The fishing of wild pearl oysters ceased prior to the mid-1990s.
- Indonesia’s industry is not strictly regulated, and no quotas exist regarding the number of oysters that farmers can seed and breed. Also, the government has not set any limit on the number of licenses it issues.



Figure 2. Note the warm “golden” color of these South Sea cultured pearls. Photo © GIA and Tino Hammid.

- Indonesian seawater temperatures are relatively stable (26°–30°C, versus 18°–31°C in Australia), which promotes regular, even growth, without Australia’s seasonal limitations. Because the oysters (and the pearls inside) usually grow faster, pearl growth periods can be shorter, between 18 and 24 months, depending on location and conditions.
- The pearls cultivated in Indonesia are smaller (approximately 10.5–11 mm on average) than those from Australia. They tend to have a warmer color (see, e.g., figure 2), often with tints of “champagne,” “cream,” yellow, “gold,” and pink. The nacre is usually thick, and the pearls have a high luster.
- There are more than 50 farm sites in Indonesia, and it is estimated that more than 2 million oysters will be seeded this year.
- Indonesia has good future potential. Although the production is still smaller than Australia in terms of total value and weight, it has already surpassed Australia in terms of the number of pearls it cultivates.

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### *The Philippines*

- Similar to Indonesia, the government sets no limit on the number of licenses it issues, or on the number of oysters to be seeded.
- A major breakthrough with hatchery technology took place over the past three years, and the industry is developing fast nowadays, mainly using propagated *Pinctada maxima* oysters.
- In the past, most farms were spread throughout a wide area, mainly in the south. Today, however, the largest farms are located on the southwestern island of Palawan, which has become the largest pearl-producing area in the Philippines.
- The pearls cultivated in the Philippines resemble their counterparts from Indonesia. They are relatively small, have a thick nacre, and usually show a good luster and a warm color.
- The largest farm reportedly seeded over 200,000 oysters this year. Smaller farms are seeding between 20,000 and 50,000 oysters. The total number of oysters seeded is most likely in excess of 500,000.

### *Others*

White South Sea pearls also are cultivated in countries such as Malaysia, Vietnam, Myanmar, and Thailand. Myanmar and Thailand are progressing steadily, and it is possible that their annual production will reach between 30 and 70 kan each within five years.

### **Some Thoughts for Today . . .**

#### **And for Tomorrow**

The global breakthrough in hatchery technology for farming the white-lip pearl oysters (*Pinctada maxima*) gave the biggest boost yet to this industry. Just 15 years ago, the entire industry relied on oysters fished in the wild. This year, more than 80% of the world's white-lipped South Sea oysters seeded for pearls were propagated in hatcheries.

At this writing, the Australian cultured pearl industry is being reviewed, especially in light of a "competition policy." The issues are extremely complex, and it will probably take a few years for decisions to be made and potential new laws to be implemented. Regardless of the outcome, Australian production will continue to increase, especially after the year 2000, when the pearls cultivated in propagated oysters will reach world markets.

Indonesia has great potential, but production is more difficult to forecast. One of the many reasons is that its harvests are susceptible to ocean conditions such as "El Niño" or "La Niña," and they may be disrupted by earthquakes and tidal waves. The industry suffered heavy setbacks in the 1980s and 1990s. Some of the largest producers of the past are practically out of business today. Meanwhile, others have emerged and the industry is again prospering. The Philippines, Myanmar, and Thailand are also on an expansion course.

While the past century belonged to the Akoya cultured pearl, there is little doubt that pearls cultivated in the South Seas will dominate saltwater pearl production in the new century.

## The Ongoing Challenge of Diamond Identification

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**J**EWELERS FACE LEGAL AND ETHICAL requirements to disclose information on the identity of the gem materials that they sell their customers. These requirements presuppose that the gems can be identified, either by the jewelers themselves or by laboratories that support the jewelry trade by issuing gem identification reports.

The past decade has witnessed the continued introduction of diamond treatments, synthetic diamonds, and even a significant new diamond simulant—synthetic moissanite—into the jewelry trade. Jewelers must become aware of the existence of these new treatments and materials. They also must learn which standard gemological testing instruments and techniques are most helpful in their identification, and at what point they should turn to a gemological laboratory for assistance.

### Diamond Treatments

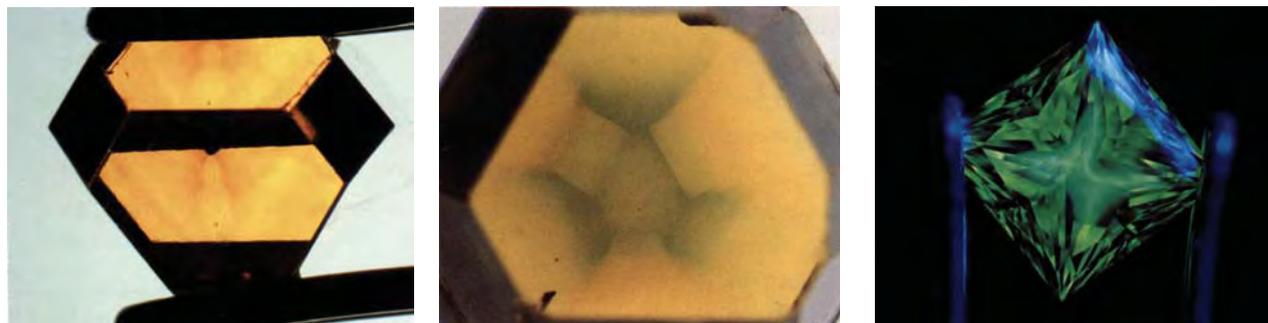
The diamond treatments most commonly encountered include methods to improve apparent clarity, such as cleavage- or fracture-filling (widespread occurrence) or coating (rarely seen), and to enhance color using exposure to radiation and/or heat (seen among some col-

ored diamonds). Diamonds with cleavages that have been filled with a glass-like material can be recognized by the distinctive interference (“flash”) colors displayed by the filled areas, which can be observed with magnification (see, e.g., McClure and Kammerling, 1995). Diamonds with a surface coating often exhibit an unusual color or appearance, one that is not consistent with their other gemological properties. Colored diamonds that have been treated by exposure to radiation and/or heat usually require examination with advanced analytical equipment to detect evidence of treatment. Since exposure of a diamond to radiation and/or heat can take place in the earth, it is not always possible to distinguish if a particular diamond has been treated.

### Synthetic Diamonds

Synthetic diamonds, usually in small sizes and typically brownish yellow (but sometimes blue, red, and—rarely—near-colorless), occasionally are encountered in the jewelry trade. For the most part, the synthetic diamonds that we have seen in the trade have been produced in Russia or the Ukraine. Cubooctahedral crystals up to a few carats (although usually less than 2 ct) can be grown from a molten metal alloy at high

*Figure 1. Among the distinctive characteristics of colored synthetic diamonds are unusual color zoning (left and center) and a cross-shaped fluorescence pattern (right). Photomicrographs (left to right) by Shane Elen (magnified 20×), John I. Koivula (25×), and Taijin Lu (2.5×).*



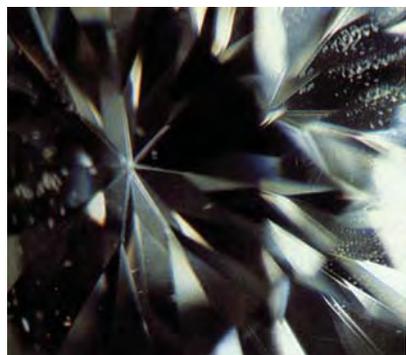


Figure 2. Synthetic moissanite can be readily separated from diamond by its doubly refractive optic character, as revealed by the doubling of the facet junctions as you look through the stone (left). Synthetic moissanite also may contain distinctive tube-like or flat, reflective plate-like inclusions (right). Photomicrographs by Shane Elen, magnified 15 $\times$ .

temperatures and pressures. These growth conditions give rise to the distinctive gemological properties of synthetic diamonds (figure 1). Faceting of these crystals yields polished synthetic diamonds that typically weigh less than 0.50 ct, and often have a modified square shape to retain weight (or are fashioned as even smaller round brilliants). For polished synthetic diamonds, the distinctive properties include uneven color zoning, intersecting graining, metallic inclusions (resulting sometimes in attraction of the synthetic diamond to a magnet), uneven ultraviolet fluorescence (often stronger to short-wave in comparison to long-wave UV), and—for near-colorless material—prolonged phosphorescence. The identification of synthetic diamonds can be confirmed by advanced spectroscopic and chemical analysis methods. (For further information on the identification of synthetic diamonds, see Shigley et al., 1995, and the articles cited therein.)

### Diamond Simulants

Near-colorless synthetic moissanite currently presents an identification problem because standard thermal probes (used to distinguish diamond and imitation materials such as cubic zirconia [CZ]) will often mistakenly identify synthetic moissanite as “diamond.” However, synthetic moissanite can be separated by its non-isotropic optic character (when examined with magnification looking *through* the sample, facet junctions will appear “doubled”; see figure 2, left), strong absorption of light at the blue end of the visible spectrum, lower specific gravity, unusual needle- or plate-like inclusions (figure 2, right), lack of ultraviolet flu-

orescence, and—often—electrical conductivity (see, e.g., Nassau et al., 1997). The fact that synthetic moissanite is now available in greater quantities and is being distributed worldwide means that jewelers could encounter it more frequently in the marketplace. Therefore, knowledge of these identifying features is critical.

### What the Future Holds

In the future, it is likely that new methods for treating diamonds will be developed or become more prominent, such as the new high pressure/high temperature treatment that reportedly removes or alters color. [Editor's note: see the article in this issue on GE-processed diamonds for further information.] Synthetic diamonds will continue to be produced, but high costs and the restricted availability of synthesis equipment are likely to limit the number, sizes, and quality of synthetic diamonds and keep prices high. Jewelers will need to stay informed about technological developments in diamond treatment and synthesis, as well as current gem-testing methods, to fulfill their responsibilities to their customers.

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### REFERENCES

- McClure S.F., Kammerling R.C. (1995) A visual guide to the identification of filled diamonds, *Gems & Gemology*, Vol. 31, No. 2, pp. 114–119.
- Nassau K., McClure S.F., Elen S., Shigley J.E. (1997) Synthetic moissanite: A new diamond substitute. *Gems & Gemology*, Vol. 33, No. 4, pp. 260–275.
- Shigley J.E., Fritsch E., Reinitz I., Moses T.E. (1995) A chart for the separation of natural from synthetic diamonds. *Gems & Gemology*, Vol. 31, No. 4, pp. 256–264.

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# The Identification of Ruby and Sapphire

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**W**HETHER A RUBY OR SAPPHIRE is being bought, sold, or appraised, the fact that it has or has not been enhanced by heat may make anything from a minor to a major difference in its value. Hence, today one of the key trade concerns upon reading a laboratory report is whether a determination has been made of the heated or unheated nature of a ruby or sapphire. In all treatments, the gem world is also moving closer to fully implementing a “Total Disclosure” policy, and so beyond the pricing factor may soon lie a very strong moral, if not legal, reason for requiring such a determination.

Several factors are of critical concern in the identification of ruby and sapphire, including: how to determine enhancement by heat, residues from the heating process, glass and other fillings, color and asterism surface diffusion, and synthetic rubies and sapphires. Given that today all major gemological testing laboratories enlist advanced technology for identification procedures, it is also important to understand the information provided by ultraviolet-visible and infrared spectrometers, energy-dispersive X-ray fluorescence (EDXRF) chemical analysis, and laser Raman microspectrometry.

## **Enhancement by Heat**

The appearance of silk may help in the determination process; that is, the presence of unaltered silk will indicate that the stone has not been heated. In blue sapphire, internal diffusion of blue color in areas that were once occupied by individual rutile needles indicates that the stone has been heated. “Silk” formations composed of oriented fine “dust-like” inclusions also may indicate heat treatment for stones from certain localities, such as Sri Lanka.

The appearance of included crystals and feathers also may help. Feathers that are composed of “bubble-like” formations, or have an overall “glassy” appear-

ance, and crystals with a melted or “snowball” appearance (figure 1) are good indicators of heat enhancement. However, perfectly formed feathers and crystals point toward an unenhanced stone.

Some absorbance observations also may assist in determining enhancement by heat (see, e.g., Schwarz et al., 1996). Similarly, some heat-treated stones have distinctive fluorescence reactions, such as the chalky appearance of some heat-treated blue sapphires when exposed to short-wave ultraviolet radiation.

## **Diffusion of Surface Color and Asterism**

The most common color produced in “surface-color diffused corundum” is blue, but other colors, such as orange and red, also may be seen. The simplest identification technique is to examine a suspect stone over a white diffuser plate, so that color concentrations will be observed at facet junctions if the stone is surface-color diffusion treated. More definition is gained if the stone is immersed in methylene iodide.

Using standard gemological microscopic techniques, but particularly with overhead reflected light, the phenomena that cause surface-diffused asterism will be observed only in a layer near the surface of the stone, not throughout the stone as would be the case for a natural star sapphire or ruby.

## **Glass in Cavities and Open Fractures, and Residues within Essentially Closed Fissures**

Either by design or by accident, glass may be deposited in open fractures and/or surface cavities during the heat treatment of rubies (and sometimes sapphires). It is important to disclose the presence of such glass on laboratory reports and to any potential purchaser of a stone. For the most part, the presence of glass is revealed by its surface luster (figure 2), which is differ-

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ent from that of the ruby host. When making such observations, however, one should be aware of other possible causes for such differences in surface luster, for example, where natural unaltered or even altered inclusions have been exposed at the surface during the polishing process.

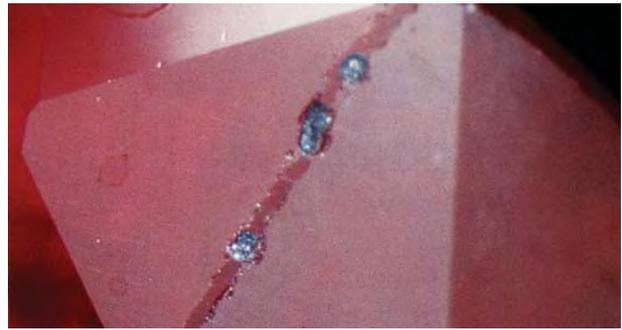
Following heating, various residues may be discovered within fissures; in these cases, no differences will be seen in surface luster, and their presence is revealed only by internal inspection. Most major laboratories will reveal the presence of such residues, and some quantify the amount using such terms as *minor*, *moderate*, and *significant*.

### Separation of Natural from Synthetic Gems

Twenty years ago, the separation of natural ruby and sapphire from their synthetic counterparts was not complicated by such practices as heat enhancement, which can significantly alter the appearance of natural inclusions. There also were fewer processes used to manufacture synthetic rubies and sapphires.

Nevertheless, certain identification principles still apply; for example, the presence of curved growth lines in ruby or curved color banding in sapphire is a sure indicator that the stone is of synthetic origin. However, experience in viewing all the different kinds of inclusions likely to be present in natural and synthetic rubies and sapphires is essential if the gemologist is to avoid errors such as mistaking the “melted” inclusions in a heat-treated Mong Hsu ruby for the flux inclusions of a synthetic. It can be equally as costly to mistake the dark or blue zones sometimes present in a synthetic ruby manufactured by Chatham for

*Figure 1. Snowball-like inclusions, here surrounded by a stress fracture, are commonly seen in heat-treated sapphires. Photomicrograph by Kenneth Scarratt.*



*Figure 2. Note the difference in luster between the glass-filled fracture and the host ruby. Photomicrograph by Kenneth Scarratt.*

the dark or blue zones expected in unheated rough material from Mong Hsu. The chance of error increases when the synthetic has been “manufactured” to resemble the external appearance of the Mong Hsu material.

Certain inclusions within a synthetic ruby or sapphire can be very helpful in the identification process, such as platinum platelets and bright orange flux. Growth phenomena such as the undulating structures seen in hydrothermally grown synthetic rubies and sapphires also are very distinctive, as is the presence of a partial seed plate.

Identification becomes increasingly difficult when there are no inclusions or those present have an unusual appearance. Raman analysis of inclusions may positively identify the material and, on the basis of that information, allow identification of the host. When there are no inclusions, or Raman does not produce the needed information, then chemical analysis by EDXRF may reveal the presence of trace elements that are indicative of one of the synthetics or a natural source.

UV-visible spectroscopy also may be useful in the identification of sapphire, especially the geologic origin of a natural stone. When this information is combined with trace-element data and a detailed knowledge of inclusion scenes from different localities, it may not only identify the natural or synthetic nature of the stone, but it may also provide information on the geographic locality of the natural material or the manufacturer of the synthetic.

### REFERENCE

- Schwarz D., Petsch E.J., Kanis J. (1996) Sapphires from the Andranondambo region, Madagascar. *Gems & Gemology*, Vol. 32, No. 2, pp. 80–99.

# Distinguishing Natural from Synthetic Emeralds

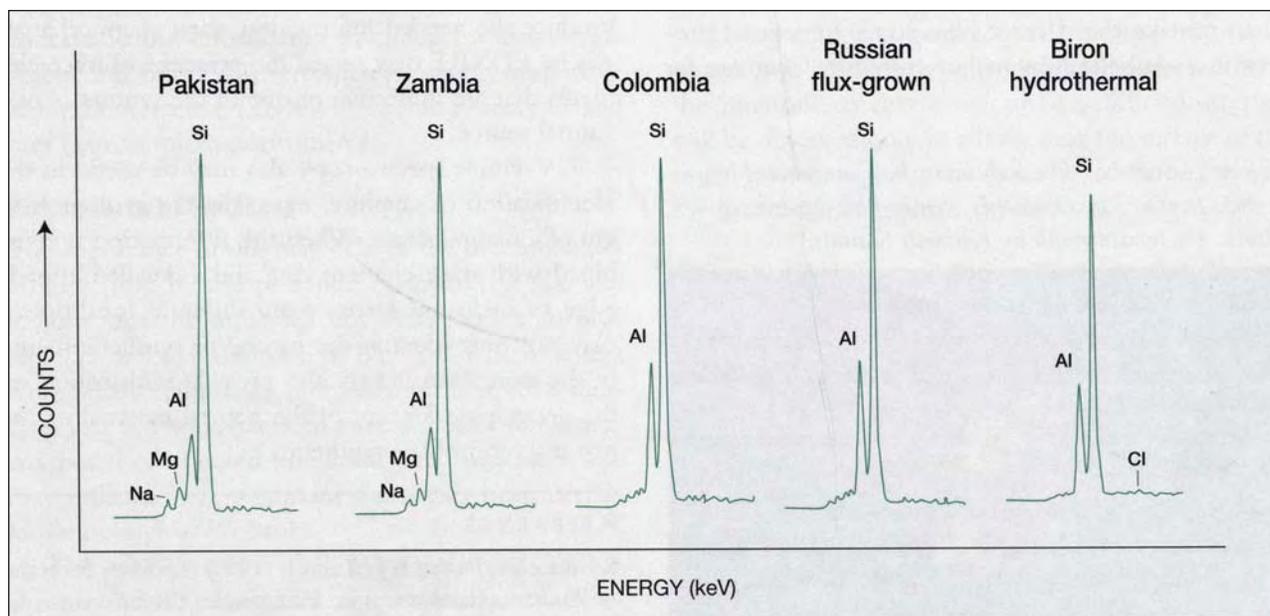
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VARIOUS NONDESTRUCTIVE METHODS are applied to distinguish natural from hydrothermally or flux-grown synthetic emeralds. Microscopic examination is used to determine the presence or absence of solid, fluid, and/or multiphase inclusions, as well as for the determination of diagnostic growth patterns and color zoning. Inclusions can be characterized further by laser Raman microspectrometry or by electron microprobe analysis. Chemical properties of the host material (and sometimes inclusions) can be determined by X-ray fluores-

cence or electron microprobe analysis. Absorption spectroscopy in the visible and ultraviolet ranges can detect the presence or absence of color-causing transition metals such as chromium, vanadium, iron, nickel, and copper. Infrared spectroscopy can reveal the presence or absence of different types of water molecules and/or chlorine.

For most of these techniques, diagnostic properties exist that are useful to separate natural from synthetic emeralds, but there are also areas of overlap. Specifically, certain characteristic features are typical

Figure 1. These spectra were recorded by means of the energy-dispersive X-ray analysis system of an electron microprobe, for natural emeralds from Swat, Pakistan; Miku, Zambia; and Muzo, Colombia—as well as for the following synthetic emeralds: Russian flux-grown synthetic and Biron hydrothermal synthetic. Characteristic sodium and magnesium peaks were observed for the natural samples from Pakistan and Zambia; distinct amounts of chlorine are diagnostic for Biron synthetic emeralds. The peak positions (in keV) are Na-1.0, Mg-1.3, Al-1.5, Si-1.7, and Cl-2.6.



for either natural or synthetic emeralds if present, but their absence is of no unequivocal diagnostic value. The presence of distinct amounts of sodium and magnesium, for example, is useful to characterize natural emeralds from numerous sources (figure 1). The presence of these elements can be determined by wavelength- or energy-dispersive X-ray fluorescence analysis or electron microprobe analysis, but natural emeralds from some sources—such as some Colombian or Nigerian stones—contain only very low amounts of sodium and magnesium. Thus, the sodium and magnesium values of these natural emeralds overlap those of their flux-grown and hydrothermal synthetic counterparts (again, see figure 1).

The presence of distinct amounts of chlorine—as determined by X-ray fluorescence, electron microprobe analysis (figure 2), or infrared spectroscopy—is used to characterize hydrothermal synthetic emeralds produced in China or Australia (Biron). An absence of chlorine, however, is known not only for natural emeralds from various sources, but also for flux-grown synthetic emeralds and for some other hydrothermal synthetic emeralds (e.g., produced in Russia or in Austria [Lechleitner]).

The presence of certain trace elements, such as molybdenum, is useful to characterize some flux-grown synthetic emeralds (e.g., Chatham, Gilson, and Zerfass). However, no residual molybdenum compounds are found in natural emeralds, in hydrothermal synthetic emeralds, or in flux-grown synthetic emeralds that are produced in molybdenum-free flux compositions, as is the case for samples grown in Russia from lead vanadate solvents.

An even more complex pattern of overlap is observed for other features, such as water-related infrared absorption bands. No water is present in flux-grown synthetic emeralds. Absorption bands of water molecules that are not related to alkali ions (such as lithium and sodium) are observed for some hydrothermally grown synthetic emeralds, such as Linde and Biron. However, some natural and some synthetic samples contain comparable amounts of water molecules not related to alkalis, as well as

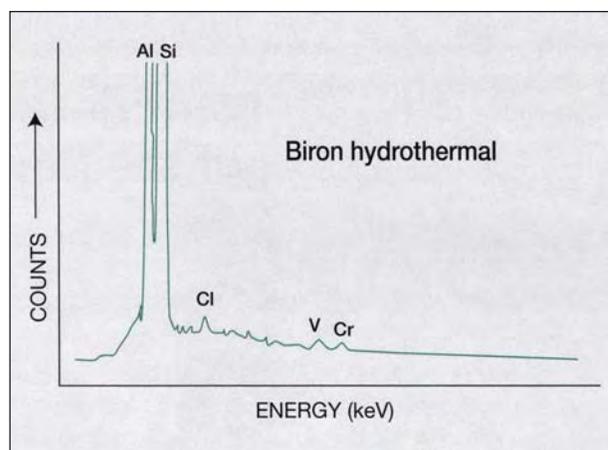


Figure 2. This energy-dispersive X-ray spectrum of a Biron hydrothermal synthetic emerald was recorded by means of an electron microprobe; the sample reveals a characteristic chlorine content as well as almost identical amounts of vanadium and chromium. The presence of both color-causing trace elements, vanadium and chromium (here, at 5.0 and 5.4 keV, respectively), is typical for this synthetic emerald grown in Australia, although vanadium and chromium may also be seen in Colombian emeralds.

some alkali-related water. For this group, which consists of Russian and Lechleitner hydrothermal synthetic emeralds as well as low-alkali-bearing natural emeralds—such as those from Colombia or Nigeria—identical water absorption bands may be measured in the infrared. For natural emeralds with higher amounts of alkali-related water molecules, the infrared spectra again are diagnostic for natural emeralds.

Consequently, a combination of techniques is sometimes necessary to determine unequivocally whether an emerald is natural or synthetic. In general, gemologists in the major laboratories must decide, after microscopic examination and standard gemological testing, which additional techniques must be performed to determine the origin of a sample.

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# Identification Challenges of the New Millennium

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ONE OF THE MOST INTERESTING things about working in a gemological laboratory is the opportunity to see the most challenging new developments in gemology—often before they are seen by almost anyone else in the field. This discussion presents a few of the more interesting or significant items that have recently come through the GIA Gem Trade Laboratory.

## Jadeite Jade

Because of the demand for fine-quality jadeite and its rarity, jadeite is treated in many different ways to make the most of what little material is available. Small carvings of dark green, nearly opaque jadeite are hollowed out from the back so that they appear to be a pleasing (and more salable) lighter green. Because the walls of these carvings may be less than one mil-

limeter thick, the back is usually filled with plastic to keep the jadeite from breaking. We also have seen large cavities in bangle bracelets that have been filled with a plastic mixed with a speckled green material—so the filler blends in with the rest of the bracelet. Several pieces of dyed green jadeite submitted to the laboratory did not show the characteristic absorption spectrum used to detect the dye. In addition, we have seen very believable imitations of fine jadeite, such as dyed quartzite (figure 1).

## Imitation Tanzanite

We recently examined an excellent new tanzanite imitation. The material is synthetic forsterite, a mineral in the olivine group, which has been doped with cobalt. Its appearance is very similar to tanzanite, including the strong pleochroism characteristic of that material. However, synthetic forsterite is easy to separate from tanzanite based on its gemological properties (especially the refractive indices, 1.635–1.670 for forsterite as compared to 1.69–1.70 for tanzanite).

## Zachery-Treated Turquoise

This proprietary turquoise treatment reduces the natural porosity of turquoise, so that the treated material will take a better polish than untreated material and will not discolor by absorbing foreign materials such as oils. It also can darken the color of the material. Extensive testing has not detected the presence of any polymers or other foreign materials within the turquoise after treatment. One indication of treatment

Figure 1. Quartzite can be dyed to imitate fine jadeite, as illustrated by these 8 mm beads. Photo by Maha DeMaggio.



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seen in some of the stones that had improved color was blue concentrations along fractures. However, a higher-than-normal potassium content is the only way at this time to identify the treatment conclusively.

### Diffusion[?]-Treated Topaz

Blue-to-green topaz that reportedly derives its color from diffusion treatment has been available for several years now. Whether or not this treatment is actually a diffusion process has not yet been proved, but it is significant to note that this material is substantially different from the pink-, red-, and orange-coated topaz that has been on the market. The coatings that produce these other colors are temporary and will easily scratch off. The color layer of the "diffused" material has the same hardness as topaz and has been shown to be very durable. The color is produced by cobalt, and the stones often show an elevated R.I. (sometimes over the limits of the refractometer). This treatment creates an extremely thin color layer that can be detected easily by its spotty appearance in the microscope.

### Synthetic Aquamarine

Hydrothermally grown synthetic aquamarine has become commercially available during the last year, and has been sold in Brazil as small calibre-cut goods (figure 2). It appears that the quantities available are small and the stones are easy to identify, as they have the characteristic chevron-like graining seen in many hydrothermal products (figure 3).

### Tsavorite

A very significant new deposit of fine-quality tsavorite has recently been found in southern Tanzania. Many kilos of the material have been recovered, with the best of the stones being of the finest quality when finished. We discovered some very interesting graining patterns in one of the stones we examined. This graining consisted of parallel striations that were curved in such a way as to remind us of the swirl striae often seen in glass. Fortunately, the stone had many other inclusions that proved its natural origin.

### Glass Imitations

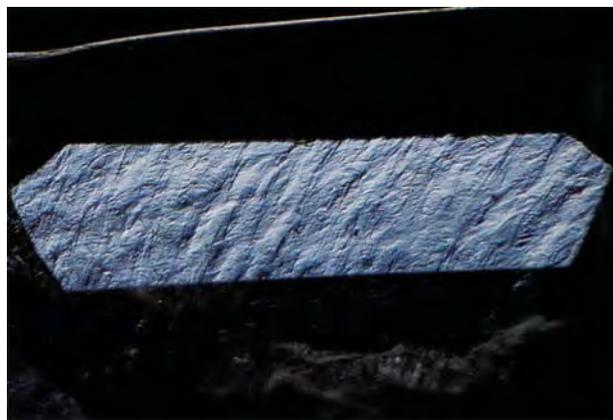
We continue to see high-property glass represented as natural stones. The most recent incident was a green glass that was being sold as Chinese peridot. This glass had a very high refractive index (over the limits of the



Figure 2. One of the newest synthetics on the market is hydrothermally grown synthetic aquamarine. The cut samples average approximately 1 ct. Photo by Maha DeMaggio.

refractometer), was very clean, and was visually identical to peridot. Gemologically, this material is easy to distinguish from peridot because none of their properties overlap. The greatest danger in this type of imitation is when it is sold in the rough or mixed in with parcels of natural stones.

Figure 3. The presence of chevron-like graining proves that the host stone is a hydrothermal synthetic, in this case synthetic aquamarine. Photomicrograph by Shane F. McClure; magnified 25 $\times$ .



## Identifying Diamond Treatments

Ilene M. Reinitz

GIA Gem Trade Laboratory

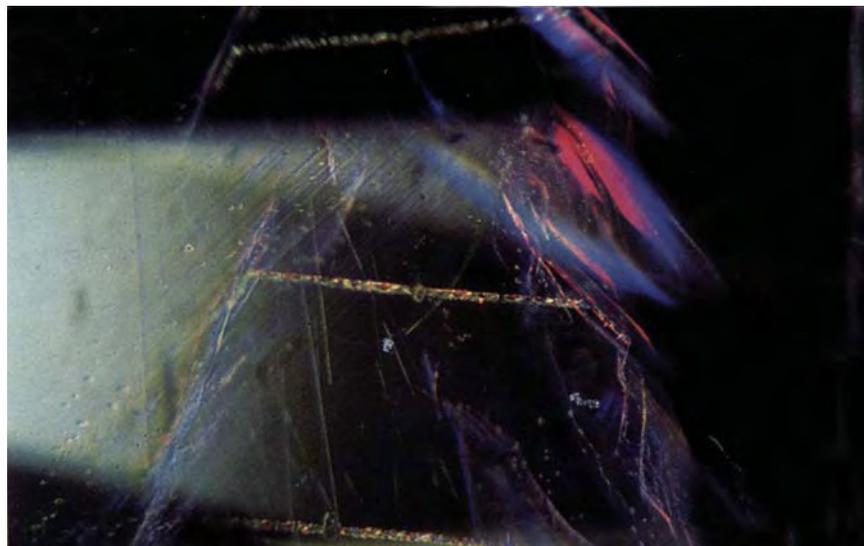
New York

**D**IAMONDS CAN BE TREATED to alter their clarity or their color. Although modern technology has increased the number of treatments to which diamonds may be subjected, most diamond treatments still can be detected through careful gemological observation and testing.

### Clarity Enhancement

A common treatment used in the trade to improve clarity is laser drilling. This technique creates access to a subsurface inclusion which, if it has not been vaporized by the laser beam, can then be dissolved by acid. Drill holes can be differentiated from natural etch channels by their appearance (Johnson et al., 1998). Specifically, drill holes are round in cross-section, whereas etch channels in diamond are square, triangular, or hexagonal.

Clarity also can be altered by introducing a high-refractive index glass into surface-reaching fractures (fracture filling), which greatly reduces their visibility. However, since the glass does not match the refractive index of diamond at all wavelengths, a “flash effect” is seen when observing the diamond parallel to the plane of the fracture (McClure and Kammerling, 1995). Non-surface-reaching fractures may be filled through a drill hole, but the hole itself is usually too wide to be concealed by this treatment. An unfilled drill hole disperses light around its edges, and may display a subtle partial rainbow when observed perpendicular to its length, whereas a filled drill hole may exhibit pinpoints of light showing various colors (figure 1). Knowledgeable observation with good lighting and magnification of at least 10× is the key to identifying clarity treatments.



*Figure 1. The laser drill hole and fracture in this 2.51 ct diamond have been filled with a high-refractive index glass. Note the various-colored pinpoints of light along the drill hole, and the pink-to-purple flash colors along the fracture. Photomicrograph by Vincent Cracco; magnified 63×.*

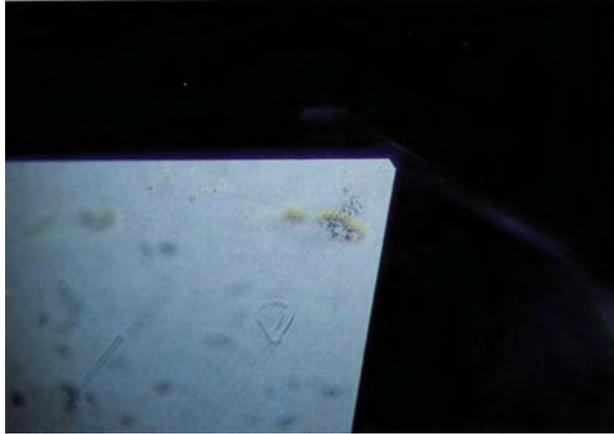


Figure 2. A sputtered-metal coating—visible here in diffused transmitted light as indistinct dark spots—has been applied to the pavilion of this 2.02 ct diamond. Photomicrograph by Nick DelRe; magnified 63×.

### Color Enhancement

Off-color diamonds are commonly treated to create a more attractive, saturated color. The most important development in this area over the last decade is that there is now substantial overlap in the color appearance of natural and treated diamonds, especially for yellow, greenish yellow, and pink hues. Most color treatments involve irradiating and/or heating the diamond to create various color centers (Collins, 1982). Some of these treatments produce a diagnostic distribution of the color (e.g., concentration at the culet), while detecting others requires careful analysis of a UV-visible-near infrared spectrum taken at low temperature; luminescence reactions may also be diagnos-

tic (Reinitz and Moses, 1997, 1998). The origin of color in some green diamonds—and, on rare occasions, some diamonds of other hues—cannot be determined as being either natural or treated.

In rare instances, diamonds are coated to produce a fancy color; more frequently, they are coated to make a pale yellow or brown diamond look more colorless. Coating techniques vary from the commonplace (such as fingernail polish) to the highly sophisticated (such as sputtered metals; see figure 2). To date, all coatings can be identified by careful observation with 10× or higher magnification, using a variety of lighting conditions, especially diffused transmitted light and reflected light.

The release of GE-processed diamonds onto the market has provided the most recent—and perhaps most significant—identification challenge for gemologists (see report in this issue of *Gems & Gemology*, pp. 14–22).

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### REFERENCES

- Collins A.T. (1982) Colour centres in diamond. *Journal of Gemmology*, Vol. 18, No. 1, pp. 37–75.
- Johnson M.L., Schwartz E., Moses T.M. (1998) When a drill hole isn't. *Rapaport Diamond Report*, Vol. 21, No. 45, pp. 1, 19, 21, 23, 25–26.
- McClure S.F., Kammerling R.C. (1995) A visual guide to the identification of filled diamonds. *Gems & Gemology*, Vol. 31, No. 2, pp. 114–119.
- Reinitz I., Moses T. (1997) Gem Trade Lab notes: Treated-color yellow diamonds with green graining. *Gems & Gemology*, Vol. 33, No. 2, p. 136.
- Reinitz I., Moses T. (1998) Gem Trade Lab notes: Diamond—Color treated from orangy yellow to reddish purple. *Gems & Gemology*, Vol. 34, No. 3, pp. 213–214.

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# Fluxes and the Heat Treatment of Ruby and Sapphire

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THE DISCOVERY OF EXTENSIVE RUBY deposits in the Mong Hsu area of Myanmar (Burma) has provided the marketplace with a much-needed source of fine ruby in smaller sizes (see, e.g., Hlaing, 1991; Henn and Bank, 1993; Kammerling et al., 1994). Much of the ruby from this location is characterized by blue or blue-black cores which generally are removed by heat treatment (Peretti et al., 1995). The heat treatment is straightforward: Temperatures of 900°C or above in an air atmosphere are usually sufficient to accomplish the desired change in color. When substantial quantities of Mong Hsu ruby began arriving at gemological laboratories worldwide, new features were recognized that were soon identified as residual flux inclusions (Peretti, 1993; Milisenda and Henn, 1994). These

*Figure 1. This 28 ct ruby from the John Saul mine in Kenya shows two glassy blebs that resulted from heat treatment without flux. They probably represent the melting of micaceous inclusions, and could easily be mistaken for residual flux.*



observations were mentioned in grading reports (Hänni et al., 1998), and have initiated a serious debate on the use of flux in heat treatment and, in particular, what the presence of large amounts of flux means in terms of the quality and durability of the original ruby.

What is a flux? A flux is simply a material that is usually a solid at room temperature, but at high temperatures it becomes molten and is a solvent for minerals and other inorganic materials. There are many types of fluxes in use, such as oxides, borates, silicates, molybdates, and fluorides, as well as various combinations of these materials. For example, fluorides are often used to reduce the viscosity of other fluxes. Fluxes based on borax (sodium tetraborate decahydrate) are widely used in Thailand for the heat treatment of ruby and sapphire (Abraham, 1982; Peretti et al., 1995).

It has been stated that a flux is necessary to prevent thermal-shock fracture of ruby and sapphire during heat treatment (Robinson, 1995). Nothing could be further from the truth. Natural ruby and sapphire are highly resistant to thermal shock fracture; much more so, in fact, than the ceramic crucibles in which the stones are placed, or the refractory materials of the furnace. Fluxes are used solely to enhance the appearance of lesser-quality material.

In principle, a flux can have many functions. It can slightly dissolve the surface of ruby or sapphire, giving it a somewhat polished appearance. It can fill fractures that are open to the surface. It can match the average index of refraction of corundum, thus masking fractures and other cavities. It can dissolve inclusions or staining in fractures that reach the surface. It can dissolve the amorphous layers that result from

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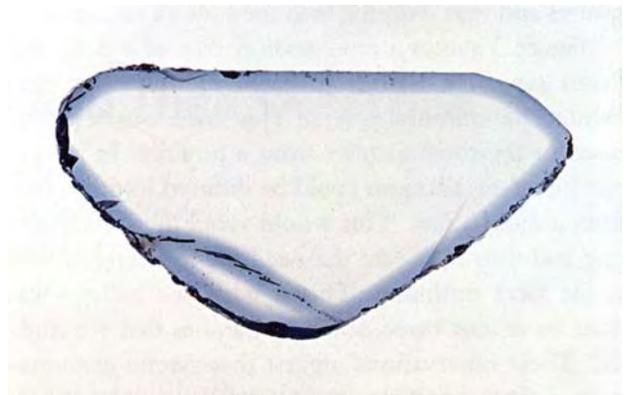
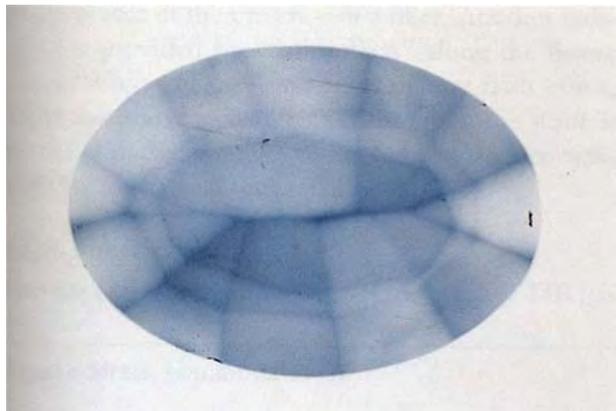
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aluminum hydroxide decomposition along parting planes. Finally, a flux can combine chemically with inclusions that melt out of a ruby or sapphire.

Upon cooling, a flux can redeposit dissolved corundum (Hänni, 1997–1998; Hughes and Galibert, 1998), resulting in very limited re-growth, or it can simply solidify as a corundum-containing material. It cannot, however, completely re-grow corundum in a fissure, because the flux usually contains less than 20% dissolved corundum (Nelson and Remeika, 1964; Linares, 1965). The solidified flux can be a glass, a polycrystal, a single crystal, or all of these phases, depending on the final composition, viscosity, cooling rate, volume, and substrate. In addition, each of these phases can have a different chemical composition.

Although today fluxes are used routinely to heat treat nearly all types of ruby and sapphire, determining that a flux has been used is *not* straightforward. First, many fluxes are based on borates, and boron is not detected by the X-ray fluorescence (XRF) spectrometers routinely used in gemological laboratories. Second, mineral inclusions may melt out of the corundum during heat treatment, and these melt droplets may appear very similar to flux deposits. The two glassy blebs on the surface of the ruby in figure 1 could easily be misidentified as flux. These glassy materials are composed of the oxides of silicon, aluminum, and magnesium, sometimes with calcium,

*Figure 2. Color concentrations along facet junctions are clearly visible in this deep-diffused sapphire that has been immersed in methylene iodide. This uneven coloration—which is considered characteristic of diffusion treatment—results primarily from the recutting and repolishing of the stone, not the diffusion treatment.*



*Figure 3. This slice of a faceted, deep-diffused sapphire shows the diffusion profile extending out from a "fingerprint"-like inclusion (bottom left) that reaches the stone's surface. The deep diffusion of this sample was performed by heating in a Ti-containing powder, which is the usual practice. However, a Ti-containing flux theoretically could produce the same result without the surface damage caused by powder sintering.*

potassium, or sodium. They apparently result from the melting of various micaceous mineral inclusions. Given the wide compositional range of fluxes, the variety of inclusions that can melt and/or dissolve in a flux, and the variety of morphologies that result from the cooling of flux materials, the identification of a flux as a filling in fractures or cavities can be very challenging.

In what may be yet another application of molten fluxes, we recently examined five fine sapphires of 3–5 ct each that we believed to have been deep diffused; yet they did not exhibit the color concentrations at the facet junctions that are typical of this treatment (Kane et al., 1990; see, e.g., figure 2). Note that this facet outlining is an artifact of recutting and repolishing the sapphire, which was necessitated by the pitting of the surface that was caused by powder sintering (Carr and Nisevich, 1975) during deep diffusion, and not the deep diffusion process itself. Prior to recutting and repolishing, the outlining of the facet junctions in deep-diffused gemstones generally is not visible even with immersion. We identified three of these stones as being deep diffused on the basis of the diffusion profiles seen on surface-reaching "fingerprint" inclusions when they were viewed edge-on. Because titanium dioxide—the material typically used for diffusion treatment—has a very high surface-diffusion rate on sapphire, it will propagate into any open

fissures and start diffusing into the bulk of the stone.

Figure 3 shows a cross-section slice of a deep-diffused sapphire with a fingerprint inclusion that exhibits the diffusion profile. This stone was deep diffused in the usual manner from a powder. In principle, however, titanium could be diffused into sapphire from a molten flux. This would avoid the surface pitting and thus eliminate the need for recutting as well as the facet outlining. This is what we believe was done to at least three of the five stones that we studied. These observations suggest that careful examination of fine sapphires is most prudent, even when there is no evidence of color concentrations at the facet junctions.

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#### REFERENCES

- Abraham J.S.D. (1982) Heat treating corundum: The Bangkok operation. *Gems & Gemology*, Vol. 28, No. 2, pp. 79–82.
- Carr R.R., Nisevich S.D. (1975) *Altering the appearance of sapphire crystals*. United States patent 3,897,529, filed December 15, 1969, issued July 29, 1975.
- Hänni H.A. (1997–1998) Short notes on some gemstone treatments. *Journal of the Gemmological Association of Hong Kong*, Vol. 20, pp. 44–52.
- Hänni H.A., Kiefert L., Chalain J.P. (1998) Ruby. In *Standards & Applications*, SSEF Swiss Gemmological Institute, Basel, Switzerland.
- Henn U., Bank H. (1993) Neues Rubinvorkommen in Myanmar (Burma). *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 42, No. 2/3, pp. 63–65.
- Hlaing U.T. (1991) A new Myanmar ruby deposit. *Australian Gemmologist*, Vol. 17, No. 12, pp. 509–510.
- Hughes R.W., Galibert O. (1998) Foreign affairs: Fracture healing/filling of Mung Hsu ruby. *Australian Gemmologist*, Vol. 20, No. 2, pp. 70–74.
- Kammerling R.C., Scarratt K., Bosshart G., Jobbins E.A., Kane R.E., Gübelin E.J., Levinson A.A. (1994) Myanmar and its gems—an update. *Journal of Gemmology*, Vol. 24, No. 1, pp. 3–40.
- Kane R.E., Kammerling R.C., Koivula J.I., Shigley J.E., Fritsch E. (1990) The identification of blue diffusion-treated sapphires, *Gems & Gemology*, Vol. 26, No. 2, pp. 115–133.
- Linares R.C. (1965) Properties and growth of flux ruby. *Journal of the Physics and Chemistry of Solids*, Vol. 26, pp. 1817–1820.
- Milisenda C.C., Henn U. (1994) Neues Rubinvorkommen in Myanmar (Burma). *Goldschmiede und Uhrmacher Zeitung*, Vol. 92, No. 4, pp. 147–148.
- Nelson D.F., Remeika J.P. (1964) Laser action in flux-grown ruby, *Journal of Applied Physics*, Vol. 35, No. 3, part 1, pp. 522–529.
- Peretti A. (1993) Foreign substances in Mong Hsu rubies. *JewelSiam*, Vol. 4, No. 5, p. 42.
- Peretti A., Schmetzer K., Bernhardt H.J., Mouawad F. (1995) Rubies from Mong Hsu. *Gems & Gemology*, Vol. 31, No. 1, pp. 2–26.
- Robinson N. L. (1995) Thais get burned by glass filling. *Colored Stone*, Vol. 8, No. 4, pp. 1, 13–14, 16–18.

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# Fissure-Filled Emeralds and Their Detection

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**F**ISSURES AND FRACTURES IN GEMSTONES are commonly filled with various materials such as glass, wax, oil, or artificial resins to improve their clarity. In the case of emeralds, fissure filling traditionally has been performed with organic materials. These fillings usually are visible with microscopic inspection, or with UV radiation due to their fluorescence. However, such observations need confirmation by other methods. Identification of such fillings is usually possible with infrared spectroscopy or laser Raman microspectrometry.

At the SSEF Swiss Gemmological Institute, the analysis of fissure fillings is now routine. Identification of the filling is performed in three steps: (1) optical (microscopic) examination, (2) FTIR analysis, and (3) Raman microspectrometry. For both the infrared and Raman techniques, the spectra obtained are compared to those of known (reference) materials.

## Microscopic Examination

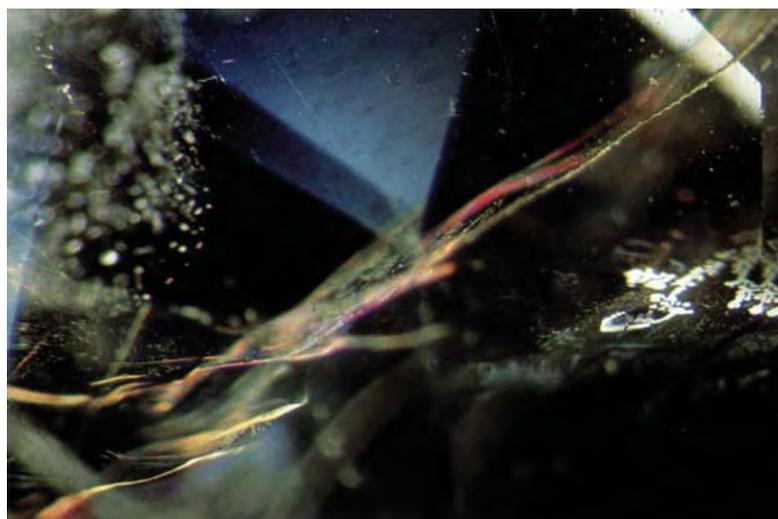
A detailed study with the microscope generally allows detection of the presence of a filler substance in the emerald and the extent of treatment. It also provides indications of the identity of a possible filler substance. Trapped air bubbles and dendritic patterns are a reliable indicator of the presence of a filler. Another indication is provided by “flash effects” along the fissure planes. While oil may create an orangy flash effect, flashes that show a change of color when the stone is viewed at different angles to the light source are typically due to artificial resins (figure 1).

## FTIR Spectroscopy

Fourier-Transform Infrared spectroscopy (FTIR) is

more versatile than conventional infrared spectroscopy for studying the molecular structure of organic compounds. However, a problem arises when fillers are analyzed within an emerald: Most of their characteristic features — at around  $1600\text{ cm}^{-1}$  — cannot be detected because of the absorption interference from the host emerald. Fortunately, emeralds are transparent to infrared radiation in a second spectral area, between  $2800$  and  $3200\text{ cm}^{-1}$ , from which characteristic features of organic substances can be obtained. The FTIR technique can be applied in two modes (i.e., transmittance or diffuse reflectance), depending on such considerations as the size of a stone and whether it is set in jewelry. Whichever FTIR technique is used, however, the analyzed volume of the sample is usually large enough to cover several fissures. Therefore, this

*Figure 1. Multicolored flashes in emerald fissures often indicate clarity enhancement by an artificial resin. Photo ©SSEF Swiss Gemmological Institute.*



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“macro method” may enable the identification of multiple fillers when the emerald has been successfully filled with different substances.

### **Raman Analysis**

With Raman microspectrometry, the identification of organic fillers in emeralds is also feasible. Waxes, oils, and natural and artificial resins show distinct Raman spectra. The characteristic peak areas are between  $1300$  and  $1700\text{ cm}^{-1}$  and from  $2800$  to  $3200\text{ cm}^{-1}$ . To obtain an analysis, the laser is focused into a narrow beam that is directed at a specific fracture (i.e., it is a “micro-analysis”). Complications may arise with this technique if a stone contains several substances, or mixtures of pure organic fillers, in a single fracture filling. In such cases, it is necessary to compare not only peak positions, but also peak intensity ratios. This enables the detection of admixtures and, frequently, residual fillers from earlier treatments. However, it may not be possible to identify decomposed filler materials (e.g., figure 2) with Raman analysis.

Because the successful identification of an organic filler using either FTIR or Raman microspectrometry depends on comparison to reference data, a compre-



*Figure 2. The chemical properties of a filling substance that has dried, as shown here, may be different from those of the original substance. Photo ©SSEF Swiss Gemmological Institute.*

hensive collection of reference spectra for known materials is a necessity. Our laboratory maintains such a library and it is constantly being enlarged. In addition, several Raman users, as well as equipment manufacturers, are presently compiling databases of Raman spectra that will be of particular value to the gemological community.

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# An Overview of Gemstone Treatments

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GEMSTONES THAT ARE DEFICIENT in either color or clarity can be enhanced by a wide variety of treatments (Nassau, 1994). An estimated two-thirds of all colored gemstones used in jewelry today are enhanced, and the use of enhancements on diamonds continues to grow.

Important factors to be considered in gemstone enhancement are: (1) the permanence of the treatment, that is, whether it is stable under normal conditions of wear and display (i.e., exposure to light—in the absence of excessive heat—and repolishing); (2) whether the presence of the treatment can be identified by standard gemological methods; and (3) whether the treatment can be reversed, should one wish to do so.

The effect of the simple heat treatment of various gem materials is summarized in table 1 (top). All of the heat-treated materials in table 1 are stable, and most of the treatments can be reversed. The effect of radiation treatments is similarly summarized in table 1 (bottom). Most of the irradiated materials are stable, and the treatment can be reversed in most cases.

Table 2 summarizes other types of gemstone treatments under two categories: (1) bleaching, dyeing, and filling techniques (top); and (2) other processes (bottom). Treatments in the first category generally are not stable (or their long-term stability is uncertain), and none can be fully reversed except in unusual circumstances. Among the other treatments, the recently announced GE POL process (see, e.g., Bates, 1999) undoubtedly uses high temperature at high pressure to lighten the color of certain diamonds (see, e.g., Nassau, 1994).

Many of the treatments in tables 1 and 2 can be identified by standard gemological examination, but many others cannot. Irradiated gem materials often pose the greatest challenge, because the exposure to

radiation may occur naturally or in the laboratory, with varying degrees of permanence. For example, yellow and “padparadscha” sapphire, as well as yellow to brown (“Imperial”) topaz, occur in both stable and fading forms (sometimes even together in the same sample), in both artificially irradiated and naturally occurring material.

Using equipment described by Nassau (1996a), a simple test can be performed to identify rapidly fading materials (e.g., irradiated spodumene, grossular, and green topaz, and some natural or irradiated yellow-to-brown topaz and padparadscha sapphire). Care must be taken to keep the temperature below 50°C to avoid heat destruction of color, a precaution that has been missing from some studies (Brown, 1993; Nassau, 1996b). Fading of both natural and enhanced gemstones is also a problem for curators of gem and mineral collections (Nassau, 1992).

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## REFERENCES

- Bates R. (1999) Diamonds: Mystery treatment announced. *Jewelers' Circular Keystone*, Vol. 170, No. 4, p. 19.
- Brown G. (1993) Maxixe-type beryls: Ghosts from the past. *Journal of Gemmology*, Vol. 18, No. 7, pp. 215–221.
- Nassau K. (1992) Conserving light-sensitive minerals and gems. In F.M. Howie, Ed., *The Care and Conservation of Geological Materials*, Butterworth-Heinemann, Boston, pp. 11–24.
- Nassau K. (1994) *Gemstone Enhancement: History, Science, and State of the Art*, 2nd ed. Butterworth-Heinemann, Oxford, England, 252 pp.
- Nassau K. (1996a) Fade testing: Has the time come? *Jewelers' Circular Keystone*, September, pp. 1116–1117.
- Nassau K. (1996b) On the identification and fade testing of Maxixe beryl, golden beryl, and green aquamarine. *Journal of Gemmology*, Vol. 25, No. 2, pp. 108–115.

TABLE 1. Simple heat and irradiation treatments.

Gem material	Change	Result	Stable? <sup>a</sup>	Reversible?
<b>SIMPLE HEATING</b>				
<b>Near-total to widespread use</b>				
Amethyst	To yellow	Citrine	Yes	Yes
Beryl	Green to blue	Aquamarine	Yes	Yes
Chalcedony	Yellow to brown to red	Carnelian, agate, tiger's eye, etc.	Yes	No
Corundum	Develop, lighten, or intensify blue	Sapphire	Yes	Yes
Topaz	To pink	Pink topaz	Yes	Yes
Zircon	To colorless or blue	Zircon	Yes	Yes
Zoisite	To purple-blue	Tanzanite	Yes	Yes
<b>Frequent to occasional use</b>				
Amber	Clarified, sun-spangled	Amber	Yes	No
Corundum	Develop or intensify yellow	Yellow sapphire, "padparadscha"	Yes	No
Corundum	Develop asterism or remove silk	Ruby, sapphire	Yes	Yes
Ruby	Remove "off" shades	Ruby	Yes	Yes
<b>Rarely used</b>				
Organics	Age (darken)	Amber, ivory	Yes	No
Quartz	Remove "smoky"	Greenish yellow	Yes	Yes
<b>IRRADIATION</b>				
<b>Near-total to widespread use</b>				
Quartz	To smoky, black	Smoky quartz	Yes	Yes
Topaz	To blue	Blue topaz	Yes	Yes
<b>Frequent to occasional use</b>				
Corundum	Develop yellow	Yellow sapphire, "padparadscha"	? <sup>b</sup>	Yes
Diamond	To blue, green, yellow, or red	Colored diamond	Yes	Yes
Pearl	Darken	Black pearl	Yes	No
Tourmaline	Develop red	Red, purple, and multi-color	Yes	Yes
<b>Rarely used</b>				
Amethyst	Partial change	Amethyst-citrine	Yes	Yes
Beryl	Develop blue	Blue (or green) Maxixe(-type)	No	Yes
Spodumene	Develop green	Green spodumene	No	Yes
Topaz	Develop yellow to brown	Imperial topaz	? <sup>b</sup>	Yes

<sup>a</sup>Stable for normal wear and display, and to repolishing.

<sup>b</sup>Stable and unstable colors can both occur, even in the same sample.

TABLE 2. Other treatments.

Process	Gem material	Stable? <sup>a</sup>	Reversible?
<b>BLEACHING, DYEING, FILLING</b>			
<b>Near-total to widespread use</b>			
Bleach	Chalcedony, coral, ivory, pearl, petrified wood, tiger's eye, and others	? <sup>b</sup>	No
Dye	Agate, chalcedony, marble, onyx, pearl, and others	?	No
Crack fill: colorless oil/polymer	Emerald	?	No
Impregnate: colorless oil/polymer/wax	Agate, chalcedony, lapis lazuli, turquoise, and others	No	No
<b>Frequent to occasional use</b>			
Crack fill: colorless glass	Diamond, ruby, sapphire	?	No
Dye	Amber, coral, ivory, jade, turquoise, and others	No	No
Impregnate: colored oil/polymer/wax	Agate, chalcedony, jade, lapis lazuli, turquoise, and others	No	No
<b>Rarely used</b>			
Crack fill: colorless oil/glass/polymer	Ruby, sapphire, and others	?	No
Crack fill: colored oil/glass/polymer	Beryl, diamond, emerald, ruby, quartz, and others	No	No
<b>OTHER PROCESSES</b>			
<b>Frequent to occasional use</b>			
Doublets, triplets	Opal	Yes	No
Laser drilling of inclusions	Diamond	Yes	No
Surface-diffused asterism and/or color	Ruby, sapphire	No	No
<b>Rarely used</b>			
Crackling	Ruby, sapphire	Yes	No
Crackle and dye	Quartz	No	No
Doublets, triplets	Any gemstone	?	No
Foil, mirror, and star backs	Any gemstone	?	Yes
High pressure/high temperature	Diamond	?	?
Reconstruction	Amber	Yes	No
Surface color coating	Amber, carnelian, diamond, turquoise, and others	No	Yes
Synthetic overgrowth	Emerald on beryl	No	No

<sup>a</sup>Stable for normal wear and display, and to repolishing.

<sup>b</sup>Stability not known.

## Chaumet—A Very Parisian Jeweler

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**T**HE 19TH CENTURY was a golden age for jewelers everywhere, but particularly for those in Paris, who showed an extraordinary ability to create a succession of new styles and techniques for the rest of the world to copy. We are fortunate that the records of Chaumet—at 12, Place Vendôme—have survived intact. They provide a guide to this most creative period of jewelry history—the changing pattern of designs, the emergence of new clients—and offer an explanation for Parisian preeminence.

Chaumet's story begins with a father-and-son partnership, M. E. and F. R. Nitot. Appointed court jewelers to Napoleon Bonaparte before his coronation as Emperor in 1804, they were given the task of creating jewelry that would express his absolute authority. To this end, they supplied the magnificent tiaras, earrings, necklaces, brooches, and bracelets—set with diamonds, pearls, and fine colored stones—that transformed the ladies of the Bonaparte family into royalty. The Nitots' mastery of the grand manner has never been surpassed, and it set the pattern for the rest of the century, when emblems of rank such as the tiara were a Chaumet specialty.

In the next phase of French history, from the fall of Napoleon in 1815 to the declaration of his nephew as Napoleon III in 1852, the Nitots' successors showed a similar genius for translating a new mood into jewelry. They turned their back on the imposing classical styles of the Empire and introduced diamond jewelry inspired by nature—garlands of wild roses, jasmine, hawthorn, and bulrushes—mounted on trembler springs for extra realism. At the same time, a passion for history led to “Gothic” and “Renaissance” types of gold and enameled jewelry which could be worn with daytime dress. Other jewels reflected religious faith, political involvement, sporting interests, and sentiment for family, friends, and lovers. The most important French customers were the women of the great bank-

ing families of Rothschild and Fould, but even they were eclipsed by the scale of purchases from the Russians, English, and Spanish, either as visitors or residents in the city. According to the Chaumet ledgers, wealthy Americans—Colonel Thorn with six daughters to marry, Mrs. Bingham from Philadelphia, and Mrs. Henry Livingston II from “old New York”—were now acquiring important collections of jewelry.

*Figure 1. This circa 1910 Chaumet design for an important diamond, pearl, and emerald corsage ornament hanging from shoulder straps anticipated the fashions of the 1920s.*



Figure 2. John Rubel made this Art Deco-era Egyptian Revival brooch for Chaumet in 1924. The hunters, fashioned from ruby and emerald, stand on a pavéed diamond background; the onyx sides are gripped by lotus motifs. Courtesy of A. C. Cooper Ltd., London.



The patronage of Napoleon III and his wife, Empress Eugénie, raised the jewelry trade to new heights. The Emperor encouraged the leading masters to participate in the International Exhibitions that were held at regular intervals from 1851, and their stands always drew huge crowds. So firmly entrenched was Parisian supremacy that little changed after the exile of Napoleon III and the establishment of the Third Republic in 1872. Thanks to improvements in rail and steamship travel, more and more visitors were drawn to Paris not only from other parts of Europe, but also from North and South America.

The Chaumet design albums record these purchases, which show a strong preference for 18th century themes—flowers, leaves, ribbons, bowknots, and tassels—executed in diamonds and precious stones. The quality was superb, each drawing a work of art in itself, and those pieces that have survived exhibit exemplary craftsmanship (see, e.g., figure 1). What kept standards so high? Clues are provided by the daybooks, which give every detail of client visits to the shop and their correspondence. Each jewel was the result of a dialogue between the customer and the firm, and the customer required “something not yet known” that was compatible with the very latest couture fashion. From the grandest tiara to the most modest brooch, everything had to have the stamp of Parisian chic, and it might be returned as “old-fashioned, clumsy, too dear” if it failed to please. Such criticism provided the spur for the constant renewal

of ideas and techniques that gave the business its vitality. So, too, did the competition from other great houses such as Bapst, Boucheron, and Mellerio, which made Paris a buyer’s paradise—though Mrs. Michael Herbert complained after visiting them all that trying to choose a necklace for her sister Grace Vanderbilt from such a wonderful array “was despairing work.”

By this time Joseph Chaumet, who joined the firm in 1875 and gave his name to it, was in charge. Not only did he guide Chaumet through the glories of the Belle Epoque, but he adapted to the challenge of Art Deco (figure 2). After his death in 1928, his son Marcel weathered the difficult years of economic depression and World War II. Marcel, in turn, was succeeded by his two sons, who directed Chaumet through the golden years that followed the peace of 1945. Chaumet International, now owned by an international company, is managed by Pierre Haquet.

#### FURTHER READING

- Scarlsbrick D. (1995) *Chaumet: Master Jewellers Since 1780*. Alain de Gourcuff, Editeur, Paris, and Chaumet International.
- Scarlsbrick D., Hurel R. (1998) *Chaumet: Two Centuries of Fine Jewellery*. Catalog of an exhibition at the Musée Carnavalet, March–June 1998, Paris.
- Vever H. (1908) *Histoire de la Bijouterie Française au 19ième Siècle*. H. Floury, Paris.

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## Early 20th Century Jewelry

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**R**ADICAL CHANGES IN WESTERN SOCIETY during the early decades of the 20th century are clearly reflected in the jewelry design of the period. This evolution is evident in the specific types of jewelry that were popular, how they were worn, the motifs used, and the gems incorporated.

At the turn of the century, Western society regarded jewelry as an outward expression of wealth, and women of the upper classes wore an impressive amount, particularly on formal occasions. Evening jewelry often included a tiara, several necklaces, long strands of pearls, brooches, corsage ornaments, bracelets, and rings. The garland style, using lacy, delicate motifs drawn from the decorative arts of the 18th century French court, was favored for jewelry design by the wealthy women of the Edwardian era

(figure 1). Diamonds and natural pearls were the preferred gems, set predominantly in platinum, a new metal for jewelry. This monochromatic look perfectly complemented the pastel colors that dominated clothing fashion. Diamonds from the recently discovered South African deposits were plentiful, as were pearls from the Persian Gulf and Ceylon (now Sri Lanka). When colored gems were incorporated, they were always the finest and were set off by diamonds and/or pearls. Favored colored gems included amethyst, peridot, opal, turquoise, demantoid garnet, emerald, ruby, and sapphire.

The 1910 Paris production of *Scheherazade* by Ballets Russes had a profound impact on Western society. Clothing design was immediately affected, as less-confining “harem dresses” in gauzy fabrics came



*Figure 1. This lacy bow corsage ornament, which consists of diamonds set in platinum backed with gold, is typical of the garland style that was popular with the upper classes during the Edwardian era. It was made by Tiffany & Co. around 1900. Courtesy of the Neil Lane Collection, Beverly Hills, California. Photo © GIA and Tino Hammid.*

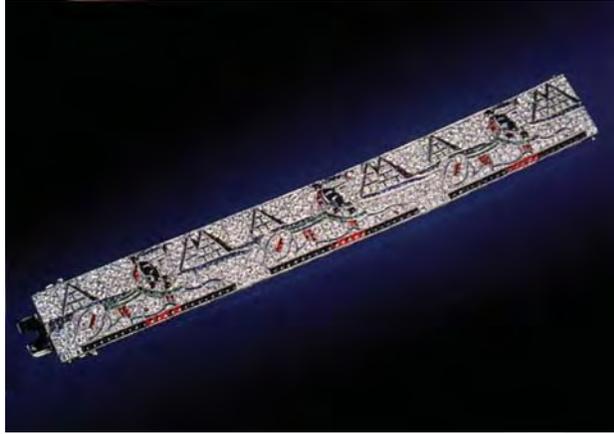


Figure 2. The Art Deco period is well represented by this flexible strap bracelet, with a repeating Egyptian sphinx and pyramid motif, fashioned from diamonds, rubies, emeralds, sapphires, and black onyx set in platinum. It was made by Janesich, circa 1925. Photo © GIA and Tino Hammid.

into style, supplanting the long dresses over tight corsets that had been the fashion. This softer, looser clothing couldn't support the heavy bodice jewels that were previously fashionable, so they quickly went out of style. Jewelry became more compact, and fewer pieces were worn at any given occasion. Platinum workmanship came into its own during this period. Every surface of the finely fabricated platinum mountings was polished, embellished with exquisite hand engraving or beaded with millgrain to add extra shimmer. Delicately sawpierced platinum plaques studded with gems were popular as pendants or brooches. Motifs for jewelry became more symmetrical and geometric, and natural subjects became sleeker and more stylized.

Jewelry design was forgotten with the onset of World War I and the Russian Revolution. The enormous casualties of men between 1914 and 1918 drew women into the workforce. As women accepted these new responsibilities, their attitudes, dress, and jewelry also evolved. Postwar women were more pragmatic and independent, and their look was slim and boyish, with cropped hair and shorter skirts.

Designers revived the trend toward geometric patterns in jewelry that began before the war, and also drew motifs from the Middle East and Asia. In this,

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and in the use of a strong primary color palette, we see the influence of the Ballets Russes resurfacing. Diamonds and platinum again were fashionable, now set to contrast with bold combinations of ruby, emerald, sapphire, black onyx, rock crystal quartz, jade, lapis lazuli, coral, amber, turquoise, or mother-of-pearl. Step-cut diamonds (introduced in 1915) ideally suited the geometric style of the jewelry, and colored gemstones carved in geometric shapes, as beads, or as stylized leaves and flowers were very popular. Cultured pearls, newly introduced, were more affordable than natural pearls, thus causing a shift in market value for all pearls.

Jewelry, like clothing, was designed to emphasize the vertical line. Evening dresses were sleeveless and cut low in front and back. Long strands of pearls or beads, often terminating in pendants or tassels, were echoed by long, dangling earrings and long lapel brooches. Narrow, flat, strap bracelets in continuous geometric motifs outlined in calibrated colored gemstones (figure 2) were worn in multiples on bare arms. Jeweled cigarette cases and vanity cases came into being, as women began to smoke and wear make-up in public, and wristwatches were introduced as the modern way to tell time.

Looking back, it is fascinating to see how economic fluctuations and developments in art, science, and technology all have had a direct impact on how jewelry is worn at any given time in history, as well as on what gems and materials are used. Knowing this gives us a definite perspective on current jewelry designs and allows us to speculate on future changes that will certainly manifest themselves in the new millennium.

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#### FURTHER READING

- Bennett D., Mascetti D. (1989) *Understanding Jewelry*. Antique Collector's Club, Woodbridge, Suffolk.
- Nadelhoffer H. (1984) *Cartier: Jewelers Extraordinary*. Harry N. Abrams, Inc., New York.
- Proddow P., Healy D., Fasel M. (1992) *Hollywood Jewels: Movies, Jewelry, Stars*. Harry N. Abrams, Inc., New York.
- Rudoe J. (1997) *Cartier: 1900–1939*. Harry N. Abrams, Inc., New York, and The Metropolitan Museum of Art, New York.
- Scarlsbrick D. (1995) *Chaumet: Master Jewellers Since 1780*. Alain de Gourcuff Éditeur, Paris, and Chaumet International.

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# The Marketing of Period Jewelry During the 20th Century and into the Next Millennium

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**W**E MUST FIRST REMEMBER that period jewelry was contemporary jewelry when it was sold initially. It can only be described as “period” when it moves into secondary markets as the result of subsequent ownership, or with the passage of time.

## New Marketing Opportunities

The important periods before 1950 are well known, in particular Victorian, Edwardian (figure 1), Art Nouveau, Art Deco (figure 2), and Retro. Unfortunately, jewelry designed after 1950 has not been named by jewelry historians; I call it “previously owned jewelry” when it moves into secondary markets.

The marketing of quality period jewelry depends on recognizing two characteristics that are inherent to the human psyche. One is the universal desire to collect. This appears at an early age and lasts a lifetime. The other is connoisseurship, which is a subjective judgment that derives from one’s ego.

What better product exists to satisfy these human needs than fine artistic collectible jewelry? We have a unique product, the result of the unusual partnership of Mother Nature’s wondrous creative force in producing from the depths of the earth beautiful, rare gem materials with the creative genius of fine craftsmen. Few other collectibles can make this statement.

The important auction houses have seized this opportunity to do business in the marketing of “artistic collectible” jewels. Today, they report sales in this field of several hundred million dollars. This business has such great promise that the auction houses have shifted their emphasis from marketing to the jewelry trade to marketing directly to private individuals.

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The profit centers of independent jewelers are being threatened by the commoditization of diamonds, the expanded marketing of “branded” designer jewels, and of course the new marketplace of the Internet. In fact, major auction houses such as Sotheby’s have recently made partnerships with important players in this field of e-commerce—in this case Amazon.com.

Is there an opportunity for the independent jeweler to establish a profit center in this area of artistic collectibles? I believe there is, but it first requires the acquisition of an inventory of quality period jewelry to establish credibility, and then demands a commitment to the training and education of at least one salesperson in the organization to become an expert in this field. The appearance of learned and articulate jewelry historians over the last 25 years has produced many books and articles useful in this process. Finally, he or she should ally with at least one recognized

*Figure 1. Edwardian jewelry, like this circa 1900 platinum brooch set with pearls and diamonds, is popular with collectors. Courtesy of J. & S. S. DeYoung.*



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dealer in period jewelry for help in establishing authenticity and direction.

### The Importance of Provenance

Period jewels with the provenance of important jewelry houses of the past command a substantial premium—a premium that appears to be increasing yearly. Some of the key names that appear on jewelry sold in America in the first half of this century are Tiffany, with its high-quality gemstone jewelry as well as its Art Nouveau collectibles; T. B. Starr, of Marcus & Co. (who branched out from Tiffany); Dreicer & Co.; Black Star and Frost; and Raymond Yard, who came from Marcus & Co. Cartier (figure 3), which did not become established in America until the early 1920s, could be considered the artistic leader of this era because of the firm's European influence.

Period jewelry was also produced by several manufacturing firms in the first half of this century, and was sold by fine jewelry stores in major and secondary cities. Except for the manufacturer Oscar Heyman, however, these firms have disappeared from the scene, battered by the effects of the Great Depression and World War II. Most of this jewelry, though highly desirable, does not carry a name.

The 12 years that began with the Depression and ended with World War II were a bleak period for the

*Figure 2. It is important that sales staff understand the distinctiveness of period pieces, such as these Art Deco (circa 1930) clip brooches, fashioned from rubies and diamonds set in platinum. The clips can be worn separately or as a single brooch. Courtesy of J.&S.S. DeYoung.*



*Figure 3. This diamond necklace has a known provenance—"Cartier, London"—which greatly enhances its value. Courtesy of J.&S.S. DeYoung.*

jewelry industry. After the war, Van Cleef & Arpels probably was the artistic design leader for 40 years. Harry Winston, with his emphasis on the juxtaposition of large stones to create a "free-form" effect, introduced a new look in the 1950s and '60s that was extensively imitated. Other niche players with their own look were David Webb, Schlumberger at Tiffany, and Verdura.

### Conclusion

Great jewels, whether new or previously owned, flow to the markets where new wealth is being generated and where there are wealthy patrons who encourage artistic innovation. As we approach the new millennium, the technological revolution is already creating—and will continue to create—great wealth in the United States. The opportunity is there for the enterprising jeweler.

## Adapting Classic Designs to Modern Markets

Robert Lee Morris

Robert Lee Morris Design Studio  
New York

THE MODERN MARKETS TODAY demand constant change and innovation. Fashion and advertising have trained us to have a throwaway mentality, ready to leap from one trend to the next, guiltlessly abandoning any brand loyalty. It is my contention that for one to remain sane in this culture of the microchip and its blinding speed, people need a lifeline to ground themselves. This could be found in classic design language, a thread that winds its way throughout consciousness in all cultures. It is from classic, primordial forms that artists in visual media can breathe vitality into our modern products.

As designers are challenged to create more ultra-modern, high-tech concepts—whether in clothing, jewelry, architecture, or Web site pages—it is their responsibility to constantly adapt classic designs into their work, for designers are the ones who manipulate our sense of well-being in the most subliminal manner.

The artist is the liaison, the shaman between the worlds of ordinary reality and the dream state and spirit dimension. Artists are the magical beings in our society who can translate for the rest of us the ineffable experience of the mysterious universe. To be effective, therefore, the language of the artist must be one we all can understand, one that is composed of certain essential elements that I choose to call “classic components.” Carl Jung would call them “symbols of the Collective Unconscious.”

Some examples of these elements of design are spirals (as in hurricanes, whirlpools, and seashell patterns), whiplash and serpentine curves (as in river bends, snakes, and fabric folds), fractals (random patterns of chaos, as in piles of leaves in the forest, or the shapes of sand dunes or of pebbles washed up on the beach), and natural architectural forms (such as spider webs, ant and termite mounds, bee hives, or a bird’s nest).

What makes one artist more popular and successful than another artist is often the unique and harmonious blend of both classic design language and the personal signature style of the artist. When the latter comes deeply from the heart and reflects the true soul of the maker, then the use of the symbols of common human consciousness become that much more emotionally moving. People in today’s urban society crave images that connect us to our natural environment, for it is not only grounding, but soothing to our industrialized and anxious souls.

*The uneven spirals of a hurricane provided the classic design element for this contemporary gold and diamond necklace and bracelet. Photos courtesy of Robert Lee Morris Design Studio.*



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## Creating a Luxury Brand

David Yurman  
Yurman Design  
New York

**T**HE EVOLUTION of *Yurman* into a designer luxury brand has taken 25 years, with a transformation from artist to designer to designer name brand to designer luxury brand. My wife Sybil and I were originally artists—she was a painter, I was a sculptor—and together as partners we decided to bring our art forms to the world of jewelry. Unfamiliar with jewelry manufacturing, we applied unconventional techniques and often wound up using materials that nobody else wanted. Before long, we began using cables in our pieces, and of course the cable product eventually became our symbol. Although some were quick to label Yurman as “the cable company” or a “one-trick pony,” our cable product was more a matter of *consistency* in communicating our message.

Brands (luxury brands in particular) are in fact built on continuity and consistency of message, so becoming a brand was our next evolutionary step. Grudgingly—I was reluctant to emphasize my name above the beauty of the product—we developed the DY logo collection. We took our thinking “outside of the box” once again simply by putting diamonds in silver (the “Silver Ice” collection). We chose our retailers carefully and developed an authorized retail network. We trademarked and copyrighted our products in order to control the image and protect the brand. Protecting the brand is essential not only for our company, but also for the retail customer who seeks a sense of quality and authenticity. Brands collaborate and create alliances in this way: Customers want to join up, they want to belong.

In recent years, we have focused on establishing Yurman as a luxury brand that carries the same classic style and classic shapes. Today we are experiencing a luxury revolution, one that began when companies like Gucci and Armani started to globalize luxury. Technology—which enables us to understand the demographics of our customers through database marketing—and an era of unprecedented wealth have combined to transform the concept of luxury. Whereas in the past luxury was exclusionary and extremely expensive, today’s luxury is accessible and broad-based. It involves joining, rather than standing apart. The accessibility of luxury should not be dismissed as designer-brand pollution, because the quality of today’s luxury signatures is very real.

*The cable bracelet is recognized worldwide as the Yurman Design signature piece.*



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# The American Designer Jewelry Movement: Where It Came from and Where It's Going

Cindy Edelstein

*Jeweler's Resource Bureau*

Pelham Manor, New York

WE HAVE ALL BECOME ACCUSTOMED to the use of designer “names” in our business. They represent the sizzle in our industry, so much so that many manufacturers now add a person’s name to their company logo whether or not that person actually designs jewelry or, in some cases, even exists at all. That trend will only continue to grow in the coming years (see, e.g., figure 1).

But designer jewelry as a business category is still relatively new. Up until the mid-1970s, the only designer names that consumers could relate to were those of the big retail design houses such as Cartier and Tiffany. Little was available to the middle class beyond princess rings, bangle bracelets, and love

beads until 1969, the year of the first Bennington (Vermont) Craft Fair. Many historians use that event to mark the birth of the contemporary designer movement. Several designers whose names we all know well, such as David Yurman and Michael Good, got their start there.

At about the same time, a wave of metal artists were graduating from a diverse range of universities and art schools. Thanks in part to the efforts of Mort Abelson and the Jewelers of America trade shows, by the late 1970s these artisans slowly became businesspeople. Trade shows have since played an enormous role in the designer jewelry marketplace, and they will continue to be vital to the success of most designer businesses.

Still other influences contributed to the growing power of designers. Arts and crafts galleries began showcasing handmade jewelry; as the galleries flourished, jewelry became accepted as a contemporary art form. The fashion world played its part as well, with the work of designers such as Robert Lee Morris (figure 2) gracing the covers of *Vogue*, *Mademoiselle*, and other fashion magazines. Designer organizations such as the American Jewelry Design Council, the Contemporary Design Group, and more recently the International Jewelry Design Guild also have had a positive impact. Trade magazines had always written about designers, but *JQ* magazine was the first to claim the movement as its own. *Lustre* magazine, launched two years ago, added the term *better brands* to our vocabulary. *JCK* entered the fray with a mini-magazine called *Luxury*, which speaks to the high end of the market. Design competitions were also a major part of the designers’ success story. Commodity promoters such as the World Gold Council and Platinum Guild International became major sponsors, and they

Figure 1. This collection of Lisa Jenks jewels showcases her signature “modern primitive” motifs.



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*Figure 2. This dramatic sterling silver bracelet by designer Robert Lee Morris illustrates Morris's use of positive and negative space and his ability to make metal look fluid and soft. Photo by AB Studio, courtesy of Robert Lee Morris.*

benefited from the buzz generated by the unique, exciting pieces that designers created for these competitions.

Even the economy was a factor. As it recovered from the '80s slump, those manufacturers still left standing saw that designers had done well in difficult times, so they adopted that approach as their own. A new trend emerged: The mass-market manufacturer began taking on a designer look, sometimes line for line. Most designers are incensed by this trend, but for the manufacturers it is a good marketing concept that has already been tested. Today, this is a growing practice, one that blurs the lines both between designer

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and manufacturer and between true artistic talent and clever inspiration. We will see more of it in the years ahead. Also ahead are the following trends:

In marketing, designers are reaching out directly to the consumer through the retailer. First, designers created their own brochures and handouts, then their own packaging, logo plaques, and even display units. Designers are not likely to relinquish this control. In the last five years, designers have made consumer magazine advertising a priority.

More recently, designers have embraced the Internet. They have put up Web sites as an extension of their printed advertising materials, to control and promote the image they want the consumer to have. The next logical step is e-commerce, and with it comes the critical question: Will designers start to sell directly to the consumer, and leave the retailer out of the chain? Only time will tell.

E-design is another digital influence to consider. Virtual-design technology that lets retailers work with their customers to create a custom design almost instantaneously is already here. De Beers has just added a program to its Web site with which consumers can design their own engagement rings. This points to the observation that if everyone can do it, then it is no longer unique; since the lure of the unique is eternal, the challenge for true designers is to figure out how to differentiate themselves and their work from the pack.

Another trend we see is a growing chasm between the big guys and the not-so-big guys, as investors and large companies jump in either to back or swallow up designer-owned businesses. For the really successful manufacturers out there, it might be easier to buy some designer talent than find it on their own.

More designers are opening their own stores, which helps strengthen the designers' position in the marketplace for themselves and their retailers. But to become really big, designers will diversify into fashion accessories, home accessories, and similar products as part of a category called "lifestyle fulfillment."

Will these trends bring about the demise of real jewelry designers, or will they stimulate greater interest in the designer jewelry movement as a whole? We'll have to wait and see.

## Perspective of a High-End Jeweler

Stephen Magner

Neiman Marcus

Dallas, Texas

**W**HAT DOES IT MEAN to be a high-end jeweler? Do you simply sell more expensive items than your industry cohorts? Do you have fancier real estate? Do you have bigger markups? Or do you *act* differently?

I suppose that being high-end means that your average transaction is significantly higher than the norm and that you primarily deal with the top 10% of the moneyed population, those who can afford to pay for your merchandise immediately or certainly within a year.

Note, though, that less than 1% of the U.S. population currently has a household income over \$150,000 (approximately 2.2 million people). And households with an income over \$500,000 number a mere 420,000. By the time these households pay their taxes and bills, how much is left? And how many even like or believe in owning jewelry? In essence, the top of the pyramid is very small. So if you're going to get into the chase in the new millennium, you'd better be prepared. Your competition will be tough and coming from all directions. The Web-savvy customers in the new millennium will be much more informed than ever before. They will be able to learn about products, grading criteria, manufacturers, designers, prices, and your competitors. They will know the important questions to ask, and they will expect you to be able to defend your claims.

Having said that, where does the high-end jeweler go from here—to this mind-boggling new millennium full of smart people?

When I visit our Neiman Marcus salons, I try to make observations in the following four categories, which I believe will be the ingredients for success as a high-end jeweler: Facility, Support, Merchandise, and People. People are, by far, the most important. Merchandise is second.

### Facility

You have to have an arena in which to perform. Regardless of your salon's size or style, it should be

inviting, relaxing, and well-lit. The environment should be as invisibly secure as possible. This new millennium will bring much better security devices, detectors, showcase development, and light venues to allow us to make even better and more "user-friendly" presentations. After all, we are in one of the few truly romantic businesses. How romantic is it to be buzzed in past the rent-a-guard, seated under the surveillance camera with the sales associate fumbling through six keys to show you two items at a time, wiping your fingerprints off as they retest the first item they showed you with a diamond detector?

Your facility must make it easy for customers. They have limited patience, and their time is very valuable. A comfortable, well-appointed viewing room is highly recommended.

### Support

Support areas include loss prevention, human resources, advertising, marketing, public relations, credit services, information services, and inventory control. Whether you have a staff for these areas or have to wear all of these hats yourself, things are going to change. Again, technology is going to enable us to network more and save time so that we can focus on our most important function: Selling jewels!

If you don't have a bar code system, get one. If you don't surf the Net, start. It is a sea of information. There is software available to aid in almost all support areas. Public relations, marketing, and advertising will all be especially important in either putting yourself on the map or keeping yourself off it.

### Merchandise

I think there are two great sins that get jewelers in trouble: (1) Owning too much inventory, and (2) not knowing the real value of the merchandise. We are in a slow-turning, expensive-inventory business. *Turn* is the biggest focus one should have. I think *borrowing* inventory is a great idea, if you can acquire it at the

*The merchandise carried by a high-end jeweler should have a special look, a distinctive quality. Such quality is illustrated by these pieces of high-end platinum jewelry, from Neiman Marcus's Estate collection, which are set with diamonds and sapphires. Courtesy of Neiman Marcus.*



right price. In addition, a high-end jeweler's merchandise should have a look, a distinction. It is difficult to make a statement if you try to be all things to all people.

Merchandise to me falls in one of five categories: designer, estate, traditional, and "precious" jewelry—and watches. All of these categories have a bright future for various reasons. I expect the new millennium to bring some wonderful new and innovative designers and watchmakers.

### **People**

This is the most important entity there is in this industry. The skills needed to be a successful high-end jeweler are quite varied. They have not changed dramatically over the centuries: They have only intensified.

First—then, now, and always—you must be a selling-minded communicator. You must be able to articulate complex information to your clients, your staff members, your bankers, and your vendors.

You have to be aware of fashion, of business trends, of current events. You have to share some commonality with your clients. Is the chairman of

your city's largest company going to feel comfortable taking your advice or that of a staff member? The high-end jeweler in the new millennium will need to be a socialite, a detective, an accountant, a gemologist, a teacher, a marketing expert, and, of course, a great salesperson. People buy jewels from the people they like and trust. If all things are equal, you must give the customer a reason to shop with you.

The high-end retailer is also responsible for a staggering amount of product knowledge. You have to know diamonds, colored stones, gold, platinum, treatments, trade-in values, watch making, setting, repairs, disclaimers, anti-trust laws, and so on. There are a lot of pitfalls, and because you are dealing with successful, moneyed, demanding people, you really need to know—or have access to knowledge on—everything related to the jewelry you sell.

The great reward is that you become the place where desires are fulfilled—the finder, the seller of rarities, the dealer of the precious commodity. The next millennium will actually be a lot of fun for those in the jewelry industry with enough dedication and patience. It is a lifelong journey, and a worthwhile one.

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## Perspective of an Electronic Retailer

John Calnon

QVC

West Chester, Pennsylvania

AS RECENTLY AS THE MID-1980s, the idea of shopping from home meant flipping through catalogs and other printed media. And while some catalogs came to represent sizeable sales volumes, these were typically limited to certain niches such as apparel and hobbies. They never developed into a major factor in the jewelry business.

Today, electronic media are fundamentally changing how people shop. With the growing appeal of television- and personal computer-based retail channels, the very definition of *shopping* is evolving. In the U.S. alone, three-quarters of all adults made purchases from the comfort of their homes in the past year. In categories such as books and music, online retailers like Amazon.com are stealing huge chunks of market share away from traditional bookstores and music retailers.

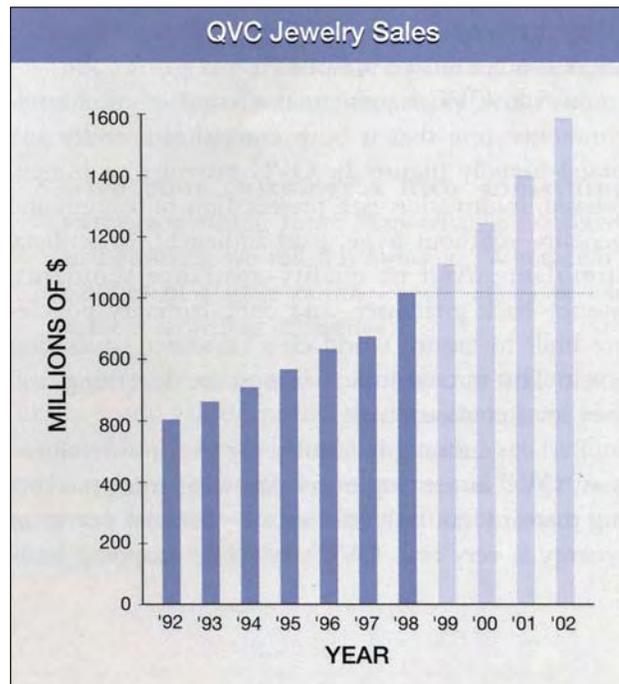
What does all this convergent e-commerce mean for the jewelry industry: Does it mark the end of the traditional jewelry retailer? Will everyone soon be buying their jewelry from their couches? Or will the jewelry industry somehow remain uniquely immune to all these tectonic shifts in retailing? The answer is "no" on all counts.

QVC has a unique perspective on electronic retailing. With 1998 net sales of \$2.4 billion, QVC is now larger than many well-established traditional retailers such as Bloomingdale's and catalog merchants such as L.L. Bean, and it is more than twice the size of either The Home Shopping Network or Amazon.com. QVC's TV- and PC-based retailing services reach more than 70 million U.S. homes 24 hours a day, and they will generate over 600 million page views, 100 million phone calls, and 60 million

package shipments in 1999. Within the jewelry category, QVC's credentials are even more noteworthy: With annual U.S. shipped sales of over \$1 billion in jewelry alone, QVC is among the largest-volume jewelry retailers in the world's largest consumer market. At its current growth rate, QVC will surpass \$1.5 billion in jewelry sales by 2002 (see figure 1).

QVC's growth remains largely misunderstood by industry observers, many of whom mistakenly attribute QVC's success to its technology and infrastructure. Yet, when the Harvard Business School did

Figure 1. QVC projects jewelry sales of more than \$1.5 billion in 2002, almost double the amount of 10 years earlier.



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*Figure 2. Two factors in QVC's success as an electronic retailer are its relaxed on-air presentations and its efficiency in handling customer orders.*



a case study on QVC, they found that QVC is less a story about technology, and more about a culture that is obsessed with pleasing the customer. In their words (Rayport and Louie, 1997), QVC represents “a breakthrough service business.”

In fact, QVC represents that rarest of retail environments: one that is both consumer-friendly and brand-friendly (figure 2). QVC provides an honest, relaxed, information-rich presentation of features and benefits—without hype, paid audiences, or artificial stimulants. And its quality-assurance standards, money-back guarantee, and confidentiality policies are built to ensure world-class customer satisfaction levels. This in turn attracts an upscale, discerning, and very loyal customer base.

Perhaps more importantly for the jewelry business, QVC is proving every day what most marketing theorists can only talk about—that the power of synergy is very real. QVC's televised shopping busi-

ness excels at creating demand that spills over to traditional retail. Viewership data confirm that for every order QVC takes, the network reaches thousands of viewers who ultimately choose to shop at traditional retail. In many ways, QVC represents a true hybrid of marketing and distribution, creating more overall demand for a wide variety of categories, most notably jewelry. In direct contrast to the old-school retailing obsession with market share, retailing in the new millennium will call for a new understanding of how channels of trade can actually complement one another. In the end analysis, a bracelet sold on QVC means many more sold at the jewelry counter.

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#### REFERENCE

Rayport J.F., Louie D.L. (1997) *QVC, Inc.* Harvard Business School Publishing, Boston, MA, 32 pp.

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## Meeting Customer Needs

Matthew Stuller  
Stuller Settings Inc.  
Lafayette, Louisiana

HERE ARE MANY WAYS for the jewelry manufacturer to help the retailer be profitable. Each is ultimately some form of customer service, a concept that extends far beyond just being courteous.

- **Document.** Be exacting, be precise with facts and figures. Any time you can't provide something for the retailer, your sales representatives should be documenting it and finding out why not.
  - **Deliver on or before your promised dates.** Add a little extra cushion to your estimated date, which will allow for any unexpected problems in the manufacturing process.
  - **Listen to the jewelers, and know exactly what their needs are.** What are their specific problems, what can they sell, what can't they sell, what are the issues they must deal with on a daily basis? The manufacturer should set up focus groups of customers throughout the country to identify strengths and weaknesses.
  - **Help finance the retailer.** Today's manufacturer often must serve as a bank for the retailer. Offer special terms for buying seasons, and offer special conditions for products they are unable to sell. Having your customer stuck with product is bad for everyone.
  - **Make it easy and pleasurable to do business with your company.** Think about it: We spend half of our waking lives in business. If it's painful to do business with you, a retailer can always switch to one of your many competitors, so you should make things fun, humorous, and personal.
  - **Be the retailer's partner.** Help the retailer create marketing campaigns and advertising programs. Stores can't carry everything on their counters, so supply catalogs, CD-ROMs, and literature that are retail-sensitive and priced correctly. Never compete against them by selling retail.
  - **Be flexible.** It may seem difficult, but today's manufacturer cannot set a minimum order. Every sale is crucially important to the retailer, whether it's a \$40,000 diamond or a 40-cent foil-backed stone. Even if it isn't profitable, stock the product that the retailer needs to take care of his or her customers. Similarly, be able to customize and handle special orders.
  - **Provide "just-in-time" inventory.** The retailer should be able to rely on the manufacturer to deliver rush orders directly to the consumer on time, every time. As more retailers are becoming involved in commerce over the Internet, "just-in-time" inventory will become even more important.
  - **Give your customer a little something extra,** something more than what is expected. In Louisiana, we call this *lagniappe*. Whether it's candies or a little bonus check, *lagniappe* can make a surprising difference.
- Once you've taken care of your customers and finally made a little profit, the manufacturer's next responsibility is to give something back to the industry. Support organizations, programs, and educational seminars. Invest in our industry's future to ensure that it stays strong and bright.

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# Can a Family Business Compete in the 21st Century Jewelry Market?

Thomas Tivol  
*Tivol Jewels*  
Kansas City, Missouri

AS WE COMPLETE THE CENTURY, many family jewelry stores will have mastered the basic merchandising, marketing, pricing, display, lighting, legal, and accounting functions that enable them to compete successfully in the current retail climate. As the millennium closes, however, the family jewelry store faces an uncertain future. Competitors will have access to the same techniques, technologies, and even creative energies. Continuing commoditization and the public's demand for a bargain (or the illusion of a bargain) will put a strain on the small retailer, and ultimately the exhaustion of running the business and the squeeze on profits may force many families to seek a living elsewhere. How can the family business hope to survive in the 21st century?

## Importance of a Teaching Relationship

Historically, much of the internal and external power of a family business derives from the parent-child relationship. Children require a caregiver in order to survive. From the first month, the child forms emotional attachments to the parent, and these are expanded in myriad ways in a family business. Similar in kind, although different in structure, are the concepts of apprenticeship and mentoring. All of these involve a teaching relationship—sometimes between old and young—with duty and respect as its core, and a life-long passion for work as its function. The author

believes that these types of relationships, when successful, have an integrity that propels those involved to become the best they can be. At the same time, this philosophy represents a key business strategy: placing primary emphasis on staff development to compete and win against large concentrations of jewelry wealth in other merchandising formats.

## The Complete Retailer

Smaller retailers can take what is appropriate from the parent-child model, apprenticeship, and mentoring to develop their staff members into consummate professionals. That is, the employee is taught to “live” the entire retail jewelry experience, rather than merely being trained in certain aspects of product knowledge and salesmanship. Retailers, even those with established in-house training programs, generally expect too little from their staff members, and thus these employees learn only the minimum required. The complete retailer demands much more: detailed study of the history of our art, gemology, design, engineering (watch and shop technologies), ethics, and law. A store that is always represented by a well-trained, professional sales staff can more than offset the apparent wizardry of technology and the profit pinch of commoditization. Such training is an important key to longevity for the independent retail jewelry merchant.

## Panel Discussions & The War Rooms

### Panel Discussions

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## Diamond Production in the 21st Century

### PANELISTS

- James Picton** *Petra Diamonds, Lanseria, South Africa*  
**A. J. A. "Bram" Janse** *Archon Exploration, Perth, Australia*  
**Uri Okoemov** *Alrosa, Moscow*  
**James R. Rothwell** *BHP Diamonds, Vancouver, Canada*  
**Alfred A. Levinson** *University of Calgary, Canada*

**G**LOBAL DIAMOND PRODUCTION statistics and projections for future sources and supply were the focus of this panel. Individual experts discussed production and exploration in the world's most important mining regions: Africa, Australia, Russia, and Canada. Minor producing areas—primarily in South America, India, Indonesia, and China—also were discussed.

#### Africa

**James Picton** reported that, in 1998, Africa accounted for 68.8 Mct—(60% by weight and 74% by value) of the approximately 114 Mct of rough diamonds mined worldwide. Botswana alone accounted for 17% by weight, and 29% by value of the total. Jwaneng and Orapa should produce for another 45 and 63 years, respectively, so Botswana will continue to be a major producer well into the 21st century.

South Africa, with its six major producing mines, presently contributes 9% by weight, and 17% by value, to world diamond production. The major pipe mines—Venetia, Finsch, and Premier—will produce for at least 30 more years. South African beach and marine producers Alexkor and Trans Hex account for only 0.3% of current world production by weight, but the value is exceptionally high (US\$275/ct and \$379/ct, respectively). Angola and Namibia account for 11% and 6%, respectively, of world production by value (but only 3% and 1%, respectively, by weight). The (Democratic Republic of) Congo (formerly Zaire) accounts for about 27% of the world's dia-

monds by weight, but only 6% by value (average \$14/ct). Minor production also comes from Tanzania and certain West African countries, mainly Guinea, Ghana, and Sierra Leone.

Mr. Picton expects Africa to become even more important in the next few years. For 2005, he forecasts world rough diamond production at 122 Mct, with Africa accounting for 75% of this total both by weight (91.9 Mct) and value (average \$81/ct). The increase of 23.1 Mct (above the 68.8 Mct in 1998), will come mainly from Angola, Botswana, and South Africa. At present, De Beers's (including Centenary) African production accounts for 28% of the world total by weight and 50% by value; in 2005, these values are projected to be 50% and 45%, respectively.

#### Australia

**Dr. Bram Janse** concentrated on the Argyle mine and its huge production during the last 15 years: over 500 Mct from the pipe, and 40 Mct from nearby alluvial sources. For each of the last seven years, Argyle has produced an average of about 40 Mct, equivalent to 35% of the world's annual production by weight. On the basis of present ore reserves and the planned expansion of the pit, production is anticipated to continue through 2005. Future underground exploration could enable Argyle to stay active until 2009.

After years of exploration, Ashton Mining discovered the diamond-bearing Merlin kimberlite field, consisting of 12 small pipes, in the Northern Territory about 600 miles (960 km) east of Argyle. Now active,

the mine is expected to produce for about five years. Production will be small (150,000–300,000 ct/yr), but the diamonds are of good quality. Merlin's mostly colorless, well-crystallized diamonds are worth about US\$150/ct, whereas Argyle's brownish and poorly shaped stones are worth about \$8/ct on average. Exploration is continuing in various parts of Australia.

### Russia

Uri Okoemov presented a detailed account of the diamond industry in Russia, starting with the establishment of the mines and polishing factories in the 1960s. Russia currently accounts for more than 20% of world diamond production by weight and is second only to Botswana in total value of rough. Russia's polished production in 1997 exceeded US\$700 million, so that it is now the world's fifth largest diamond manufacturing country.

Almost all (98%) of Russia's rough diamond production comes from the Republic of Sakha (Yakutia) and is controlled by Alrosa. This government agency sells the rough diamonds on the world market and also distributes them to designated Russian cutting factories. About 97% of the polished production is exported.

It is estimated that Russia will eventually produce 2.5 times more rough than at present, with Yakutia accounting for more than 40% of this amount. The remaining 60% will come primarily from Northern European Russia (e.g., the Arkhangelsk region) and southern Siberia. New sources include: the Yubileynaya (Jubilee) pipe, opened in 1996; the Internationalaya pipe, the first underground diamond mine in Russia, scheduled to start production in 1999; and Botuobinskaya and Nyurbinskaya, two major pipes in Yakutia that are scheduled to begin operations in 2000 and 2002, respectively.

### Canada

James Rothwell discussed the world's newest diamond-producing country. Particular emphasis was on the Ekati mine in the Northwest Territories (NWT), which officially started production in October 1998. It has the potential to supply 4% of the world's diamonds by weight (up to 4.5 Mct annually) and 6% by value; reserves are sufficient for at least 25 years.

The Panda pit is the first of five kimberlite pipes that eventually will be mined at Ekati. It cost about US\$700 million to bring the Ekati mine to produc-

tion, including exploration. The mine is a joint venture between BHP Diamonds Inc. (51%), Dia Met Minerals Ltd. (29%), C. E. Fipke (10%), and S. L. Blusson (10%). BHP Diamonds will distribute 35% of its production through De Beers and 65% through BHP's own offices in Antwerp.

The outlook for additional diamond mines in Canada is promising. More than 300 kimberlites have been identified in the NWT alone. Diamond exploration activity is under way in the NWT by other companies at several promising kimberlites, notably Diavik, Jericho, Snap Lake, and Kennady Lake. Kimberlites have also been found in other parts of Canada. It is estimated that Canada will supply about 10% of the world's rough diamonds by early in the 21st century.

### Other Sources

Dr. Alfred Levinson discussed those diamond-producing countries not covered by the other panelists—each of which contributes < 2% of current world production. The six countries in this category are Brazil, Venezuela, Guyana, India, Indonesia, and China.

In the South American countries, mining is confined to alluvial deposits on the major rivers, for which the primary sources are largely unknown. Brazil is the most important of these, with up to 2 Mct mined annually in recent years, mostly from the states of Roraima (in the north) and Mato Grosso (in the southwest). Brazil has at least 600 known kimberlite and lamproite pipes. Although many are diamond bearing, none is economic at present. Considerable exploration activity is in progress.

Closely associated with the Brazilian alluvial diamond production in Roraima are deposits, also alluvial and of unknown primary source, in adjacent parts of eastern Venezuela and Guyana. Alluvial diamonds are also mined in the Guaniamo district of western Venezuela. The source of these diamonds has been traced to uneconomic Precambrian kimberlites. In recent years, Venezuela and Guyana have produced annually up to 500,000 ct and 50,000 ct, respectively.

The remaining countries have only limited production at present: India (~25,000 ct/yr), Indonesia (~10,000 ct/yr), and China (~50,000–180,000 ct/yr). Exploration for diamonds in each of these countries is either planned (India) or of minor significance (Indonesia, China) compared to that in other localities.

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# Manufacturing and Marketing Diamond Jewelry in the 21st Century

## PANELISTS

- Anna Martin** *ABN AMRO Bank, New York*  
**Edward Bridge** *Ben Bridge Jewelers, Seattle, Washington*  
**Sheldon Kwiat** *Kwiat, Roisen and Ferman, New York*  
**Eve Goldberg** *William Goldberg Diamond Corp., New York*  
**Martin Gruber** *Nova Stylings, Van Nuys, California*

THE 21ST CENTURY will mark a revolution in the way diamond jewelry is manufactured and marketed. Banking practices, distribution channels, diamond reports, niche marketing, and evolving marketing opportunities will create a diversity of challenges and opportunities for the diamond jewelry industry. This panel of innovative businesspeople shared their views on these various aspects of the diamond jewelry industry, with one resounding conclusion: If the challenges presented are met with a balance of education, creativity, and business acumen, then more opportunities will be available than have been seen by any previous generation.

### Financial Perspective

**Anna Martin** described two key financial challenges facing the diamond jewelry industry in the new century. The first challenge is the shift of inventory responsibility from retailer to manufacturer. In the past, retailers paid cash for inventory in a relatively short time. Now these same retailers are demanding that manufacturers provide memo, bin stocking, returns, and marketing support—without an increase in manufacturers' margins. Second, the industry needs to reinvent itself. Vertical integration, with suppliers owning retail outlets and retailers owning manufacturing facilities, will become necessary. Retailers, faced with knowledgeable and cost-conscious consumers who have alternate sources for their jewelry needs, often must stretch credit terms to attract these consumers.

Mergers, acquisitions, and strategic alliances will strengthen the industry so it can meet these challenges.

The financial centers are very optimistic about the future of the industry, according to Ms. Martin, and they are proactively adapting their financing practices to meet its needs.

### Retailer's Perspective

**Edward Bridge** discussed the retailer's perspective on the five trends that will affect the gem and jewelry industry in the next century. First is the overall economy. Since 1992, a great economic boom has seen diamond sales flourish in the U.S.; however, business operates in cycles, and there is no way to know when the current situation will change. Second, there will be more competition and more distribution channels. Although only a small percentage of retail jewelers currently use the Internet, it represents a major shift in the way diamond jewelry is bought and sold. In addition, the Internet threatens to turn diamonds into a commodity. Approximately 80% of Web purchases provide "no smell, no feel" during the sales transaction. However, Mr. Bridge believes that, because of the nature of the product, people still will want to go to stores where they can touch, feel, and compare diamonds.

The third trend is the application of new technology to diamonds. Color and clarity enhancements will continue to affect the way diamonds are sold. Branding and designers are the fourth trend. Although brands cost more, this trend will differentiate diamonds and protect their integrity. The fifth and final trend is demographic change. Aging baby-boomers and the transfer of wealth to new generations are cre-

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ating increased opportunities for selling diamond jewelry. Retailers who recognize and address these trends will realize success in the new century.

### **Role of Diamond Reports**

**Sheldon Kwiat** provided a history of the diamond grading report and the opportunities that these reports present for future diamond sales. First introduced in 1955, diamond reports have become a staple in the '90s. The diamond report has changed the nature of the relationship between buyers and suppliers. At the same time, consumer awareness of reports poses challenges and offers opportunities. Sales associates must be educated and trained to recognize the strengths and weaknesses of a diamond report, and they must convey this information to the consumer. Mr. Kwiat noted that some retailers use reports to protect themselves from overzealous sales associates. Although reports differ from one laboratory to the next, with different grades, standardization is not practical or desirable due to the demands of local markets.

Mr. Kwiat predicted that reports will have an even greater impact in the future. In particular, there will be more emphasis on cut. Demand by consumers and insurers alike will increase, as will demand for additional services such as laser inscription with report numbers and brand names. With the threats posed by diamond substitutes, synthetics, treatments, and Internet fraud, there is a pressing need for trade associations to meet on the future of diamond reports in order to protect the consumer and the industry itself.

### **Marketing Fine Diamonds**

**Eve Goldberg** noted that greater consumer wealth provides opportunities to market high-quality diamonds and designs. While acknowledging the increasing importance of reports and lists, she emphasized that marketing in the 21st century need not be limited to these instruments. People are proud to sell a superior product, and they recognize that top cuts are created at a higher cost due to lower yields. The basic foundation of diamond jewelry sales is a well-made round-brilliant-cut diamond accentuated with a quality setting; it takes more creativity to sell fancy cuts. The Internet provides a sales forum for lower-quality diamonds. However, those who want high-quality diamond jewelry with top cuts will use the Internet for information only; then they will seek retailers in order to see, feel, and admire the diamonds. These



*Brand-name diamond jewelry, such as this Kwiat Couture by Robin Garin, will become more prominent in the 21st century. Jewelry courtesy of Kwiat, Inc.; photo courtesy of Platinum Guild International USA.*

consumers want to buy the best. Ms. Goldberg also predicted that there will be a return to romance in the future, which will provide new opportunities for manufacturers, suppliers, and retailers of diamond jewelry.

### **New Marketing Opportunities**

**Martin Gruber** questioned whether there is too much marketing opportunity. The Internet and advertising in all media create a great amount of stimuli. However, with more opportunities now than ever before, it could become difficult to recognize the ones that will work. Mr. Gruber also noted that the development of designer brand names, a crossover from the fashion industry, is only going to increase until designer brands become the norm. Baby-boomers with greater discretionary funds are seeking something different and unique. These consumers are now beginning to turn to artists for a less-commercialized, more-personalized new look. The limited distribution of these artisanal works provides the "uniqueness" sought by this consuming group. Manufacturers are being challenged to develop new setting styles, using a larger range of metals. Mr. Gruber called for balance between retailers, who have the ability to support limited product lines, and designers, who can deliver these products to the market.

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# The Role of Laboratory-Grown Materials In the 21st Century

## PANELISTS

**Thomas Chatham** *Chatham Created Gems, San Francisco, California*

**Hisashi Machida** *Kyocera Corp., Tokyo*

**Emmanuel Fritsch** *University of Nantes, France*

**Kurt Nassau** *Nassau Consultants, Lebanon, New Jersey*

**L**ABORATORY-GROWN MATERIALS have certainly contributed to the constantly evolving nature of the gem and jewelry industry. New materials, and new processes by which lab-created gems are made, present jewelers and gemologists with an ever-growing number of opportunities and challenges. The panelists shared their unique perspectives on this important topic by addressing the production and distribution of lab-created gems, their identification, opportunities that these gem materials represent, and some specific gems that may be created in the future.

### Opportunities with Luxury Synthetics

**Tom Chatham** was quick to point out that “change is happening all around us,” and that we should be alert to the benefits change can bring. As examples, Mr. Chatham mentioned inventions such as the light bulb and the telephone, which were not universally recognized as significant when they were first made public. Similarly, gems made in the laboratory have not always been appreciated. The opportunities for such materials, however, are growing tremendously. Lab-created gems provide a beautiful product with an attractive price tag. Mr. Chatham pointed out that the supply of some natural gemstones is simply not keeping up with demand. In addition, natural gems are subject to extensive manipulation, given the various treatments that exist today. Laboratory-grown materials have withstood the test of time, responded well to competition, and overcome the problems stemming from a lack of understanding of the material. Customers who are properly educated are choosing

lab-created gems. As technology continues to advance, the options available to consumers will increase, providing a wider variety of attractive alternatives to natural gemstones.

### Production and Distribution

**Dr. Hisashi Machida** addressed the topic of production and distribution from the perspective of Kyocera Corp., which first marketed Inamori-created emerald in 1975. Inamori now produces 12 varieties of created gem material: synthetic emerald, alexandrite, cat’s-eye alexandrite, blue sapphire, ruby, star ruby, pink sapphire, yellow sapphire, “padparadscha” sapphire, green chrysoberyl, white opal, and black opal. The synthetic emerald is produced using a flux method, the synthetic chrysoberyls and corundums by a combination of a flux process and pulling, and the synthetic opal by precipitating tiny silica particles in water. According to Dr. Machida, all of these materials are easy to identify with a microscope. They all have characteristic internal features, such as the veil-like inclusions and phenakite needles found in the lab-created emeralds. Dr. Machida called attention to the fact that Inamori synthetic stones are used in the creations of numerous jewelry designers. This jewelry is sold in traditional jewelry stores, department stores, catalogues, door-to-door, at exhibition fairs, and in 20 Kyocera retail stores. Loose Inamori synthetic stones are sold only by authorized dealers who are skilled in explaining the factors that set these gems apart from others. Various qualities are available, and they are graded using a system adapted from the GIA colored stone grading system.

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## Identification Challenges

**Dr. Emmanuel Fritsch** cautioned that, in the last decade, more attention has been paid to the detection of treatments than to the identification of laboratory-grown materials. Dr. Fritsch stated that “the best basis for the identification of synthetics is a keen sense of observation.” In those situations where observation and classical gemology are not sufficient, however, advanced instrumentation becomes essential. There are a number of such sophisticated tools and practices. UV-visible-near infrared absorption spectroscopy, for example, can be useful in detecting most synthetics, because they usually are more transparent to ultraviolet radiation than are natural gems. Other techniques that Dr. Fritsch mentioned are infrared absorption spectroscopy, X-ray fluorescence, and laser Raman microspectrometry. There also are instruments that are gem specific, such as the DiamondSure and DiamondView (developed by De Beers), which are used only to separate natural from synthetic diamonds. In the future, instruments will need to be developed or adapted to look at details that we cannot study at present. One such tool would be the ion probe, which detects impurities one or two orders of magnitude smaller than is possible with instruments commonly in use today.

## Future Synthetic Gemstones

In making his predictions for new synthetic gemstones of the 21st century, **Dr. Kurt Nassau** referred to actual developments that had come about since he had originally predicted them in his book *Gems Made by Man* (1980). One material that he predicted 20 years ago was gem-quality synthetic moissanite. This has become an important diamond simulant, with 14,000 carats shipped by the manufacturer in the first three months of 1999 alone. Dr. Nassau pointed out that there have been one or two significant new laboratory-grown gem materials every decade for the past 20 or 30 years. Laboratory-grown gem materials that have become more important in the past two decades include synthetic ametrine, synthetic red beryl, flux-grown synthetic red spinel, and synthetic diamond.

Dr. Nassau believes that we will continue to see the introduction of new synthetic gems, despite the fact that the “easy” synthetics already have been grown. Although in years past, certain individuals and companies set out to create gem materials for the jewelry industry, recent synthetics are “spin-offs” of technology focused on other industries, and this trend is likely to



*Synthetic moissanite (here, approximately 0.4–0.7 ct each) is one of the newest laboratory-grown materials to enter the gem and jewelry trade. Photo courtesy of Charles & Colvard.*

continue. Hydrothermal synthetic tourmaline and topaz may become available, but they probably will not be economically viable in the near future. Gems that are more likely to be synthesized commercially, according to Dr. Nassau, are malachite, jadeite, and nephrite. It is even possible that a truly synthetic pearl will be developed.

## From the Audience

During the question-and-answer session, it became apparent that there is real concern among jewelers and gemologists regarding the accurate and consistent identification of laboratory-grown gems. Dr. Nassau was asked if he thought synthetic tanzanite would ever become available commercially. He replied that it was unlikely, although Mr. Chatham said that his company has been considering the possibility. Another attendee wanted to know how large a synthetic emerald could be grown, presumably so that she could make certain assumptions about the identity of large emeralds that she might encounter. Mr. Chatham did not put her mind at ease when he responded that there is a Chatham-created emerald in the Smithsonian that weighs 14,000 ct. A rumor that synthetic moissanite could be treated in such a way as to make it isotropic was also questioned. The concerned party was assured that such a result is impossible.

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# The Leadership Role of Fine Jewelry in the 21st Century

## PANELISTS

- Thomas Gübelin** *The Gübelin Group, Lucerne, Switzerland*  
**Ralph Destino** *Cartier Inc., New York*  
**Helene Fortunoff** *Fortunoff, Uniondale, New York*  
**Henri Barguidjian** *Van Cleef & Arpels, New York*  
**Terry Davidson** *Asprey & Garrard, London*

TRADITIONALLY, THE WORLD'S finest jewelry houses have set the standards by which luxury goods are sold. They have defined merchandising trends, marketing and branding strategies, and customer service standards that the rest of the retail jewelry industry emulates. It is no wonder that the industry now looks to these houses for guidance regarding the future. Members of this panel addressed a number of key issues that affect the way businesses will be run in the 21st century. Among them are mass retailing, e-commerce, emerging technologies, and changing global markets.

### The Gübelin Group

**Thomas Gübelin** provided an optimistic analysis of the European luxury goods market. The current market is prospering as a result of the fall of the Iron Curtain and the consolidation of national economies. Today, 60% of the wealth is concentrated in the hands of consumers who are 50+ years old. About 70% of European households own jewelry, and the market has yet to approach saturation. There is a strong trend in women making purchases for themselves. Tastes tend toward the traditional and understated, with preferences for white metals, including stainless steel for watches. Diamond is the most popular gemstone, with aquamarine and tanzanite as popular colored stones. Mr. Gübelin has observed a change in the attitude of the European consumer, who now feels less obligated to hold on to inherited jewelry and is more apt to update or sell it. Competition is brisk, and low-end European retailers are now using dis-

counting as a means of differentiating themselves. Mr. Gübelin's advice to retailers is to use custom designs, quality guarantees, and customer service as the means to gain a competitive edge.

### Cartier

Despite somber predictions pointing to the Internet, catalog marketers, and mass merchandising as accomplices in the demise of the traditional retailing environment, **Ralph Destino** remains positive about the future. A high-end jewelry or specialty store can offer shoppers a pleasurable experience that is not duplicated by any other format—an inviting setting, a unique product, social interaction, and a sense of community. Mr. Destino also discounted the discounters, citing studies by both the Roper Group and the Mendelsohn Organization that show that the young American consumer is informed, responsive to products embodying craftsmanship and design integrity, and willing to pay a premium for top-quality, lasting merchandise. Regarding the Internet, Mr. Destino conceded that most luxury brands see it more as a threat than an opportunity. With the Internet comes the possibility of a gray market of goods offered at steep discounts, eroded brand images and prestige, ruptured distribution networks, and threats to established pricing structures.

### Fortunoff

**Helene Fortunoff** argued that rather than fine jewelry houses influencing the industry at large, business-at-large is now the "pied piper." She cited the roles

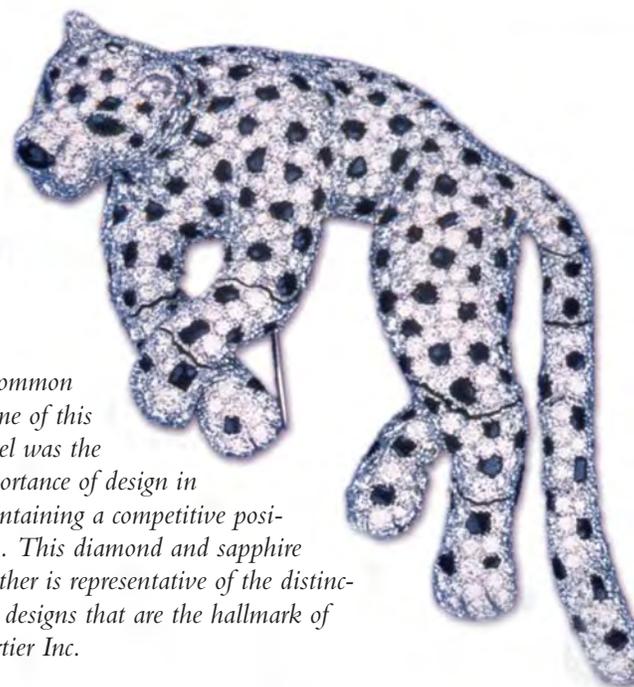
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that auction houses and e-commerce are playing in shaping the industry. The elaborate and expensive marketing techniques employed by auction houses have resulted in \$2 billion in turnover, with approximately \$700 million in fine-jewelry sales. Auction houses have successfully extended their market share into niches once solely occupied by retailers; and with the acquisition of Butterfield & Butterfield by eBay, auction houses are now extending their territory into cyberspace.

Another force to be reckoned with is electronic home shopping, which currently accounts for 12% of industry sales. With more than one-third of its programming devoted to 14K jewelry, the home shopping network QVC averages 270,000 customers per day. Unlike Mr. Destino, Ms. Fortunoff is a proponent of the powers of cyberspace to sell product and promote brand identity and message. Her company is currently rebuilding its Web site to include an online bridal registry, complete with catalog and online ordering capabilities. Plans for Fortunoff include “embracing new retail modalities to expand nationally without real estate” and courting “the new consumer . . . to overcome the competition’s simplistic dependence on price alone by extending the ‘Trust Fortunoff’ franchise.”

### **Van Cleef & Arpels**

**Henri Barguirdjian** recalled that the luxury goods market once catered only to the super-rich, but today this market does more business than ever before by appealing to a broader base. That is because jewelry continues to function as a universal symbol of love, and this will not change in the next millennium. The independent jeweler will continue to be the key contact in the transaction, providing the customer with a level of intimacy that is not found in other selling environments. Mr. Barguirdjian offered two key ingredients for business growth: integrity and creativity. Clients today are more informed about their purchases, but they are also more confused by the vast array of information available regarding products, treatments, and brands. Absolute disclosure about the product is essential, as is impeccable customer service. With shrinking margins in loose stones, the second ingredient for business growth becomes the creativity and originality of designs. The new breed of client is younger, and price is not an issue. These clients look



*A common theme of this panel was the importance of design in maintaining a competitive position. This diamond and sapphire panther is representative of the distinctive designs that are the hallmark of Cartier Inc.*

to jewelry as a status symbol, but it also must be fashionable, enjoyable, and adaptable to their lifestyles.

### **Asprey & Garrard**

**Terry Davidson** admitted that while Asprey & Garrard may have little name recognition in the U.S., his company represents the recent merger of two of the oldest purveyors of luxury products in the United Kingdom. With the two houses combined, Asprey & Garrard represents more than 400 years of custom work in leather, *objets d'art*, silver, and jewelry. Their in-house designers and workshops allow the firm to continue the production of one-of-a-kind goods. Today's customers are even more discerning than their predecessors were. Well-traveled and inspired by the different cultures they encounter, they bring their informed tastes to bear when selecting jewelry and other luxury goods. In a video clip, Mr. Davidson demonstrated Asprey & Garrard's recently launched branded diamond, the Eternal Cut, which is being offered in a range of jewelry styles. As world economies gain strength, the future for fine jewelry is promising. But to stay competitive, Mr. Davidson warned, “We must supply innovative product that is manufactured, merchandised, and marketed to the highest standard, and offer our clients a service that is next to none.”

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# Marketing Pearl Jewelry In the Next Millennium

## PANELISTS

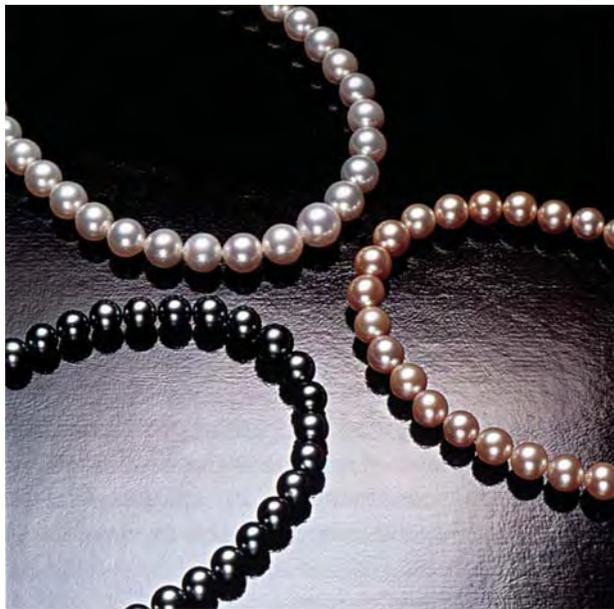
- Koichi Takahashi** *Mikimoto, New York*  
**Frank Mastoloni** *Frank Mastoloni & Sons, New York*  
**Eve Alfillé** *Eve J. Alfillé Ltd., Evanston, Illinois*  
**Gina Latendresse** *American Pearl Company, Nashville, Tennessee*  
**Ralph Rossini** *Honora Ltd., New York*

**T**HE PRESENTATIONS BY THESE PANELISTS seemed to have one theme in common: The pearl market is thriving. With the many varieties and price points of pearls today, there is something for all segments of the market in the next millennium.

### Strategy for the 21st Century

**Koichi Takahashi** began his presentation with a look back at the beginnings of the cultured pearl

*A wide variety of cultured pearls will provide exciting opportunities for consumers in the 21st century. These strands show some of the colors available for South Sea cultured pearls. Photo courtesy of Mikimoto.*



market. He retraced some of Kokichi Mikimoto's footsteps, from the first cultured pearl recovered by Mikimoto's wife Ume in 1893, to the pearls he gave to celebrities such as Marilyn Monroe. Mr. Takahashi explained how Mikimoto's promotions still incorporate these celebrities and reported that the company's plans for the future include also selling gift items such as pens, scarves, vases, and watches. Quality, craftsmanship, design, and artistry are all important in the promotion of pearls today and will be important in the future.

### The Benefits of Quality

Among the first to market cultured pearls in the United States was **Frank Mastoloni**. In the 1950s, natural pearls were hard to come by, so he decided to enter the cultured pearl market. It was a great alternative to imitation pearls, as the cultured pearls were actually grown in the sea. Mr. Mastoloni described the many products available today, including Chinese freshwater, South Sea, and Tahitian cultured pearls—and how these products can be promoted to all market segments. There are fine-quality pearls in all varieties. He emphasized the importance of product knowledge, noting that if different qualities are explained to customers, they will choose the better-quality goods. In closing, Mr. Mastoloni offered the maxim "Quality is long remembered after price is forgotten."

### Importance of Design

**Eve Alfillé** predicted that designer pieces will play an important role in preventing cultured pearls from



*“Specialty” pearls add a distinctive look to creative Jewelry designs. This brooch, “Earth’s Twilight” by Nina Ward, features an American cultured Domé pearl with emerald-cut tourmalines (0.25–1.88 ct) from Brazil, 3 mm Maine tourmalines, and diamonds. Photo courtesy of American Pearl Co.*

becoming a commodity in the next millennium. Before the new varieties of cultured pearls became more readily available, Akoya cultured pearls dominated the market. Designs were very basic: round pearls made into strands and stud earrings. According to Ms. Alfillé, the retailer should entice the customer into purchasing all of the different types of cultured pearls now available. Tying in pearl designs with clothing fashions will help increase sales. Designer showpieces enhance the prestige of cultured pearls and attract the upscale customer.

### Specialty Products

There is great versatility in cultured pearls today because of the many varieties of mollusks in which they are cultivated. But in her presentation, **Gina Latendresse** went beyond the Akoya, Chinese freshwater, South Sea, and Tahitian varieties. Other additions to the mix include natural abalone pearls,

conch "pearls," melo melo "pearls," American natural and cultured pearls, Domé pearls and, cultured mabé pearls from French Polynesia, Mexico, and New Zealand. Ms. Latendresse emphasized that offering this expanded palette of pearl colors and shapes will keep the retailer's business fresh.

### The Chinese Products

“The pearls of the future”: new shapes, new colors, and—best of all—affordable. If you were to ask **Ralph Rossini** what that statement describes, he would not hesitate to answer, “Chinese freshwater cultured pearls.” Today, a larger audience can own thick-nacred, good-luster pearls at a lower price point. These products come in a wide variety of colors, shapes, and sizes, thus allowing for new, fashionable creations. During his presentation of a recent trip to the pearl farms in China, Mr. Rossini showed one mollusk that was being implanted with enough pieces of mantle tissue to yield about 40 cultured pearls. China's production for the present year is projected to be approximately 1,500 tons. If the Chinese pearl farms continue to produce at this rate, there certainly will be sufficient supply as we move into the new century.

*Sales of fine-quality pearl jewelry, such as this parure featuring white South Sea cultured pearls, are enhanced through product knowledge. The cultured pearls in the earring and the ring are approximately 13 mm in diameter; photo courtesy of Mikimoto.*



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# Critical Issues in the 21st Century

## PANELISTS

**Matthew Runci** *Jewelers of America, New York*

**James Marquart** *Manufacturing Jewelers and Suppliers of America, Providence, Rhode Island*

**Douglas Hucker** *American Gem Trade Association, Dallas, Texas*

**Robert Bridel** *American Gem Society, Las Vegas, Nevada*

**Eli Izhakoff** *J. Izhakoff & Sons, New York*

**T**HIS PANEL OF LEADERS from key segments of the industry examined various critical issues that face the retail and guild jeweler, jewelry manufacturer, and diamond or colored stone dealer. Although the specific challenges presented by each panelist differed, they seemed to share a number of common themes, especially the need to build and maintain the industry's image, to improve staff and customer education, and to embrace or prepare for the inevitable change that the 21st century will bring.

### Retail Jewelers

The retail jeweler, standing directly on the front line, must demonstrate professional core elements to succeed in the new century. **Matthew Runci** cautioned that the ability to gather unlimited information from the Internet without an informed perspective, combined with the possibility of diluted branding, could ultimately confuse the consumer. Mr. Runci went on to outline a three-tiered "Millennial Strategy" for the retail jeweler.

1. *Integrity*: The retail jeweler must behave ethically and follow rules of professional conduct. Jewelers must make sound judgments and ethical decisions when confronted with business dilemmas.
2. *Knowledge*: Jewelers must make a lifelong commitment to career development with continuing

education not only for themselves, but also for their staff members and their customers.

3. *Skills*: A jeweler's skills are his or her livelihood, and each jeweler must enhance those skills and develop a qualified staff, through testing and certification.

### Manufacturing Jewelers

In the United States, manufacturing jewelers today face some of their most difficult times ever. **James Marquart** reported that many U.S. firms have lost nearly one-third of their workforce, which has resulted in a reduction in domestic and global market share for these organizations. The key to the success and regrowth of this segment in the coming millennium lies in several critical areas. One focus must be on helping the industry sell its products, which in part is being addressed through consumer advertising campaigns that include consumer magazines, billboards, and co-op pieces with clothing manufacturers and retailers. Another key is to overcome United States trade policies that have hindered the ability of manufacturing jewelers to distribute their products to the world market. Mr. Marquart reported that MJSA is working with the U.S. government to draft a new international trade policy that will reduce or eliminate many current tariff-based trade barriers and level the playing field for the U.S. manufacturing jeweler.

### Colored Stone Dealers

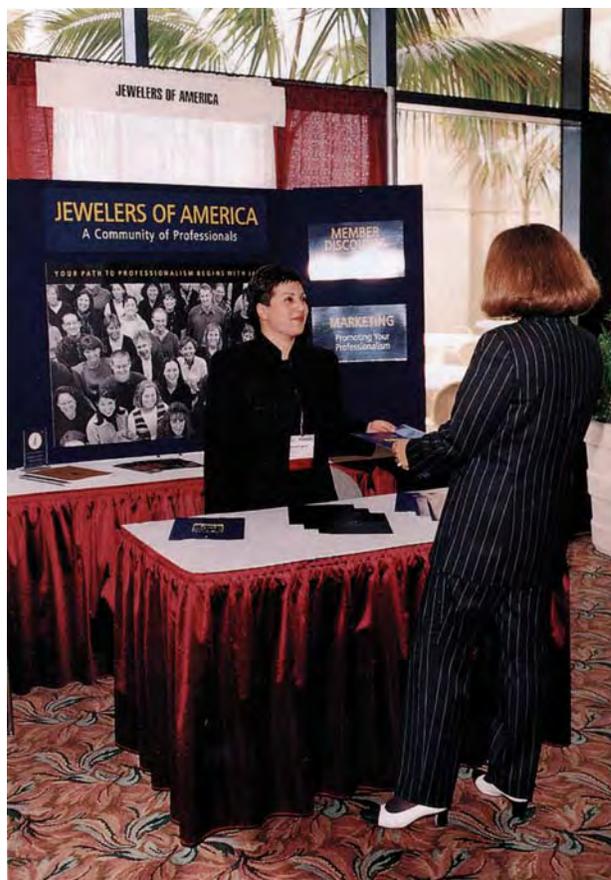
The technological and ethical challenges facing the colored stone market are certainly not news, but advances in treatments and synthetics continue to emerge at a record pace. **Douglas Hucker** stressed that ethics regarding disclosure, and education to stay on top of technology, will guarantee the success of colored stone dealers and retailers in the future. Mr. Hucker also added that today's consumer, being more informed about colored stones, is looking to make a more serious colored stone jewelry purchase. It is still up to the colored stone retailer, however, to fill in the information gaps, and to promptly answer the variety of questions that consumers are sure to ask. Every salesperson must have the education to answer technical questions, but it is equally important to promote and maintain the beauty and romance of colored stones, which are what attract the customer in the first place.

### Guild Retailers

**Robert Bridel** provided valuable insight into how guild retailers can elevate their businesses through innovative marketing, the use of available technology, and customer service. Some of the marketing strategies Mr. Bridel proposed include one-on-one marketing to individuals, the implementation of nonjewelry events—such as concerts or book readings—to bring potential new customers into a store, and adherence to strict standards for advertising and pricing. The use of new technology could promote and support a business. For example, a Web site can show product samples or even sell products, profile customers on-line, or strengthen operations and management internally. Mr. Bridel suggested that the jeweler “make a friend of every potential customer,” then pamper those customers with personalized service and clear, reasonable selling practices.

### Diamond Dealers

A positive light was shed on the state of the diamond industry by **Eli Izhakoff**, former head of the World Federation of Diamond Bourses. Mr. Izhakoff reported that supply and demand for diamonds seems to be running hand-in-hand, with Far East markets experiencing a resurgence. He cautioned, however, that the large diamond companies will become even larger in



*Trade organizations not only foster business integrity, but they are also a source of knowledge for staff members and their customers alike.*

the new millennium, and that small and medium-size businesses will need to face the likelihood of shrinking distribution channels, or ultimately they will risk elimination. He further stated that although there are new critical issues facing diamond dealers, this resilient industry has regularly thrived in the face of seemingly insurmountable challenges. Laboratory grading reports and price sheets, which were rejected in the 1970s and '80s, have now become almost indispensable tools. The new challenges seem to be treatments and processes, as well as the trend toward diamond branding. Mr. Izhakoff believes that the industry will respond accordingly and learn to accept—and even embrace—the changes on the horizon.

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# Marketing Opportunities in the 21st Century

## PANELISTS

**Susan Jacques** *Borsheim's, Omaha, Nebraska*

**Leopoldo Poli** *La Nouvelle Bague, Florence, Italy*

**Andrew Johnson** *The Johnson Family's Diamond Cellar, Dublin, Ohio*

**Scott Kay** *Scott Kay, Inc., Hackensack, New Jersey*

**Laurence Grunstein** *Citizen Watch Company, Lyndhurst, New Jersey*

AS WE MOVE INTO THE NEW millennium, jewelers want to know where the best prospects will be found for new products, greater market share, and—of course—increased sales. This spirited panel looked at maximizing opportunities in five key categories: colored stones, gold jewelry, diamonds, platinum, and watches.

### Colored Stones

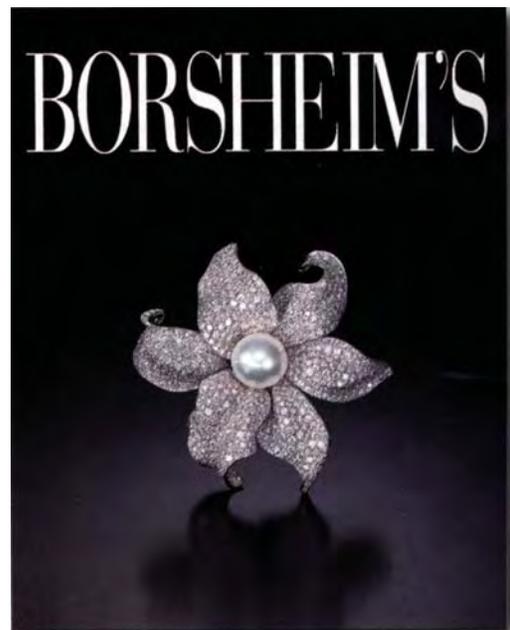
What tools are available to make customers more aware of, and comfortable with, colored stones? According to **Susan Jacques**, a well-trained sales staff and the use of the Internet can both inform and sell. Today, attractive catalogs can serve many purposes: in-store use, direct mail, and even an electronic version on your company's Web site. Her experience has shown that: (1) educated customers are far more likely to make a purchase, (2) customers will sometimes become fascinated about treatment processes rather than consider them a negative, and (3) beauty is often more important than whether the gemstone being offered is one of the "big three" (ruby, sapphire, or emerald). Because of the greater interest in, and availability of, many colored gems, they will continue to be important in the future.

### Gold

Referring to an item of jewelry as a contemporary design simply because it is manufactured in the present is both unfortunate and inappropriate, according to **Leopoldo Poli**. He prefers to assimilate the most

profound and significant events, emotions, behavior, music, and the words of the time in which we live—and then recreate them in a stylized figure. Thus, the jewel truly reflects the period in which it was created. This is accomplished by innovation, which he describes as ably interpreting and expressing the high

*Attractive promotional materials make useful marketing tools. At Borsheim's, the jewelry catalog is available for in-store use, as well as through direct mail and on the Internet. Photo courtesy of Borsheim's.*





*Consumer preference for beauty is contributing to the popularity of colored gemstones other than ruby, sapphire, and emerald. The 18K white and yellow gold rings shown here were designed by Jean-François Albert, and feature aquamarine, yellow beryl, tanzanite, pink and green tourmaline, and amethyst—some of which are accented with diamonds. Innovative designs, such as the “SignatureFit” self-sizing mechanism in these rings, enhance customer satisfaction. Photo courtesy of Jean-François Albert.*

est values of our time, not by repeating stylistic codes. Ultimately, the designer needs to be the creator of customer satisfaction.

### **Diamonds**

A common theme found in **Andrew Johnson’s** presentation was the importance of modern technology in the future of marketing diamonds. Expanding markets in Asia, India, South America, and Eastern Europe can be reached by means of the Internet, telecommunications, and overnight shipping. By using various combinations of traditional and modern marketing techniques, the retailer can reach all generations of consumers. In addition, use of demographics makes it easier to track customer lifestyles and life events for which diamonds can be packaged. As diamonds become more of a commodity and profit margins continue to shrink, massive amounts of information will be needed to remain competitive in the future.

### **Platinum**

From a fad to a trend: **Scott Kay** traced the recent popularity of platinum jewelry from the 1980s, when jewelry was primarily all yellow; to two-tone jewelry

(50/50); to white metal with little yellow accents; to the all-white platinum jewelry that we’re seeing today. “Platinum is to metal what diamonds are to gemstones” was repeated throughout his presentation. He credited the bridal market with “driving the fashion end of our business.” In Mr. Kay’s opinion, white metal will overtake yellow as the color of choice in the 21st century.

### **Watches**

According to statistics offered by **Laurence Grunstein**, last year approximately one in four Americans bought a wristwatch. Narrowing the discussion to watches over \$50, he reported that 17.6 million such watches were sold in the U.S. in 1998, with jewelry stores responsible for approximately 40% of these sales. These numbers are expected to increase as jewelers take advantage of brand recognition, product training, customer support, point-of-sale materials, customizable displays, advertising, and co-op advertising. For most jewelry stores, Mr. Grunstein recommended that they carry five or six watch brands that do not overlap one another and that best fit the customer profile of their store.

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# The Importance of Electronic Networking in the 21st Century

## PANELISTS

**Jacques Voorhees** *Polygon Network, Dillon, Colorado*

**Martin Rapaport** *Rapaport Diamond Report, New York*

**Fred Mouawad** *Precious Link, Bangkok*

**Dona Dirlam** *Gemological Institute of America, Carlsbad, California*

**Richard Drucker** *Gemworld International Inc., Northbrook, Illinois*

**The Internet, a New Distribution Channel**  
Citing recent research conducted by the Gannett Group of newspapers, **Jacques Voorhees** noted that 83% of U.S. consumers plan to buy *something* online in the next 12 months. He added that electronic commerce revenue could swell to as much as \$3.2 trillion in 2002. Against this statistical backdrop of extraordinary growth, Mr. Voorhees described the three basic types of jewelry Web sites now online:

- Information-only Web sites, where no actual commerce is conducted.
- Commerce sites directed to the consumer, with searchable databases that list certificate specifications and pricing information.
- Commerce sites restricted to the trade only. Trade passwords are required to access these sites, a measure designed to protect the retailer.

Traditionally, products were warehoused and sold locally at the point of sale. This arrangement accommodated the immediate transfer of money and merchandise, as well as any first-hand product knowledge that was needed. Along with the advent of overnight delivery service and payment by credit card, the Internet has transformed the traditional distribution system in all industries by making the ordering, payment, and delivery processes almost instantaneous.

Mr. Voorhees emphasized that the physical store will never disappear altogether. Some consumers will continue to shop in the traditional store as long as concerns exist over credit card security and the reliability of online product information. The retailer

must keep these shoppers coming to his or her store, all the while taking steps to evolve in an Internet environment. Retailers, too, can use the Internet for sourcing, which will lower their own cost of goods.

### The Power of a Virtual Marketplace

Despite the unprecedented growth of the digital economy, **Martin Rapaport** believes that we have only witnessed the beginning of an Information Technology Revolution. This revolution promises to bring about a historic shift in society, economics, and virtually every aspect of our lives. In fact, what we are seeing now is so powerful that none of us fully realizes how big it is. The spectacular growth of high-tech stocks is only the first indication of a massive economic shift in the balance of power.

According to Mr. Rapaport, having your company's products or product information available on the Web is no longer optional. Denying your company an online presence, he warned, is comparable to taking down your sign from a storefront, or removing your company's listing from the phone book. He advised being careful with how the information is used—think about it strategically, and incorporate it into every aspect of your business. While information is power, he explained, *well-managed* information is even more power, and information that is used to reach out and market is awesome power.

In closing, Mr. Rapaport predicted that the Internet's single most profound impact will be to reduce the cost of retailing. He urged the audience to take advantage of "the greatest opportunity that has ever come to the diamond industry."

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## The Benefits of Network Interaction

Fred Mouawad encouraged traditional retailers to use *online networks* to compete with the new breed of virtual retailer, the “giants.com” who are eroding retail margins by buying directly from manufacturers and selling directly to consumers. Mr. Mouawad defined a network as an information service that is accessible through connected computers and provides a medium for trading and information exchange. By using the resources of an online network, retailers can centralize their entire stock and offer it to a worldwide audience “just in time.” The resources of a network include:

- **Community**—Members are encouraged to share information. Forums are available for voicing opinions, asking questions, and making contacts.
- **Trading**—Inventory is readily available and can be uploaded immediately.
- **Directory**—Members are able to find people, searching by product category, region, or company name. The directory allows the retail store to broaden both its customer base and its supplier base.
- **Services**—Members are offered a news center that keeps them informed about the industry, as well as advertising services.

Mr. Mouawad recommended that retailers check with their various trade associations to see how they are participating online.

## Evaluating the Message and the Messenger

A more democratic flow of information exists today than ever before. While this is undoubtedly a positive aspect of the Internet, **Dona Dirlam** cautioned that we face the increasing difficulty of assessing these countless layers of information. Accordingly, Ms. Dirlam presented the following strategy for *information evaluation*:

- What is the purpose of the information that is provided on a particular Web site? Is it intended to inform or to sell?
- How up-to-date is it? Timeliness can be critical. Check the date of the site, and the dates on the information given.
- Is the Web site more useful and efficient than other resources (e.g., a reference librarian)?

Ms. Dirlam also offered some perspective for *information providers*:

- Keep in mind your audience, and the purpose of your Web page. Remember to check grammar and spelling.
- Copyrights: In the Information Age, how do you maintain rights to information? Copyright laws have been strictly enforced in the past, but will that hold true in the 21st century?
- The conservation and archiving of information will take on an even more important role. Where will all of this information be 50 years from now?

## Integrating Traditional Media and Networks

The ability to provide more information to customers is the best use of the Internet, according to **Richard Drucker**. Pure information is usually the first reason a person goes to the Internet; purchasing is secondary. Although Web sites are capable of providing much more information than single-page magazine ads, for instance, Mr. Drucker recommended using traditional media to get people to your site. Magazine ads should always list the Web site. Banner advertisements and links from other Web sites are effective ways of drawing people to your own. Likewise, selling advertising space on your own site is a good source of revenue.

Mr. Drucker pointed out that developing a corporate Web site can be relatively easy and inexpensive. A company can develop a Web site on its own, or else it should set aside some money from its budget. In his opinion, money spent on the Internet is the most cost-effective investment a business can make. The site itself does not have to be sophisticated—but it *does* need to be up-to-date, so that visitors will have a reason to return.

Once people reach your Web site, it is important to keep them there. To do this, Mr. Drucker recommended that companies use a clear and simple screen design. Keep in mind the *60-second rule*: You only have one minute at the most to keep people interested.

Acknowledging the widespread flow of misinformation via the Internet, Mr. Drucker recommended using this problem to your advantage by openly addressing it for your customers. Doing so gives you an excellent opportunity to educate them and earn their trust.

## Branding War Room

### PANEL

**Elizabeth Chatelain** *MVI Marketing Ltd., Los Angeles*

**Sheldon David** *W.B. David & Co., New York*

**Esther Fortunoff** *Fortunoff, Uniondale, New York*

**Eli Haas** *Diamond Dealers Club, New York*

**Scott Kay** *Scott Kay, Inc., Hackensack, New Jersey*

**Steven Lagos** *Lagos Inc., Philadelphia, Pennsylvania*

**Al Molina** *Molina Fine Jewelers, Phoenix, Arizona*

**Glenn Rothman** *Hearts on Fire, Boston, Massachusetts*

### MODERATOR

**Whitney Sielaff** *Publisher, National Jeweler*

With few exceptions, the use of product branding as a key marketing tool has been a relative latecomer to the fine jewelry industry. Unlike luxury watches, for example, which appeal to consumers largely by manufacturer name, gems and precious metals have traditionally engendered desire through their own inherent qualities.

Product branding in fine jewelry has developed with the emergence of "designer" jewelry. The heightened consumer recognition of designer brands, such as those of New York's David Yurman or session panelists Stephen Lagos and Scott Kay, has spawned a new wave of companies seeking to echo their success.

At the heart of the issue in the jewelry industry is what appears to be a conflict between branded product and efforts by individual retail jewelers to establish themselves—their own store names—as the principal brand. This sets the stage for potential confusion within the minds of consumers in instances such as print or televised advertisements. A retailer may be faced with weighing the relative importance of its own name vis-à-vis a name product when determining which angle to emphasize.

The principal bone of contention in jewelry branding arose when Scott Kay intimated that perceived image, perhaps to the elimination of all other factors, is of utmost importance. Other panelists quickly rallied to the concept of product quality as being necessary for establishing and maintaining a

name brand. Essentially, they argued, a product must distinguish itself from others in intrinsic value before consumers will buy into it. Cartier's Ralph Destino described a brand as a company's signature pledge of quality—a solemn, mutually understood contract between buyer and seller.

However, finished jewelry was not the main area of interest among the audience. Over the past two years, there has been virulent debate concerning efforts by De Beers to brand loose polished diamonds. Moderator Whitney Sielaff briefly outlined the history of these efforts. London-based De Beers has been providing and promoting "De Beers" diamonds at a several-unit retail chain in England under a pilot program that was announced in January 1999. The distinction of these branded diamonds lies in advertising and a microscopic inscription on their tables that can be read only with high magnification.

Recently, De Beers launched a global initiative involving similarly "branded" stones that are sold as a "limited Millennium edition." A dozen or so carefully selected De Beers customers have received the privilege of selling these stones, which appear to be fetching a generous premium. Diamond dealers such as panelist Sheldon David have reported sell-through of their entire inventories, even before they have received the goods.

Many in the diamond community see the Millennium diamonds as a test of the salability of the De Beers name in America, the world's largest con-

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suming market for gem diamonds. Panelist Eli Haas argued that such efforts by De Beers could eventually divide the trade into “haves” and “have-nots.” Essentially, a small group of selected De Beers customers could control the De Beers diamond franchise, while all other dealers wallow in a second-tier market of nonbranded product.

The two-hour session fell far short of exhausting the topic of branding. In the end, however, it appeared that the gem and jewelry industry is stoically embracing the belief that change of this nature is imminent. Suppliers and retailers alike will find themselves in a position where survival demands evolution.

“In the end, it all comes down to the customer: What the customer wants, what the customer is demanding. And the customer is asking for brands—brands to give them confidence, brands to give them consistency.”

—Glenn Rothman

“I think that branding is an excellent idea—for De Beers. For the rest of us in the industry. . . I think it spells a tremendous disaster.”

—Eli Haas

“I certainly think that while De Beers has a brand name that is about mining, or diamonds, or love, I’m not sure that they have a brand of diamond that anyone associates with the product.”

—Esther Fortunoff

“Most of you think you have a brand, and the reality is you don’t. A brand is the instant ability to identify with and about a name. For example, if I said, ‘Coca-Cola,’ almost everybody in this room could either taste it, smell it, visualize the can it comes in, visualize the last time they bought it.”

—Elizabeth Chatelain

“Everybody’s obsessing about De Beers, but the last I heard this is America, and it’s the land of competition. What’s to stop all of us from making one brand and another brand, and 20 or 30 brands. It doesn’t have to be a De Beers brand. Why are we so afraid of De Beers?”

—Sean Cohen,  
Rand Diamond Cutting Works

“De Beers is not saying that they’re going to brand every diamond. They are lending their name, their integrity, to a diamond of a special quality and a special color, which they feel will . . . bring a value added to their product that [retailers] will be able to sell in their stores.”

—Sheldon David

“I challenge anybody in this room to tell me that they don’t make money on David Yurman. The product sells, it turns out the store.”

—Scott Kay

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# Appraisals War Room

## PANEL

- Cos Altobelli** *Altobelli Jewelers, Hollywood, California*  
**Anne Blumer** *State Farm Insurance Company, Bloomington, Illinois*  
**Al Gilbertson** *Gem Profiles, Albany, Oregon*  
**Ralph Joseph** *The Jewelry Judge of Princeton, Princeton, New Jersey*  
**Anna Miller** *Master Valuer Program, Pearland, Texas*  
**Don Palmieri** *Gemological Appraisal Association, Pittsburgh, Pennsylvania*  
**Kirk Root** *Kirk Root Designs, Austin, Texas*  
**Joseph Tenhagen** *Joseph Tenhagen Gemstones, Miami, Florida*

## MODERATOR

- David Federman** *Executive Editor, Modern Jeweler*

**M**oderator David Federman kicked off the War Room by asking the panel to name the biggest problem (from a consumer perspective) in appraisals today. The overwhelming consensus was that using overvalued appraisals—particularly overstating color and clarity—as a sales tool is the most significant problem. Al Gilbertson and Cos Altobelli, however, cited a lack of formal education on the part of some appraisers. Ralph Joseph countered, “Ignorance can be cured much more easily than chicanery. What offends me and what I think is disgraceful in this industry is when the appraiser

knows better and puts together an organized deception against the public.”

After Anna Miller, Joseph Tenhagen, Anne Blumer, and Kirk Root related “horror stories” of grossly inflated appraisals, the role of insurance companies emerged as a topic of debate. From the audience, Gary Wright contended that jewelry stores, appraisers, labs, and insurance companies are “co-conspirators” in the inflated appraisal. Ms. Blumer denied the accusation, stating that agents, underwriters, and claims representatives are not gemologists—rather, they must rely on jewelers and appraisers for accurate information. Ms. Blumer mentioned an in-house training program currently in development at State Farm Insurance that would establish appraisal and appraiser criteria for company employees.

A turning point came when Cecilia Gardner of the Jewelers Vigilance Committee rose from the audience to speak on the enforcement of ethical standards for appraisers. Describing the disciplinary code she is subject to as an attorney and a member of the bar, she endorsed the establishment of a bar-like governing board through which the appraisal industry would police itself. The plan received widespread support from War Room participants and audience members, and the closing discussion turned to the topic of the educational standards that should be set by such a governing body. Most agreed that the standards already exist, but the more difficult matter is enforcing them throughout the appraisal industry.

*Ronald Harder outlines Jewelers Mutual Insurance Company's policy on accepting appraisals.*



“Every small Israeli jeweler knows that Princess cut will be bought probably 40% less than the list, and then—very naively—three times this value will be put on top to try and sell it. In my opinion, that is not fraud. . . . If you don’t give guidelines to the industry, you will never solve the problem.”

—*Menahem Sevdermish, Menavi International, Ltd.*

“I’m not in the insurance business, but insurance is a business. They don’t want to reject a lot of appraisals. In many cases, the value is what they use to assign premiums. So they’re normally not too concerned unless it looks outrageous. It’s a business.”

—*Joseph Tenhagen*

“The courts are friendly to consumers, and if they knew what was going on in our industry they would not be very friendly to us at all.”

—*Don Palmieri*

“The final proof comes when you have a claim. In our case, what we do is replace it with the jeweler who sold it, and that helps create this bond between the customer and the jeweler. We really don’t have that many problems with the appraisals that we receive, but we do question quite a few.”

—*Ronald Harder, Jewelers Mutual Insurance Company*

“We have inflated credentials. We have inflated grades, and we have inflated appraisals. How much fraud do we want to perpetrate on the consumer before we lose all of their confidence? These exposés could run every night.”

—*Don Palmieri*

“The minimum is appraisal theory and practical knowledge in our field. There’s no question that there are people appraising today who don’t have a clue about gemology.”

—*Al Gilbertson*

*Cecilia Gardner:* “Is it ever ethical for a jeweler who sells a jewelry item to also provide to that consumer a document called an appraisal?”

*Kirk Root:* “I’m a manufacturer, and I have copyrighted items. Nobody is more qualified than I am to appraise that piece, because I sell it every day for a certain price. That piece is appraised for exactly what it’s sold for at the retail price.”

“The only time we’re going to clean up the situation is if you can’t practice appraising unless you’re empowered to do so by a bar society. The word ‘appraisal’ should belong to the profession, and not to the practitioners.”

—*David Federman*

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## Diamond Cut War Room

### PANEL

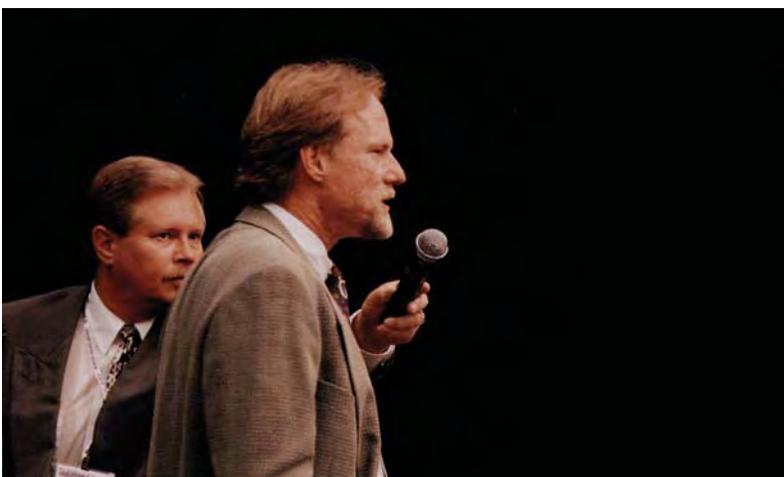
- Eric Austein** *Leo Schachter Diamonds, New York*  
**Al Gilbertson** *Gem Profiles, Albany, Oregon*  
**William Goldberg** *William Goldberg Diamond Corp., New York*  
**Niels Ruddy Hansen** *Niels Ruddy Hansen Aps, Brøndby, Denmark*  
**Ilene Reinitz** *GIA Gem Trade Laboratory, New York*  
**Robert Speisman** *Lazare Kaplan International, New York*  
**Richard von Sternberg** *Eight Star Diamond Co., Santa Rosa, California*

### MODERATOR

**Chaim Even-Zohar** *Publisher, Mazal U'Bracha*

Moderator Chaim Even-Zohar opened the War Room with a brief background discussion of Marcel Tolowsky's calculations of "ideal" proportions, and the implications of GIA's 1998 diamond cut study (*Gems & Gemology*, Vol. 34, No. 3, pp. 158–183). His first question was for Dr. Reinitz: "Apparently GIA has reversed itself [on Tolowsky] . . . Why did GIA change its mind on the Ideal Cut?"

*Retail jeweler Gary Wright of Phoenix, Arizona, argues that a cut grade should be available on diamond certificates.*



Dr. Reinitz replied, "It's not fair to say that we changed our minds." She went on to explain that with the evolution of computer technology, it was time to reevaluate the complexities of cut and appearance with tools that Tolowsky did not have access to 80 years ago.

Following a brief skirmish over the use of the term *Ideal* and whether such a cut actually exists, two opposing sides quickly emerged—what could be termed "Idealists vs. Realists." The Idealists, led by Mr. Goldberg and Mr. Speisman (and supported by several retailers from the audience), denounced the cut quality of many diamonds on the market today. Insisting that diamonds should be cut for maximum beauty above all other considerations, they called on cutters to elevate their standards. Behind Mr. Austein, the Realists contended that it is economically unrealistic to do so. Consumer tastes and spending resources vary—some prefer quality, some prefer value—and it is the industry's responsibility to meet, rather than dictate, the demands of the market.

Next, Mr. Even-Zohar guided the War Room into a discussion on cut grading. While not everyone on the panel or in the audience supported the idea of including a cut grade on diamond certificates, those who did generally agreed that such information would have to be conveyed to the public in a way that could easily be understood.

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“I’d like to change the name of this room from War Room to Love Room, because I think it’s important . . . that we love what we’re selling.”

—William Goldberg

“We can’t tell yet whether there’s any one set of proportions that are radically, obviously better at making a pretty, shiny, bright dispersive diamond than other proportions. This problem is not yet solved . . . It’s still an open question.”

—Ilene Reinitz,  
ON GIA’S DIAMOND CUT STUDY

“We’re in an information-overload society. We’re into paper. We’re into numbers, we’re into definitive pockets . . . People are asking for information, let them decide.”

—Gary Wright,  
Gary W. Wright Co.  
PROPOSING THAT A CUT GRADE  
BE INCLUDED ON CERTIFICATES

“It’s rather astonishing on the eve of the 2nd millennium that we’re basing some of the most important decisions in our industry on . . . a master’s thesis written in 1919. If you’re going to set a standard, do it right.”

—Eli Haas,  
ON THE INFLUENCE OF TOLKOWSKY

“This has all stepped up in direct proportion to the popularity of Ideal cut, as if there’s a group there that says, ‘This is getting too big.’ When it was less than one percent and it was Lazare Kaplan, it was okay.”

—Robert Speisman

“The world has different tastes, and [the Ideal cut] may very much be an American thing.”

—Chaim Even-Zohar

“One of the concerns that I have is that a lot of the stones that are on the market at the moment aren’t Ideal cut. Not only are they not Ideal cut, they’re really Lousy cut. I suggest to you all that if we all improve the make of diamonds above a certain line, above a certain point, then we can actually increase the market size for all diamond jewelry.”

—Garry Holloway,  
Precious Metals

“The difference is that the salesperson in the shop has changed. . . . Now we have an industry where the sales force moves around. And you have a sales force that has no knowledge. So therefore the only way they can sell is to have numbers. What we really ought to do is get the sales force back to loving what they sell.”

—Doug Garrod  
Gemmological Association and Gem Testing  
Laboratory of Great Britain

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# Disclosure War Room

## PANEL

- Jeffrey Fischer** *Fischer Diamonds, New York*  
**Nanette Forester** *American Lapidary Artists, Los Angeles*  
**Esther Fortunoff** *Fortunoff, Uniondale, New York*  
**Cecilia Gardner** *Jewelers Vigilance Committee (JVC), New York*  
**Mary Johnson** *GIA Gem Trade Laboratory, Carlsbad, California*  
**Roland Naftule** *Nafco Gems, Scottsdale, Arizona*  
**Francesco Roberto** *Capellaro & Co. S.P.A., Milan, Italy*  
**George Rossman** *California Institute of Technology, Pasadena, California*

## MODERATOR

- Cheryl Kremkow** *Editor, Modern Jeweler*

**M**oderator Cheryl Kremkow launched the session with a round-table discussion on the U.S. Federal Trade Commission (FTC) rules on disclosure of gemstone treatments and enhancements. In the FTC's original (pre-1996) *Guides for the Jewelry Industry*, all information about color alteration of diamonds and colored stones had to be passed on to the consumer. In 1996, the *Guides* were revised to state that if the alteration is permanent, disclosure was not necessary. However, the JVC recently initiated a petition to change the FTC's *Guides* to reflect the industry's consensus on laser

drilling, which although permanent and not requiring special care, the industry felt needed to be disclosed. The FTC has accepted the petition, and has proposed altering the *Guides* to require disclosure of treatments in diamonds as well as colored stones even if they are permanent, require no special care, and are undetectable—as long as they have a significant effect on the value of the gemstone.

The War Room panel agreed that the retail jeweler is responsible for providing treatment information to consumers, but also admitted that full disclosure is not yet a reality throughout the trade. Questions were then directed to those in the industry who deal with laboratory grading reports and appraisals: How are they going to address the disclosure and valuation of treated gemstones, especially diamonds? While the colored stone industry has been dealing with disclosure for years, only recently has the issue come to the forefront in the diamond industry. Fueling the discussion was the controversy over Lazare Kaplan International's marketing (through its Antwerp-based subsidiary Pegasus Overseas Ltd.—POL) of diamonds treated by an “undetectable” process. Although all seemed to agree that disclosure was essential, there was disagreement on the approach that should be taken. As the audience became embroiled in the issues, two general positions emerged: (1) those who felt it important to state upfront that there is a treatment, and (2) those who preferred to disclose on a more cautious, need-to-know basis.

*Cheryl Kremkow and the panel listen as Tom Chatham offers his opinion on the topic of disclosure.*



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“The important issue here is to provide the information to the consumer at the point of sale. . . . One thing that retailer jewelers must do is train their sales associates.”

—Cecilia Gardner

“I need to know and I think every consumer needs to know what’s been done to their stone . . . . It’s really okay to tell somebody [that] a year or two years from now your stone will need to be retreated, re-enhanced. Bring it back and we’ll take care of it for you. . . . It’s the responsibility of a retail jeweler to do that.”

—Nanette Forester

“For the longest time it was very difficult to take the ‘sin’ out of synthetics. . . . now synthetics are looking to have much more integrity.”

—Gerald Manning,  
*Manning International*

“Reality check. There’s going to be an article in the *New York Times* that says ‘Diamonds are treated’ . . . And if you’re not going to disclose now, when are you going to disclose? When they put your picture in the *New York Times* and say ‘Look at these guys?’”

—Martin Rapaport,  
*Rapaport Diamond Report*

“It just seems a little bit premature to start telling every single consumer that every single diamond might have been treated for color. I believe in disclosure, but it seems like it doesn’t totally make sense.”

—Esther Fortunoff

“I think that everything should be disclosed. And if you don’t know that it is treated or enhanced, then you have to assume that it is.”

—Roland Nafzule

“This treatment is here, Lazare Kaplan is not going to wait and GE is not going to wait for anybody. . . . The only thing you can really do is support the hell out of GIA’s basic research.”

—Martin Rapaport

“It was not as if Lazare Kaplan tried to sneak something and got away with it. We put a moratorium on the goods at our expense in order to do the right thing—to have a dialogue with the industry. . . . Had we wanted to sneak one by, we easily could have.”

—Robert Speisman

“I take the attitude that if you are withholding something—that is, if you are not disclosing it—then perhaps you are trying to deceive me. . . .”

—George Rossman

## A Marketplace of New Ideas

Coordinators:  
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### COLORED STONES

#### Copper Tourmaline from Paraíba, Brazil: Reopening of the Mine, Regional Exploration

**Heitor D. Barbosa**, *Heitorita Tourmalina da Paraíba Mineração, Paraíba, Brazil*; and **Brian C. Cook** (brian@naturegeometry.com), *Nature's Geometry, Graton, California*

Since its arrival on the market in 1989, the vivid and uniquely colored tourmaline from Paraíba has become legendary. The coloration is produced by traces of copper ( $\text{Cu}^{2+}$ ), which was previously not known to be a coloring agent in tourmaline (Fritsch et al., 1990). As of this writing, only one location has produced exceptional gem material: a single small hill, the backdrop for the village of São José da Batalha in Brazil's rugged northeast state, Paraíba. Subsequent to this first discovery, other pegmatites in the region have been found to contain tourmaline that is colored by copper, although not of equal gem quality. When these occurrences were plotted on a geologic map, they were found to align in a narrow band with a N-NE regional trend extending some 90 km. Metallic elements found in the pegmatite minerals of the region—U, W, Ta, Sn, Nb, Mn, Be, and Li—formed zoned assemblages along this trend. In a simplified view, this zonation forms con-

centric bands radiating outward from the center of the pegmatite field (Roy et al., 1964). Superimposing the plot of Cu-bearing tourmaline occurrences on the map creates a narrow band within this concentric zoning pattern. This distinctive imprint of the metals in the earth's crust was apparently generated from the radiant heat of the mobile plutonic emplacement some 520-plus million years ago.

For eight years, from 1990 on, general strife consumed the mine; the haphazard and reckless excavations done without control of the original founder, Heitor Barbosa, proved both costly and futile. In 1998, however, the legal controversy was resolved and Heitor Barbosa reactivated the mine with Sergio Barbosa. The land adjacent to the mine was also opened up for exploration at this time, and a more systematic program of exploration and mining is now under way.

#### REFERENCES

- Fritsch E., Shigley J.E., Rossman G.R., Mercer M.E., Muhlmeister S.M., Moon M. (1990) Gem-quality cuprian-elbaite tourmalines from São José da Batalha, Paraíba, Brazil. *Gems & Gemology*, Vol. 26, No. 3, pp. 189–205.
- Roy L.R., Dotton O., Madon H.L. (1964) *Estudos dos Pegmatitos do Rio Grande do Norte e da Paraíba*, SUDENE, Departamento de Recursos Naturais Divisao Geologia, serie geologia economica No. 1.

## Gem Vesuvianite and Grossular from the Vata Area, Apuseni Mountains, Romania

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Lucretia Ghergari, and Antonela Vadan,  
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In the southern part of the Apuseni Mountains, along the upper course of the Cerboia Valley, there are several occurrences of vesuvianite, grossular, wollastonite, gehlenite, and Ti-andradite (melanite). These minerals formed within Ca-skarns, through high-temperature contact-metasomatic processes between Upper Jurassic limestones and Lower Cretaceous quartz–monzodioritic intrusives (see figure).

Vesuvianite forms transparent, “olive” green, short-prismatic crystals that show a vitreous luster and range up to  $5 \times 2$  cm. Despite its attractive color and high luster, the vesuvianite is not suitable for faceting large stones, because of the presence of tiny inclusions of garnet and wollastonite. The physico-chemical features of the vesuvianite were investigated by crystallographic studies, microprobe analysis, infrared spectroscopy, and X-ray powder diffraction analysis.

Electron microprobe analyses of a cross-section from each of four vesuvianite crystals were performed by Dr. Sidsel Grundvig at the Geologisk Institut of Aarhus Universitet, Denmark. The chemical composition varied within narrow limits, but did show subtle chemical zoning. The cell parameters of the vesuvianite, obtained by X-ray powder diffraction analysis, are:  $a=15.42(1)$  Å and  $c=11.70(2)$  Å.

Grossular forms translucent, “olive” green, dodecahedral crystals with a vitreous luster. The calculated cell parameter is  $a=11.82(5)$  Å. The grossular crystals are quite large (up to 1.5–2.0 cm), translucent, and have a fine color.

### REFERENCE

Cioflica G. (1960) Contributions to the knowledge of the contact phenomena in the Magureaua Vata area (Drocea Mountains) [in Romanian]. *Studii Cercetari Geologie Geofizica Geografie, Seria Geologie*, Vol. 3, No. 1, pp. 509–518.

## Jasper Occurrences in the Brad Area, Apuseni Mountains (Romania)

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In the Apuseni Mountains of western Romania, polychrome jasper is hosted by andesitic volcanic deposits associated with a Neogene stratovolcano (see figure).

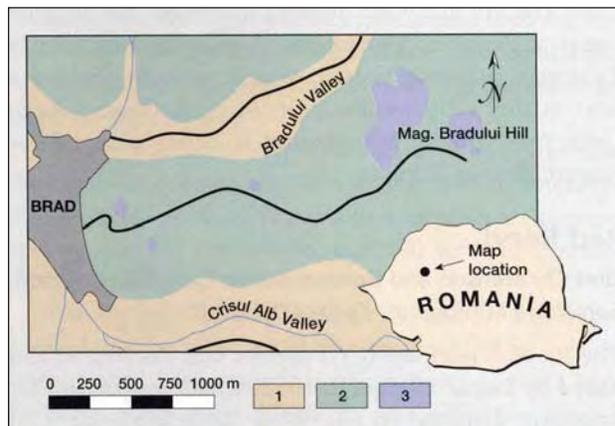


This geologic map of the Vata area (after Cioflica, 1960) shows the occurrence of the gem-quality vesuvianite and grossular. Key: 1—Upper Jurassic limestones; 2—Lower Cretaceous clays and sandstones; 3—Mesozoic ophiolites; 4—Upper Cretaceous intrusives; 5—Vesuvianite + grossular + wollastonite + gehlenite + Ti-andradite (melanite) occurrences.

The jasper is genetically related to geyser activity, and forms lenses that measure 10–30 m thick and range up to 0.01 km<sup>2</sup> in surface area.

The genesis of the jasper deposits (i.e., geysirites) began with the accumulation of various detrital fragments (composed of limestone, andesite, and andesitic and rhyolitic tuff) in small lakes formed near the volcano. Post-volcanic, subaquatic hot springs deposited

This geologic sketch map of the Brad area, Romania, shows (1) the Quaternary deposits, (2) the Neogene andesitic volcanic deposits, and (3) the jasper occurrences.



silica gels between the fragments, and these gels precipitated as cristobalite/tridymite. Later, microcrystalline quartz (chalcedony) partially replaced the cristobalite. The various colors of the jasper are caused by traces of  $\text{Fe}_2\text{O}_3$  and  $\text{MnO}_2$ . Mineralogically, the varieties cristobalite/tridymite, quartz-cristobalite/tridymite, and quartzitic geyselite were recognized. Several color varieties of the geyselite were also defined: black, brown, red and reddish brown, orange, yellow and yellowish white, gray, "ochre," off-white, and white. These varieties showed systematic differences in their mineralogy and, in some cases, texture.

## Central Asia: A Prime Source of Gemstones for the 21st Century

**Gary W. Bowersox** (MrGary77@aol.com), *Geo Vision, Inc., Honolulu, Hawaii*

Central Asia is poised to become a major source of gems and minerals in the 21st century. At present, Afghanistan, Kazakhstan, Kyrgyzstan, Pakistan, and Tajikistan are supplying the world markets with commercial quantities of gem-quality emerald, spinel, ruby, sapphire, aquamarine, tourmaline, and lapis lazuli. Other gems being mined on a smaller scale are topaz, morganite, garnet, and quartz (amethyst, rock crystal, and smoky varieties).

At the 7th Symposium on the Gems and Minerals of Afghanistan, held in Tucson, Arizona in February 1998, plans were developed to expand geological and gemological studies in Central Asia. Symposium attendees included tribal leaders and miners, as well as representatives from GeoVision Inc., ERDAS Inc., GIA, and the U.S. Geological Survey. Detailed mapping began in Afghanistan during the summer of 1998 using GPS (Ground Positioning System) in conjunction with satellite and radar data that incorporated the latest geophysical technology and computer imaging models. During the summer of 1999, another field excursion using satellite and GPS systems surveyed the emerald mines at Panjshir, Afghanistan. A ruby-bearing area in Tajikistan was also visited, which recently yielded a facet-quality ruby weighing 50.08 ct. A Central Asian Gem and Mineral Symposium is being planned for August 2000 in Pakistan.

## Red Beryl

**Clint Christenson and Gordon Austin** (goryll@juno.com), *Gemstone Mining Inc., Cedar City, Utah*

The Ruby Violet red beryl deposit was discovered and staked by Lamar Hodges in 1958, while prospecting for uranium. Located in the Wah Wah Mountains of

Beaver County, Utah, the deposit is accessible by dirt roads from the towns of Milford, Minersville, and Cedar City. Elevations vary from 6,700 to 7,100 feet (2,042 to 2,165 m) above sea level. Average temperatures range from 100°F (38°C) in the summer to 10°F (-12°C) in the winter. The ore processing plant is located about 25 miles (40 km) east of the mine on the flats west of the Mineral Mountains.

The Hodges family worked the deposit as a hobby mine for 18 years, until 1976, when Mr. Hodges sold the mining rights of the Ruby Violet property to the Harris family of Delta, Utah. During the next 20 years, the Harris family performed small-scale mechanized and hand mining from the surface.

In 1994, Kennecott Exploration Corp. entered into an "Option to Purchase with Exploration Rights" with the claim owners. Gemstone Mining Inc. assumed the agreement in March 1997. Under this agreement, Gemstone Mining has carried out an extensive program to sample the red beryl deposit, to assay the sample by traditional gemstone techniques of cutting and sorting, and to estimate the wholesale prices of the gems. The distribution of values within the deposit is, as yet, only partly understood. The decision to undertake larger-scale mining will depend on the ability to distinguish ore-grade material from waste. It is believed that the large-scale mechanized mining and crystal recovery (of up to 2,000 kg per year) planned by Gemstone Mining Inc. will be successful.

## Gemstones and Global Tectonics

**Frederick A. Cook** (cook@geo.ucalgary.ca),  
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As world shortages of gem materials become increasingly acute in the future, new deposits may be found with techniques that incorporate modern concepts of global tectonics. The earth's outer 100-km-thick outer "shell" is broken into plates that shift, separate, and collide with one another. Continents, on which nearly all gems are found, are products of these plate tectonic processes, which have been active over more than 3.5 billion years. The main plate tectonic features or processes applicable to gemstone exploration are the following:

1. Diamonds form beneath ancient *cratons* (i.e., ancient, thick, stable regions of the earth's crust). The source of the carbon was either the deep earth interior or terrestrial material that subducted when one plate was overridden by another.
2. *Rifts* where two plates separate provide heat for

tectonic uplift, volcanism, and the formation of magma chambers (i.e., plutons). Peridot from the mantle is associated with basaltic volcanics in rift zones, and granitic pegmatites in continental rifts are the source of beryl and topaz. Hydrothermal alteration associated with rifting produces red beryl, topaz, and opal in volcanic rocks, and turquoise and opal in sedimentary rocks.

3. As plates separate, ocean basins open until one plate sinks into the mantle at a subduction zone. Near a depth of 100 km, melting produces *subduction magmatism* that causes volcanism and plutonism. Some sapphires and rubies are carried to the surface in the associated alkali basalts. Subduction-related granitic pegmatites are sources of tourmaline, beryl, and topaz, and near-surface granite plutons provide beryllium for emerald formation.
4. Subduction culminates when terranes are sutured along *collision zones*. Metamorphism of oceanic sediments and basalts produces jadeite and nephrite, respectively, and these may be uplifted near suture zones. Granitic pegmatites may incorporate chromium from suture-zone oceanic rocks to form emeralds, and the metamorphism of continental sediments can form lapis lazuli.

Using global tectonic concepts, we have proposed that gem pegmatites often occur where a continent is partly subducted, and that geophysical tools can delineate such regions. This multi-faceted approach led to discovery of a previously unknown topaz pegmatite in the Yukon Territory, Canada, in 1998.

## **Tanzanite Mining Update—A Follow-Up to the Mine Disaster of April 9, 1998 at Merelani, Tanzania**

**Angelique Crown** (acrown1@compuserve.com),  
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How did the catastrophic floods that swept the Merelani mining area of Tanzania affect the miners, and what is being done to help prevent another such disaster in the future? This update on the mining conditions and other recent developments is a result of my visit to the Merelani mining area in late April 1999.

Nestled between the mountains of Meru and Kilimanjaro in northeast Tanzania, Merelani (also called Mererani or Mirarani) is the only commercial source of tanzanite in the world. The Merelani mining

area is divided into four government-controlled regions (Blocks A, B, C, and D). Block B was affected most by the flooding last year. Prior to the flooding, as many as 50 “pits” had been allocated at Block B through mining contracts to individual licensed companies. When the El Niño rains fell, a surge of water and mud flooded the pits and invaded the intricate maze of tunnels. The primitive mining conditions and tools hindered rescue of the trapped miners. Although the exact number who died may never be known, the Tanzanian government has confirmed 77 deaths and some reports indicate that up to 200 miners may have perished in the flooding.

The government of Tanzania responded to this disaster by mandating the construction of “collars” made of wood or other durable materials at each pit opening. Many of the pits that I observed did, in fact, have reinforcements. Also, wooden ladders were installed by individual mine operators to provide safer access to some of the shafts, replacing the single ropes that were formerly used as the sole means of entry and exit.

In response to this tragedy, the American Gem Trade Association (AGTA) organized the Tanzanite Miners Relief Fund and appointed Philip Zahm chairman. Approximately \$35,000 has been raised so far, which is designated for use to provide medical/rescue training and adequate shelter for the miners. In April 1999, three emergency medical technician/paramedic personnel accompanied Mr. Zahm to Merelani to conduct a three-day training session for 15 miners invited by TAMIDA (Tanzanite Mineral Dealers Association). At the conclusion of the session, the miners successfully bandaged, stabilized, and properly lifted a “victim” from the depths of a 300-m-deep pit.

I observed the training activity and had an opportunity to speak (through a translator) with several of the miners; many commented that the training would tremendously improve the response to any future disasters. In the past, the rescuers used a large sack with holes cut for the legs to hoist injured miners to the surface. The training taught the rescuers how to stabilize and move such victims to minimize the potential for neck or spine injury.

The Tanzanite Miners Relief Fund has also financed the construction of a shelter (140 m<sup>2</sup>) near the training site on Block D, which now provides a proper resting area for the miners and will serve as a refuge during storms.

During my visit to Blocks B, C, and D, I observed limited mining only at Blocks B and D. The relative quiescence of the mines may have been due to a local holiday. However, Block C was officially closed,

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because the license and mining contract had recently been sold to a joint venture consisting of African Gem Mining Resources (AFGEM) and Tanzanian nationals by Graphtan Mining, a subsidiary of SAMAX Ltd. (a gold exploration company). Although graphite has been the main material mined there, commercial production of tanzanite from the area is anticipated by the end of 2000.

## **The Short Life and Death of a Sapphire Boomtown**

**Thomas A. Cushman** (tcush@micron.net), *Allerton Cushman & Co., Sun Valley, Idaho*

Ambondromifehy, Madagascar, was originally hailed as one of the most interesting and richest new sapphire deposits to be found in the last 20 years. Interesting it was. Rich, too—but not for long. It now seems that Ambondromifehy is the latest in a long line of busted boomtowns.

Discovered in 1996, in the Antsiranana Province of northern Madagascar, the Ambondromifehy sapphires were found in alluvial deposits of an ancient riverbed. Early prospecting by local miners brought to light easily recovered (i.e., in gravels only 1–2 m below the surface) blue to blue-green sapphires that resembled the material from northern Australia. This initial recovery of sapphires and subsequent mechanized mining by various commercial groups led to a massive influx of local artisanal miners. The existing village of 120 inhabitants soon boasted a population of 7,000, which soared to 14,000 by early 1998.

Civic planning and infrastructure never had a chance to develop in the wild rush of the miners to put up some sort of shelter and join the diggings, which had spread throughout the region along the ancient river. The village expanded along both sides of the national highway; makeshift buildings were constructed of locally available materials, mostly palm leaves woven to make walls and thatch for roofs. Water and sewage disposal were supplied by a small local river, resulting in a health crisis. The new city soon acquired a variety of social facilities, such as bars, bordellos, video parlors, and casinos. Stores, restaurants, and basic hotels arose. A thriving marketplace for sapphire developed up and down the main street of this new city, with dozens of small buying booths manned by Malagasy, Asian, and African buyers. These buyers purchased rough from the artisanal miners who dug illegally on claimed, unclaimed, and protected lands along and adjacent to the prehistoric riverbed. Crime was initially dealt with in a vigilante fashion, but a per-

manent police presence was quickly established. Fire protection services never did develop, leading to several multiple-dwelling conflagrations.

All of this development came to an abrupt halt in April 1998, when the government of Madagascar banned the export of sapphires from this locality. The ban resulted from pressure by the World Wildlife Fund and other international organizations that strongly objected to the encroachment of illegal miners onto the Ankarana Forest Reserve, a national park that was intended to serve as an example of international cooperation in Eco-tourism and local development.

Concomitant with the closure of legal gem exports came the resounding commercial rejection of Ambondromifehy sapphire. Only a very small percentage of the natural material was transparent and an attractive blue. The overwhelming majority of the rough was opaque, and most of the transparent material was either too dark or greenish blue. After more than a year of experimentation, no treatment had been found by which the stones could be lightened or the green driven off. As a result, the key markets (notably Thailand and New York) would no longer accept these very plentiful goods. This situation led to an immediate decline in both the price of the sapphires and the number of buyers on site. As a result, neither of the two international mining groups are still mining in the area; at least one of these went bankrupt. Most of the independent miners soon left the dying village to search for opportunity in other regions and with other gem minerals.

The September 1998 revocation of the export ban gave a very small boost to the fortunes of Ambondromifehy, but the death knell was sounded when a new source of alluvial sapphire of much higher quality (and, therefore, value) was found in the southern region of the island. Miners immediately began a pilgrimage to this new source. By May 1999, the population of Ambondromifehy was less than 2,000, and the once-prosperous village had begun to resemble a ghost town.

## **Mining and Heat Treatment of “Geuda” Sapphire at Ratnapura, Sri Lanka**

**Branko Deljanin** (brankony@aol.com), *European Gemological Laboratory, New York*

In the early 1970s, Thai gem dealers began heat treating low-quality “geuda” sapphire from Sri Lanka, thereby supplying large quantities of attractive sapphire to the trade. The most important deposits of geuda corundum, all of which are alluvial, are found in the Ratnapura district. Gem-bearing gravel, locally

referred to as *illam*, is formed by the erosion of corundum-bearing rocks, specifically, Precambrian charnockite gneisses and associated pegmatites. At the Marapana mine, the mining process involves excavation of square shafts down to illam layers that lie about 15 m below the surface. Typically approximately 40% of the recovered corundum is heat-treatable geuda sapphire.

Prior to heat treatment, the geuda is sorted into several categories and subcategories, because not all geuda responds similarly to treatment. The classification takes into account visual appearance, transparency, intensity of color, and color distribution. As described by Rupasinghe et al. (1993), the two major divisions are:

Group 1—Described as *silky, milky, diesel, dhun*, and *ottu*. Geuda in this category requires heat treatment in a reducing environment to develop a blue color, which is attributed to Fe-Ti charge transfer.

Group 2—Described as bluish red, red, and *kowangy pushparaga*. Geuda in this category requires heat treatment in an oxidizing environment to intensify the red and yellow hues.

The most widely used heat-treatment furnace in Sri Lanka, the *Lakmini*, was developed locally. Success with this furnace is variable. More modern equipment and technical knowledge are needed if the Sri Lankan geuda heat-treatment industry is to remain competitive with that in Thailand.

#### REFERENCE

Rupasinghe M.S., Dissanayake C.B., Perera D.G.A. (1993) *The Sri Lankan Geuda*. Institute of Fundamental Studies, Kandy, Sri Lanka.

## An Examination of the State of the Gem Trade in Sri Lanka

**Aly Farook and Thahir Farook**, *Sapphire Gem Co., Beverly Hills, California*; **Dean Stevens and Andrew Lucas**, *GIA, Carlsbad, California*

Sri Lanka (formerly known as Ceylon) is one of the oldest and most important colored stone producers in the world. The *Mahavamsa* (Sinhalese chronicles from the fifth century AD) mentions—among other references to the island's gems—a king's throne encrusted with gems. That reference dates the throne to 543 BC.

It is believed that Sri Lanka was the original source of the sapphires and rubies used in jewelry by the Etruscans and by early Greeks and Romans. The Roman naturalist Pliny (23–79 AD) referred to the gem wealth of Sri Lanka, which had been described by Sri Lankan envoys who visited Rome in 45 AD. The island's gem wealth became more legendary with refer-

ences such as those of Sinbad the Sailor's adventures in *Tales of Arabian Nights*, and Marco Polo's accounts of his 13th century travels. The fame of Ceylon's gems continued to grow during the time of colonization by the Portuguese, the Dutch, and finally the English.

Today Sri Lanka produces more than 40 varieties of gems, with blue sapphire the most important economically. The major gem-producing areas are found in the southern part of the island. They extend north to Elahera, in the central part of the country. Some of the most famous deposits are found near the city of Ratnapura, which means "city of gems." Virtually all of the gem material comes from alluvial gravels. Often a wide variety of gems are recovered from a particular location. For example, the deposits around Ratnapura produce amethyst, apatite, beryl, chrysoberyl, citrine, corundum, garnet, iolite, korerupine, scapolite, sillimanite, sinhalite, spinel, taaffeite, topaz, tourmaline, and zircon.

Mining in Sri Lanka is typically primitive. In fact, it has remained much the same for centuries. Pit mining is common, whereby the gem-bearing gravels (called illam) are reached by holes dug 3 to 15 m deep (although depths of 40 m have been reported). The illam is washed, and the clean gravel (called dullam) is examined for gem material. Gems are also recovered from rivers by scuba divers, who vacuum the gem-bearing gravel into a floating sluice. Modern, mechanized mining has met with resistance, particularly from traditional miners. Currently, such mining is only allowed in locations that will be flooded by the creation of a new dam, when the gravels must be mined quickly before they are submerged.

Much of the exploration for new deposits is done by independent miners using rudimentary methods, and they tend to concentrate on known gem-producing areas. More scientific and methodical prospecting would likely improve production in established mining regions, and might also uncover new deposits elsewhere.

Master cutters and pre-formers in Sri Lanka handle expensive rough and are proficient at orienting a stone so that it shows the finest color face-up. However, Sri Lankan cutters have been criticized for the overall quality of their cutting. Traditionally, Sri Lankan cutters emphasized weight retention at the expense of appearance, which resulted in asymmetrical, unattractive "native" cuts. Now, some Sri Lankan cutters are adopting modern techniques and international cutting standards, as well as cutting calibrated sizes. Although their cutting quality meets the demands of the international gem trade, they face fierce competition from other countries with inexpensive labor, such as China.

Over the last three decades, other areas of the trade have grown more competitive as well. For example, in the 1970s dealers in Thailand began heat treating translucent, milky white geuda sapphire from Sri Lanka to yield transparent, fine-color blue gems. To supply material for this new treatment, Thai buyers began purchasing large amounts of geuda sapphire in Sri Lanka. Although the miners profited, the Sri Lankan dealers suffered in the face of this new competition from Thailand.

The State Gem Corporation of Sri Lanka was founded in 1971 to regulate, develop, and promote the country's gem industry. It handles a wide range of responsibilities, from licensing miners to determining the value of gem exports. Among its various regulations is a controversial ban on the exportation of rough. Also, all gem exports must be cleared through this agency. However, gem export figures have become more reliable since the inception of the State Gem Corporation, and the agency is taking measures to help modernize the cutting industry and improve education in areas such as gemology. The agency also has relaxed some regulations, notably import duties on rough gems, which has benefited local cutting industries and dealers. For example, as the production of fine-quality Sri Lankan sapphire dropped, the relaxed import duties encouraged Sri Lankan dealers to buy this material abroad, especially in Madagascar.

With the introduction of more-advanced treatments and synthetics, and with the increase in imports from other locations, the need for trained gemologists has grown dramatically. Their services have been requested at every level of transaction, from the mine to the dealer's office. Qualified gemologists and well-equipped laboratories with sophisticated testing equipment are crucial to the success of the Sri Lankan gem industry.

With modernized cutting, increased education, improved gemological services, and policies that attract foreign buyers, the gem trade of Sri Lanka can continue to be a major international force while retaining the cultural aspects, traditions, and generations of knowledge held by those in the gem business.

## The Smithsonian Institution's Corundum Conundrums

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There are six named corundums among the more than 10,000 gems in The National Gem Collection at the

Smithsonian Institution's National Museum of Natural History. Even though they are world renowned, little has been recorded about their history.

The *Rosser Reeves ruby* is a light red oval star stone from Sri Lanka that weighs 138.7 ct. The ruby was donated to the Smithsonian Institution by Mr. Reeves in 1965. The jewelry firm of Robert C. Nelson, Jr. sold the stone to Mr. Reeves on behalf of Paul Fisher, whose father had purchased the 140-ct ruby at an auction in England. The stone was recut slightly to remove deep scratches.

The 329.7 ct *Star of Asia* is a deep blue round star sapphire from Myanmar. The stone was acquired from Martin L. Ehrmann Co. in 1961, which acted on behalf of Jack Masson of Los Angeles and Geneva, Switzerland. The stone reportedly once belonged to the Maharajah of Jodhpur, India.

The *Star of Bombay* is a 182 ct oval star sapphire from Sri Lanka. It was a bequest from movie star Mary Pickford in 1981. An article in the October 15, 1938 issue of *Vogue* magazine mentioned Ms. Pickford as the owner of a brooch containing a 200 ct star sapphire, which we believe to have been this stone.

The *Star of Artaban* is a 287.32 ct light blue oval star sapphire of unknown geographic origin. It was donated to the Smithsonian in 1943 by W. Frank Ingram of Atlanta, Georgia, who purchased the stone from William V. Schmidt Co. of New York. In 1935, Nish Vartanian of New York bought the stone in Bombay from a Mr. Mendelsohn. An article in the August 1937 issue of *The Mineralogist* mentioned that this sapphire was the centerpiece of a traveling exhibit of star rubies and sapphires that was organized by W. V. Schmidt Co.

The *Logan sapphire* is a 423 ct blue sapphire from Sri Lanka. This cushion-cut stone is surrounded by 20 round diamonds in an antique silver-and-gold brooch. It was donated in 1960 by Rebecca Pollard Guggenheim, but it stayed in her possession until she, as Mrs. John Logan, formally presented it to the museum in 1971. An article in the July 1958 issue of *Ladies Home Journal* mentioned that the sapphire was a gift from her husband, circa 1952.

The *Bismarck sapphire* is a 98.6 ct deep blue cushion-cut stone from Myanmar that is set as the pendant to a striking necklace by Cartier. It was donated in 1967 by Countess Mona von Bismarck, who had acquired it some years earlier in India.

If you have further information on any of these stones, please contact the Smithsonian at the above e-mail address.

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## Classification of Gem Opals Using Raman Spectroscopy

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The classification and nomenclature of opals has always been a complex issue. Recently, a classification based on visual appearance was proposed for appraisal purposes (Smallwood, 1997). However, the mineralogical classification of opals is based on X-ray diffraction analysis—a destructive technique that is of no practical use for gem opals. We propose a new approach to the geologic classification (and, when possible, geographic classification) of opal based on Raman scattering, which provides a different kind of structural information than X-ray diffraction. It has the advantage of being nondestructive, and it is fairly quick compared to X-ray diffraction. Also, spectra can be obtained easily, even from mounted gems.

We studied over 70 opals from Mexico, Australia, Brazil, and Honduras using both X-ray diffraction analysis and Fourier-transform Raman spectroscopy. The samples included play-of-color as well as common opal, in several different varieties (white, black, boulder, fire, and crystal opal). The position and intensity of Raman scattering bands vary within a limited range for each locality. Preliminary results have demonstrated that this approach can do the following:

1. Distinguish between opals of sedimentary origin (Australia, Brazil) and volcanic origin (Mexico, Honduras). Opals from siliceous sedimentary rocks are generally more poorly crystallized (broader bands, different peak positions) and more hydrated than those from volcanic environments.
2. In a small number of cases, provide geographic origin information. Unlike X-ray diffraction patterns, the Raman spectra of various opals from a given locality are fairly similar. Although the spectra seem to correlate best with geologic origin, some samples, especially some Australian opals, show distinctive Raman spectra.
3. Provide information about the “water” content (molecular water or hydroxyl groups) in opal. Water is an important intrinsic component of opal. Its concentration and mode of incorporation can vary widely from one deposit (and sometimes from one sample) to the next.

## REFERENCE

Smallwood A. (1997) A new era for opal nomenclature. *Australian Gemmologist*, Vol. 19, pp. 486-496.

## Understanding Emerald Enhancements

**Charles Garzon**, **Fernando Garzon**, and **Arthur Groom**, *Gematrat, New York*

With its luscious green coloring, emerald has captivated and mystified people throughout the centuries. To some, emerald has even taken on more mystical attributes, symbolizing rebirth and fertility.

For all its mysticism, emerald has a less than glamorous beginning. The geologic processes by which it forms are brutally wrenching, often as wounding as they are wondrous. Hence, almost all emeralds have fissures that may mar the clarity appearance of the fashioned stone.

The process of “enhancing” emeralds to reduce the visibility of these fissures has been done for centuries. Although the filler materials and equipment have changed throughout the years, the premise under which an emerald is “enhanced” has *not*: Today, like centuries before, an emerald is “enhanced” to diminish the scars of its creation and bring forth its full natural beauty.

Given that clarity enhancement is often the final step in preparing an emerald for market, it is important to understand the process used, and especially the attributes and limitations of the filling material to be employed. Since the value of an emerald is determined largely by its overall appearance, it behooves us to select and apply the most stable filling material available. In today’s market, a variety of resins are available that approximate the R.I.’s of emerald, while offering excellent stability. Tradition, beauty, and technology have converged in the practice of emerald enhancement.

## Characterization of Inclusion Suites in Sapphire Using Raman Spectroscopy

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Establishing the original source of gem corundum from some alluvial deposits is difficult, and for many deposits, this must be done by inference. In the case of the Montana alluvial sapphires, no source rock has

been located yet, despite over 100 years of mining and prospecting in the region.

Gem corundum forms via metamorphic reactions in crustal rocks, or as magmatic or metamorphic reactions in the earth's mantle. Identification of inclusion suites within placer minerals such as corundum establishes a mineral assemblage that not only echoes the host rock mineralogy, but can also establish limits on the pressure and temperature of the gem's formation. Energy-dispersive methods of identification (electron and proton microprobe) require exposing the inclusion at a polished surface, a time-consuming and destructive procedure. Micro-Raman spectroscopy is a fast, nondestructive technique that can identify mineral inclusions *within* the host crystal. This technique was used to characterize the inclusions in unheated and heat-treated sapphires from the Rock Creek area (50 samples), Dry Cottonwood Creek (13 samples), and Eldorado Bar (4 samples) in southwestern Montana. The investigation also included unheated sapphires of known geologic origin from the following deposits (number of samples in brackets): (A) Those of magmatic affiliation (e.g., alkali basalt)—Australia [28]; Yogo, Montana [8]; Cambodia [4]; Shandong, China [3]; Thailand [3]; Mull, Scotland [1]; eclogitic corundum from South Africa [2]; and (B) those of metamorphic affiliation—Kashmir [1]; Myanmar [2]; Tanzania [2]; Sri Lanka [3]; Madagascar [2]; Brazil [1]; and West Pailin, Cambodia [4].

Rutile was ubiquitous in corundum from all the deposits studied, and was the most prolific mineral inclusion. In the magmatic sapphires, rutile occurred as tiny grains forming dense clouds, as blocky crystals that contained zones of ilmenite, and as needles. Needle- and rod-shaped crystals were the preferred habits for rutile inclusions in sapphires of metamorphic origin. Rutile in the Montana alluvial sapphires occurred as dense clouds and zones of tiny grains, in crystals zoned with ilmenite, and as grains associated with unidentified oval features (described below).

Magmatic sapphires were characterized by needle-shaped inclusions of rutile, ilmenite, goethite, and hematite, and by the presence of hercynite as the dominant spinel phase. Ilmenite was less common in the metamorphic sapphires; it formed zoned crystals with rutile, or micron-sized grains. Goethite and hematite formed only secondary inclusions in the metamorphic sapphires, as part of the iron-stained material in fractures. Hercynite was rare in the metamorphic sapphires; where present, the crystals formed irregular plates associated with magnetite. In contrast, hercynite in the magmatic sapphires formed rounded plates and displayed no association with magnetite.

Apart from rutile, the most common inclusion in the Montana alluvial sapphires was labradorite feldspar, which was usually found associated with muscovite. This particular inclusion combination is distinctive for sapphires from both the Rock Creek and Dry Cottonwood Creek deposits. Zoisite, epidote, rhodolite garnet, analcime, anhydrite, and apatite were also noted as inclusions in the Dry Cottonwood sapphires. Clinozoisite, diaspore, zoisite, and sapphirine were characteristic of the non-heat-treated Rock Creek sapphires. An unusual oval feature, with a distinctive but yet-unidentified spectrum, was noted in several heat-treated sapphires from the Rock Creek deposit. These features averaged  $10 \times 15$  microns in size, and locally appear to have recrystallized into rutile. They are thought to be an unstable  $\text{TiO}_2$  polymorph that formed during the heating process.

Zones of micron-sized rutile and rutile-ilmenite grains, and the presence of labradorite, muscovite, zoisite, and sapphirine (Rock Creek) were distinctive and characteristic for the Montana alluvial sapphires. This latter inclusion suite has more affinity with metamorphic than magmatic rocks. Coupled with the distinct lack of any alkali basaltic material in either the deposit gravels or surrounding rocks leads to the conclusion that the Montana alluvial sapphires have a metamorphic origin. The difference in inclusion suites in the Rock Creek and Dry Cottonwood sapphires is probably due to local differences in the metamorphic environment.

## Fissure Fillings in Emeralds: A Comparison of Different Identification Methods

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For many centuries, fissures in emeralds have been filled with oils and other natural substances to enhance the clarity of the gem. Over the past 15 years or so, various artificial resins (mainly epoxy resins) have also been used as filling substances. The different substances vary in stability and thus degree of permanence. Oils are the most volatile of the fillers used, but they can be removed easily from the stone and replaced. Artificial resins are much more durable than oils, but they decompose over time and are difficult to remove. Because of these differences, the trade often requests an identification of the substance used, which must be done nondestructively.

The first step in filler identification is visual observation with the microscope and with long-wave UV

radiation, to estimate the presence or absence of a filler, as well as the location of the filled fissures in the stone. These observations also provide an indication of the quantity and extent of the filler. Next, the substance is analyzed by infrared and/or Raman spectroscopy. At SSEF, these two complementary techniques are used together, with infrared spectroscopy as a macro method and Raman spectroscopy as a micro method. Once a spectrum is obtained with either instrument, it is compared to an extensive databank of reference spectra for the pure filler substances.

Accumulations of more than one filling substance are common in emeralds, as a result of multiple treatments. For example, a stone may be filled both in its rough state and again after it has been cut, and some emeralds are re-treated one or more times either to replace a filler that has been inadvertently removed or damaged, or to try a different filler that may better improve the appearance of the stone. The characteristic peak positions of these substances will appear as a combined spectrum, but the different components are usually identifiable. In more than 80% of the stones submitted to SSEF, the substance category (e.g., oil or artificial resin) can be identified when infrared and Raman spectroscopy are combined.

## Pyrope-Almandine Garnets from Various Mining Areas in Orissa, India

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The state of Orissa, in eastern India, produces a variety of gems, including garnets. Mining for pyrope-almandine garnet occurs within about 250 km of Kata Banghi, in all directions; this town is also the center for the sorting and sale of the garnets. The 12 mining areas are: (1) Nakta Munda, (2) Lora Munda, (3) Khairpada, (4) Malkhangiri, (5) Lounghi, (6) Matri Dari, (7) Chalna, (8) Maurya, (9) Mangher, (10) Budapada, (11) Ghantiguda, and (12) Dumer Guda. For this study, we analyzed garnets from localities 1, 4, 5, 6, 7, 8, and 12.

Properties of pyrope-almandine garnets from Orissa.					
Locality	S.G.	R.I.	L*	a*	b*
Lounghi	3.82	1.758	43.2	40.3	7.8
Dumer Guda	3.84	1.759	52.4	35.5	3.0
Nakta Munda	3.84	1.760	67.1	18.4	-4.6
Chalna	3.83	1.761	40.2	33.5	6.2
Maurya	3.87	1.763	50.9	41.1	9.8
Matri Dari	3.88	1.765	60.5	31.0	-3.6
Malkhangiri	3.94	1.780	24.0	40.2	11.1

The garnet deposits are hosted by strongly metamorphosed Precambrian rocks of the Eastern Ghats Belt. Mining began in 1975, and is generally done by hand tools. The deepest mines are not more than about 30 feet (9 m). The mineralized zones typically dip 60° east or north.

All of the garnets analyzed belong to the pyrope-almandine series. The garnets vary in composition, depending on their locality. Garnets from Nakta Munda showed the desired purplish hue, which makes this the best-known locality for rhodolite in Orissa. These garnets revealed a lower iron content (they were more than 80 mol.% pyrope) than the other localities, and this could be seen in their visible absorption spectra. All other samples had pyrope contents of 56–65 mol.%. Some garnets from Matri Dari and Dumer Guda also showed a purplish hue, but these were less purple than in the Nakta Munda material. All the other samples appeared more orangy red.

The observed colors corresponded very well to the  $L^*a^*b^*$  ( $L^*$  = “darkness”;  $a^*$  = red-green axis [a positive value is toward red];  $b^*$  = yellow-blue axis [a positive value is toward yellow]; see, e.g., Billmeyer and Saltzman, 1981) values calculated from the absorption spectra (see table). The data in the table also show a positive correlation between specific gravity and refractive index, as previously demonstrated for rhodolite by Lind et al. (1998). According to the classification of Lind et al. (1998), the samples from Nakta Munda, Matri Dari, and Dumer Guda were “Type 1,” and samples from the other localities were “Type 2.”

All of the samples contained the rutile and apatite inclusions that are typical of pyrope-almandine, and zircon was identified in some.

## REFERENCES

- Billmeyer F.W. Jr., Saltzman M. (1981) *Principles of Color Technology*, 2nd ed. John Wiley & Sons, New York.
- Lind T., Henn U., Milisenda C.C. (1998) Vergleichende Untersuchungen an Rhodolithen verschiedener Provenienz (Comparative investigation of rhodolite garnets from different provinces). *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, Vol. 47, pp. 53–59.

## Kanchanaburi Sapphires and Their Reaction to Heat Treatment

**Rak Hansawek** (Rak@dmr.go.th), *The Gem and Jewelry Institute of Thailand, Department of Mineral Resources, Bangkok*

Kanchanaburi sapphires are found in secondary deposits derived from the weathering of alkali basalt. On the basis of a geomorphologic study of the area, the sapphire deposits can be classified into three types: residual

basaltic soil, colluvium and talus, and placer. The placers form about 95% of the deposits. The sapphire-bearing secondary deposits can be traced from Ban Chong Dan in the north to Khao Chon Kai in the south, covering an area of about 110 km<sup>2</sup>.

Placer mining at Bo Phloi is generally confined to the approximately 3-m-thick sapphire-bearing horizon, which is located 13–15 m below the surface. The rough sapphires generally range from 0.5 to 4 ct, although a few exceptionally large stones, up to 400–700 ct, have been found. The principal gem-mining activities are concentrated in two areas: Ban Chong Dan and Ban Bung Hua Waen. Most of the larger sapphires are recovered from Ban Chong Dan, while the smaller sizes—frequently showing a finer blue color—are typically found at Ban Bung Hua Waen. Among

the other minerals found with the sapphire in varying proportions are black spinel, black pyroxene, zircon, magnetite, and sanidine.

The few kilograms of Kanchanaburi sapphire obtained for this study were separated into four groups according to their natural range of colors: blue, gray-brown, yellow, and violet. Trace-element data (see table) show that the coloration is related to Fe, Ti, Cr, and V, which are present in varying amounts. The presence of Fe is significant, because not only is it responsible for the blue, gray-brown, and yellow colors, but it also influences tone: The stones become darker with increasing Fe content. Heat treatment of gray-brown sapphires, and of sapphires that contain silky inclusions and milky white or brown color zoning, produces a blue color. The absorption spectra of the heat-treated blue sapphires indicate that their color is caused by Fe<sup>2+</sup>–Ti<sup>4+</sup> intervalence charge transfer.

Concentration (in wt.%) of some trace elements in sapphires from the Bo Phloi area, Kanchanaburi.

Locality and color	Fe	Ti	Cr	V
<b>Ban Bung Hua Waen<sup>a</sup></b>				
<i>Blue series</i>				
Dark blue	0.397	0.021	<0.001	<0.001
Blue	0.334	0.011	NA <sup>b</sup>	<0.001
Light blue	0.283	0.008	<0.001	<0.001
Very light gray-blue	0.278	0.008	NA	<0.001
Very light blue-white	0.285	0.004	<0.001	<0.001
<i>Gray-brown series</i>				
Dark gray-brown	0.322	0.012	<0.001	<0.001
Gray-brown	0.315	0.007	<0.001	<0.001
Light gray-brown	0.289	0.006	<0.001	<0.001
<i>Violet series</i>				
Light gray-violet	0.229	0.006	0.024	0.003
<b>Ban Chong Dan</b>				
<i>Blue series</i>				
Dark blue	0.441	0.017	NA	<0.001
Blue	0.357	0.010	NA	<0.001
Light blue	0.333	0.009	NA	0.001
Very light gray-blue	0.286	0.011	NA	<0.001
Extremely light gray-blue	0.307	0.013	NA	<0.001
<i>Gray-brown series</i>				
Dark gray-brown	0.349	0.014	NA	<0.001
Gray-brown	0.312	0.031	NA	0.001
<i>Yellow series</i>				
Extremely light yellow	0.301	0.010	<0.001	<0.001
<i>Violet series</i>				
Light violet	0.277	0.038	NA	0.003

<sup>a</sup>Also contains a yellow series (various shades of yellow, mostly light in color) that was not analyzed.

<sup>b</sup>NA=not analyzed.

#### Acknowledgments

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#### REFERENCE

Hansawek R., Pattamalai K. (1997) Kanchanaburi sapphire deposits. *Mineral Resources Gazette*, Department of Mineral Resources, Bangkok, Vol. 42, No. 1, pp. 17–38 [in Thai].

## Identifying Sources of Burmese Rubies

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There are two major sources of rubies in Myanmar (formerly Burma)—Mogok (Mandalay Division) and Mongshu (southern Shan State, also spelled Mong Hsu)—and several minor sources: Nawarat/Pyinlon (near Namkhan, Shan State); Nanyaseik and Tanai (Kachin State); Katpara (Kachin State); and the Sagyin and Yatkanzin stone tracts (Madaya township) near Mandalay. At Mogok and the smaller deposits, the rubies are hosted in white marble. The rubies within each tract reveal considerable diversity, but there are also strong similarities from one of these marble-hosted tracts to the next. Mongshu, where the rubies are associated with metasediments as well as marbles, yields stones that are distinctly different from those

Characteristics of rubies from five localities in Myanmar.

Variable	Mogok	Nawarat (Pyinlon)	Nanyaseik (Kachin)	Sagyin	Mongshu (heat-treated)
<b>No. gems observed</b>	Several hundred	>60	~30	>100	Several hundred
<b>Color</b>	Pinkish to intense deep red	Medium red with purplish overtone	Pinkish, rarely intense red, all with purplish overtone	Pinkish to medium red	Medium to intense deep red (blue may remain if heat treatment is inadequate)
<b>Fluorescence to long-wave UV</b>	Strong to very strong	Strong	Moderate to inert	Strong	Inert
<b>Zoning</b>	Bands and swirls	Swirls	Angular growth zones; swirls	Present	Pronounced bands
<b>Inclusions</b>					
Calcite	Common, with twinning or cleavage	Subhedral to rounded	Subhedral to rounded	Subhedral to rounded	Subhedral to rounded, but heat destroys them
Dolomite	Often yellow	Present	Present	Present	n.r. <sup>a</sup>
Apatite	Prismatic	Present	Present	n.r.	n.r.
Titanite	Present	n.r.	n.r.	n.r.	n.r.
Spinel	Present	Probably <sup>b</sup>	n.r.	n.r.	n.r.
Rutile crystals	Well-formed	Present	Very small	n.r.	n.r.
Rutile silk	Characteristic; patchy to uniform	Thin, patchy, and in bands	Thin and patchy	Rare fine particles, clouds	Comet-like wisps, fine dust-like particles and stringers
Mica	Muscovite, biotite	Biotite	Present	Present	n.r.
Feldspar	Present	Present	n.r.	n.r.	n.r.
Pyrite/pyrrhotite	Present	Probably <sup>b</sup>	n.r.	n.r.	Present
Others	Many	n.r.	n.r.	n.r.	White "snowflakes" and comet-like stringers—unknown minerals
<b>Healed fractures</b>	Occasional "fingerprints"	n.r.	Present	n.r.	"Fingerprints" are characteristic

<sup>a</sup>n.r.—not reported.

<sup>b</sup>"Probably" is stated because the inclusion was identified by its appearance only.

found elsewhere in Myanmar (in both their natural and heat-treated states). Thus, rubies from Mongshu are easily separated from those found at Mogok and the smaller deposits. These differences can be discerned using an optical microscope.

Rubies from Mogok are generally distinguished by their intense saturated pink-to-red color, noticeable daylight fluorescence, and light to moderate silk. Fundamentally, treated Mongshu rubies are identifiable by their "fingerprint" inclusions and the whitish spots and wisps produced by heat treatment to remove the blue coloring in the core, which otherwise readily distinguishes unheated Mongshu crystals. The table lists characteristics for rubies from five Myanmar localities. Mostly subtle differences exist among the other sources, although color, color saturation, and the presence or absence of silk appear to provide the best optical indicators of origin. Further research is required to assess cri-

teria for distinguishing among these sources and Mogok.

For more on these rubies, visit the Web site [http://research.amnh.org/earthplan/research/geh\\_rubies.html](http://research.amnh.org/earthplan/research/geh_rubies.html).

## Characterization of Some Emerald Filling Substances

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A wide variety of substances are used to fill the fissures in emeralds and thus enhance their appearance. Although some filling substances have been used for several decades, today a variety of modern chemical products are also employed. Given this variety, the goals of this study were: (1) to characterize some of the

properties of these substances, and (2) to determine to what extent the identity of the particular filling substance could be established.

**Materials and Methods.** We examined 39 filling substances that were known or rumored to be used in the trade, or were easily available for this purpose (see table). We grouped these filling substances into several *substance categories*: oils (greasy liquids, such as rapeseed oil); essential oils (liquids or solids extracted from plants, such as cedarwood oil) and resins (liquids or solids exuded from plants, e.g., saps such as Canada balsam; as cedarwood oil may also be considered a resin, the essential oil and 'natural' resin categories are sometimes combined); waxes (greasy solids, such as

paraffin wax); epoxy prepolymers and polymers (liquids or plastic solids with a specific chemistry); and other prepolymers and polymers (liquids or plastic solids with other chemistries). Substances in the first four categories may be natural or synthetic; those in the last two are always synthetic, and can be designated *artificial resins*.

We observed the color and refractive index of each liquid filling substance (in its loose form, not as a filling in an emerald) using standard gemological techniques. Specific gravity was compared to that of water (sink/float test), and viscosity was assessed visually. For infrared analysis, we examined the liquid filling substances as droplets mounted between two glass microscope slides (to simulate the liquid within a fissure). For

Properties of substances used to fill fissures in emeralds.

Properties	Oils	Essential oils	Resins <sup>a</sup>	Waxes	Epoxy prepolymers and polymers	Other prepolymers and polymers
Simple definition	Greasy liquids	Liquids or solids extracted from plants	Liquids or solids exuded from plants; saps	Greasy solids	Liquids or plastic solids with a specific chemistry	Liquids or plastic solids with other chemistries, especially UV-setting adhesives
Examples	Mineral oil, paraffin oil, Isocut fluid, sesame oil, <i>azeite de dendé</i> (palm oil), castor oil, green Joban oil	Cedarwood oils, clove oils, cinnamon oil, cassia oil	Canada balsam	Paraffin wax	Araldite 502, 506, 6005, and 6010; Epon 828; Epo-Tek 301, 302-3M, and 314; HXTAL resin; cured and uncured Opticon 224; uncured green Opticon 224; Permasafe; Super Tres	"Liquid Resin," Epo-Tek UVO 114 (uncured and cured), Norland Optical Adhesives types 63 (uncured) and 65 (uncured and cured)
Used in the trade?	Used historically	Popular now	Used historically	Used historically	Popular now	Becoming popular
Color	Colorless, light yellow, yellow, or green	Very light yellow to yellow, very light green	Yellow	White	Colorless, very light yellow to light yellow, green	Colorless or light yellow
Refractive index	1.449–1.479	1.509–1.589	1.521	About 1.52	1.500–1.577	1.481–1.553
Fluorescence to long-wave UV	Inert, moderate greenish yellow, moderate yellowish green	Inert, very weak green to very weak or weak yellowish green, moderate white, strong yellowish white	Strong yellowish white	Inert	Inert, weak to moderate greenish white, weak greenish yellow to yellowish green, strong bluish white to light blue	Inert, weak greenish yellow, moderate green or blue, strong blue
Fluorescence to short-wave UV	Inert, very weak greenish yellow, very weak to weak yellowish green	Inert to weak yellowish green	Very weak yellowish green	Inert	Inert, very weak yellowish green, weak greenish yellow, strong yellow; weak blue to moderate light or grayish blue	Inert, weak green, moderate green or blue
Relative specific gravity	Floats in water	Some sink and some float in water	Floats in water	Floats in water	Sinks in water; two solid samples have S.G.'s of 1.11	Sinks in water
Viscosity	Liquid; flows easily	Liquids flow easily or sluggishly; semi-solids	Liquid, flows sluggishly	Solid	Liquids flow easily or sluggishly; solids	Liquids flow easily or sluggishly; solids
Raman spectral group	B	C, D, E	C	B	A, B, C	A, C
Infrared spectral group	B	C, D	C	B	A, B, C	A, C

<sup>a</sup>Other than cedarwood oils.

laser Raman microspectrometry, we analyzed the samples as drops on a clean piece of aluminum foil.

**Results.** Visual and gemological features were not sufficient by themselves to distinguish the filling substances we examined, although some substance categories revealed distinctive properties (e.g., low refractive indices for oils). On the basis of their infrared and Raman spectra, we classified the substances into five *spectral groups* (A, B, C, D, and E). These are different from the substance categories defined above. Within each group, it is difficult to distinguish specific fillers, and some groups contain both natural substances and artificial resins. For example, spectral Group C, which contains cedarwood oil, also includes some epoxies and other artificial resins. When we analyzed some mixtures of filling substances, we could not always detect the presence of the minor component by spectroscopic means.

For more on this subject, the reader may wish to consult "On the identification of various emerald filling substances," by M. L. Johnson et al., Summer 1999 *Gems & Gemology*, pp. 82–107.

## Red Taaffeite

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Taaffeite is an extremely rare gemstone, with the formula  $\text{BeMg}_3\text{Al}_8\text{O}_{16}$ . A mineral with this ideal composition would be expected to be colorless. Gemological, chemical, and spectroscopic properties of eight chromium- and iron-bearing taaffeites (purple to purplish red) and two iron-bearing, chromium-free taaffeites (grayish violet) from Sri Lanka and Myanmar were determined.

Chemical and spectroscopic data reveal a correlation between color and trace-element contents. As determined by electron microprobe analyses, the taaffeites contain up to 0.33 wt.%  $\text{Cr}_2\text{O}_3$ , up to 2.59 wt.% FeO, and up to 2.24 wt.% ZnO. The purple to purplish red color is a complex function of the relative amounts of iron and chromium present. Optical properties and specific gravities of the 10 taaffeite samples also correlate well with their zinc, iron, and chromium contents.

We compared the spectroscopic properties of these taaffeite samples to those of chromium- and/or iron-bearing spinels; it is evident that the UV-Vis spectra of the two gem minerals are closely related. In taaffeite, however, we observed some additional absorption

bands (e.g., in the blue-to-violet range).

Analysis of the inclusions by Raman microspectrometry revealed a common assemblage of solid and multiphase inclusions, which indicates that these extremely rare red gemstones share a similar host rock. Apatite and zircon were frequently observed as solid inclusions, whereas healed fractures consisted of negative crystals that contained magnesite crystals as a solid component in addition to a fluid (liquid and/or gaseous) phase.

Methods for the distinction of taaffeite and musgravite ( $\text{BeMg}_2\text{Al}_6\text{O}_{12}$ ) were briefly discussed by Kiefert and Schmetzer (1998).

## REFERENCE

Kiefert L., Schmetzer K. (1998) Distinction of taaffeite and musgravite. *Journal of Gemmology*, Vol. 26, No. 3, pp. 165–167.

## The Techereu Gemological Field

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The Techereu gemstone area, in the Apuseni Mountains, Romania, is famous for its deposits of chalcedony, multicolored jasper, and especially agate. These gem minerals formed in a variety of geologic environments. Genetically and spatially associated with Early Tertiary (Paleogene) rhyolites are veins of chalcedony, as well as epithermal agates. Chalcedony, but only rarely agate, is associated with Mesozoic ophiolitic complexes. Within Cretaceous conglomerates, jaspers (yellowish, reddish, and multicolored) and agate concretions can be found in the Almasu Mare cobbles, particularly in those areas that have layers of volcanic cinders. Secondary deposits of Quaternary age contain chalcedony and agate that were derived from weathering and erosion of the primary gemstone occurrences.

## Demantoid Garnet from the Ural Mountains, Russia

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Discovered in the mid- to late-1800s, during the reign of Alexander II, demantoid (meaning diamond-like) is derived from the Dutch word *demant*, meaning diamond. It is mined in the Central Ural Mountains of Russia, where it is found alluvially in gold washings of the Sissersk District, Nizhni-Tagil; and from the Bobrovka River (in early times, it was called Bobrovka garnet as well).

Demantoid ( $\text{Ca}_3\text{Fe}_2[\text{SiO}_4]_3$ ) is a variety of andradite

that is colored green by chromium. The stones range from pale green to yellowish green (due to trace amounts of iron) to a fine “emerald” green. Its refractive index (1.89) and dispersion (0.057) are both the highest of all natural garnets. In spot illumination, a faceted stone will typically show a fine play of prismatic colors. When present, “horsetail” inclusions are usually preserved during cutting; their presence adds value to the stone.

Currently, most of the Russian demantoid comes from the Karkodino mine, about 20 km from the still-active Bobrovka area. Due to increased mining costs, fewer miners are working the deposits and production has decreased. Melee-sized material is still readily available, but larger sizes are uncommon; this year only four stones were recovered that cut gems weighing more than 4 ct (W. Larson, pers. comm., 1999).

### **Infrared Spectroscopy as a Discriminant between Natural and Manufactured Glasses**

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Glass, the great gem imitator, is still popular in today’s fashion-conscious world. Natural glasses include obsidians, impactites (e.g., tektite/moldavite, Libyan Desert glass), and other naturally fused silica glass (e.g., fulgurite). Manufactured glasses include a wide range of materials with various colors, textures, and compositions. As a result, the gemological properties of manufactured glass may overlap those of natural glass. Some glasses are of dubious origin, such as “Mount St. Helens glass” and various transparent blue or green “obsidians.” Standard gemological testing is usually sufficient to separate most natural from manufactured glasses, but occasionally, advanced techniques (e.g., Fourier-transform infrared [FTIR] spectroscopy) are necessary for identification.

Eighty-five samples of both types of glasses, which had been identified and characterized by standard gemological methods, were also studied by FTIR spectroscopy. Natural glasses suitable for use as gemstones are high in silica and relatively low in alkalis. Spectra obtained from the mid-infrared range (2000 to 6000  $\text{cm}^{-1}$ ) showed that major differences in the chemistry of natural and manufactured glasses are reflected in the infrared spectra. The absorption spectra of most obsidians show a saturated “hump” that rises sharply at about 3700  $\text{cm}^{-1}$  and tails off to lower wave numbers (about 3000  $\text{cm}^{-1}$ , but this is quite variable). Moldavite and Libyan Desert glass show an asymmetrical absorption peak at 3700  $\text{cm}^{-1}$ .

Manufactured glasses show a wide variation in

chemical composition, which is reflected in a much greater variation in their infrared spectra, as compared to those of natural glasses. They commonly show a broad plateau from about 3600  $\text{cm}^{-1}$  to the absorption edge at approximately 2100  $\text{cm}^{-1}$ , with superimposed broad peaks at 2830  $\text{cm}^{-1}$  and about 3520  $\text{cm}^{-1}$ . The intensity of the superimposed peaks is variable. A number of specialty glasses show unusual complex spectra that are indicative of their manufactured origin. All of the brightly colored “obsidians” in this study showed spectra that were consistent with manufactured glass. There are, however, some slag glasses and fused silica glasses that have spectra that are too similar to those of natural glass for a conclusive identification with FTIR spectroscopy alone.

### **Rudraksha—A Spiritual Organic Gem**

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In India, the *rudraksha* (*ruda* = Lord Shiva, *aksha* = eye) has been used as a spiritual ornamental material from time immemorial. Rudraksha, the seedpods of *Elaeocarpus ganitrus*, are covered with protrusions and grooves, by which they are classified into 14 different types or *Mookhis* (i.e., mono-grooved to 14-grooved varieties). Various other types—such as twins, triplets, and those that occur in a comma shape—also exist, as well as different simulants and imitations. This study represents the first time the gemological properties and biological effects of this organic gem material have been investigated.

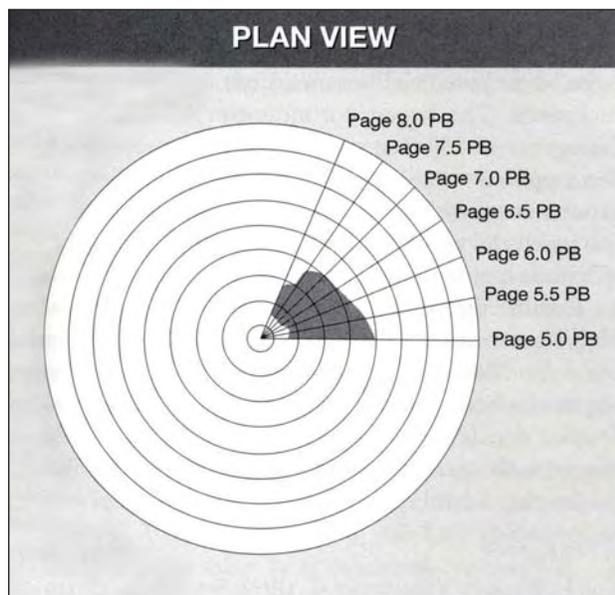
Most *rudraksha* show R.I.=1.52, S.G.=1.05–1.6, and a hardness of approximately 3.5. Chemical analyses show 49.89 wt.% carbon, 1.04 wt.% nitrogen, 16.85 wt.% hydrogen, 31.27 wt.% oxygen, and 0.58 wt.% trace elements (total = 99.63).

The biological effects of *rudraksha* as individual beads as well as in a rosary are being studied. Preliminary investigations indicate that *rudraksha* has an influence on the autonomic nervous system involving the sympathetic and parasympathetic nerves.

### **California Benitoite: A Proven Mineable Reserve and New Gemological Data**

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Commercial quantities of gem-quality benitoite are known from a single location in the world, the Benitoite Gem mine in San Benito County, California.



The color space outlined on this hue-saturation diagram represents color observations of 123 faceted benitoites, as judged with standardized lighting and viewing conditions. “Page” refers to the “purple-blue” (PB) page number in the Munsell Book of Color.

Benitoite, a barium-titanium silicate ( $\text{BaTiSi}_3\text{O}_9$ ), was discovered there in 1907, and was named the California state gemstone in 1985. It is typically colorless to blue, and is noteworthy for its high refractive indices, high birefringence, and strong dispersion. A total of about 5,000 carats of faceted benitoite have been produced sporadically over the life of the deposit. This very limited production has historically relegated benitoite to a collector’s gem, one of the rarest in the world. (See Laurs et al., 1997, for details on the discovery and gemology of benitoite, and the history of the Benitoite Gem mine.)

The Benitoite Gem mine is currently under option to AZCO Mining Inc., which has spent nearly US\$1 million over the past two years exploring the mineral deposit and defining a mineable reserve. This was done by means of an extensive bulk sampling and core drilling program. The proven and probable reserve from the alluvial and colluvial sources is estimated at >25,000 carats of polished goods (mostly melee-sized material). This is sufficient for commercial production, and for maintaining stability of price and supply for many years to come.

Benitoite is the subject of a collaborative characterization study between AZCO and GIA. This study is investigating the cause of color (which is still unknown), and will address the gemstone’s durability in the manufacturing environment. Standardized color

observations of 123 faceted benitoites were made at the GIA Gem Trade Laboratory in New York. The hue spans a narrow range in Munsell color space, from 5.0 PB (purple-blue) to 8.0 PB (see figure). About 75% of the population occupies half of this domain, in the region from 5.0 to 6.5 PB. The more violetish stones tend to be deeper in tone, and are less common than the more bluish stones.

#### REFERENCE

Laurs B.M., Rohtert W.R., Gray M. (1997) Benitoite from the New Idria district, San Benito County, California. *Gems & Gemology*, Vol. 33, No. 3, pp. 166–187.

## The First California Gem Tourmaline Locality

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The first gem tourmaline recorded in California was reportedly encountered as loose crystals on the southeastern part of Thomas Mountain, Riverside County, in June 1872 (Kunz, 1905). Two decades later, claims were staked at the granitic pegmatite source of these crystals—under the names California Gem mine and San Jacinto Gem mine in December 1892, and the Colombian Gem Mine in July 1893. The deposit subsequently became known as the Columbia [sic] Gem mine, and in 1957 was renamed the Belo Horizonte No. 1 mine. According to Hamilton (1919), more than a “bushel” (>35 liters) of red and green tourmaline crystals were mined during the first season’s operation. Many exquisite tourmaline specimens were produced during the first years of operation, the larger crystals nearly always showing “watermelon” coloration, with red interiors and green rims. Hamilton (1919) reported that \$10,000 worth of gem tourmaline was produced from the California Gem mine in 1894, from shallow trenches cut into the steeply dipping host pegmatite.

Gem- and specimen-grade elbaite occurs in clay-filled cavities (“pockets”) within the host pegmatite. This tourmaline forms euhedral, multicolored (rarely colorless) crystals up to 10 cm in diameter and 20 cm long. Color zoning when viewed parallel to the *c*-axis characteristically shows a concentric pattern composed of a large core that is orange, red and/or violet, a very thin white to colorless intermediate zone, and a narrow green rim. Sector zoning is commonly observed, exhibited as red “Mercedes” triangles similar to liddicoatite from Madagascar. Color zoning when viewed perpendicular to the *c*-axis generally progresses from black at the base, through violet, red, and/or orange, with or without green and/or blue terminations. The

crystals contain planes of multiphase (solid + liquid + vapor) inclusions that are often truncated at various stages by continued growth. These inclusions signify violent pocket-rupturing events during and after tourmaline crystallization. Primary multiphase inclusions are commonly found within the green rims as narrow tubes oriented parallel to the c-axis. Rare inclusions of microlite were also identified, by electron microprobe.

Chemical trends measured by numerous electron microprobe analyses of the pocket tourmaline are correlative with the color zonation, and range from initial precipitation of iron-rich compositions (blue-to-violet schorl and foitite), to iron depletion with manganese enrichment (pink and red-to-orange elbaite), followed by slight enrichment of iron and calcium with manganese depletion (green-to-blue elbaite). The manganese content reaches a maximum of 8.45 wt.% MnO in the red zones. One pocket produced small colorless crystals of highly aluminous tourmaline that span the compositional boundary between two extremely rare tourmaline species, olenite and rossmanite.

A recently discovered productive area within an adjacent pegmatite from an adjoining claim exhibits a remarkable similarity to the original pegmatite. Moreover, a survey using ground penetrating radar (GPR) confirmed that both producing pegmatites continue for tens of meters along strike. Past production from the very limited exploitation of the pegmatites suggests that significant quantities of gem tourmaline could be produced from this locality in the future.

#### REFERENCES

- Hamilton F. (1919) Report XV of the State Mineralogist. *Mines and Mineral Resources of Portions of California*, California State Mining Bureau, Sacramento, California, pp. 574–577.
- Kunz G.F. (1905) *Gems, Jewelers' Materials, and Ornamental Stones of California*. Bulletin No. 37 of the California State Mining Bureau, San Francisco, California, 171 pp.

## Sapphires from Shandong, China

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Gem-quality sapphires were discovered in secondary deposits in Shandong Province in 1986 and, subsequently, in 1988 as primary deposits in nearby basalts. The secondary deposits, situated in the vicinity of Wutu, Qiaoguan, and Cuijia, are of two types: eluvial (including concentrations in talus) and alluvial. The *in situ* deposits are mainly located in the vicinity of Fangshan. Total reserves are estimated at 100 million carats.

The Shandong sapphires are typically found as

large, dark blue, well-formed crystals that contain few inclusions. The largest corundum crystal discovered so far weighed 2,500 grams. For commercial purposes, the sapphires are divided into five groups. Four of the groups are based on color: blue, yellow, green, and brownish red and pink. The fifth group is composed of specimen-grade material.

Because the color of most Shandong sapphires is dark blue, heat treatment is commonly performed to improve the color. When heated to about 1,900°C in an oxidizing atmosphere, a more desirable blue color is obtained. Further details on the history of sapphire exploration in this area, the geology the deposits, and the chemistry of the sapphires can be found in Guo et al. (1992).

#### REFERENCE

- Guo J., Wang F., Yakoumelos G. (1992) Sapphires from Changle in Shandong Province, China. *Gems & Gemology*, Vol. 28, No. 4, pp. 255–260.

## Surface-Enhanced Topaz

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At the 1998 Tucson Gem Fair, a new type of enhanced topaz made its appearance (Johnson and Koivula, 1998; Hodgkinson, 1998). This treatment has been described by one producer of blue-to-greenish blue treated topaz—Richard Pollak of United Radiant Applications in Del Mar, California—as a surface-diffusion process that produces a thin layer of color at and just below the surface of an otherwise colorless topaz. Charles Lawrence of CL Laboratories in Encinitas, California, is using a similar process to produce a wider range of colors, including an “emerald” green. According to both manufacturers, the color layer results from heating topaz in a cobalt-rich powder.

Our microscopic examination of several samples confirmed that the color of this material is confined to a layer at and just beneath the surface. This layer is so thin that the question has arisen as to whether it represents a surface coating or a surface-diffusion process. However, according to Trogler (1998), the surface composition (as determined by energy dispersive analysis) shows a high concentration of cobalt, which suggests a heavily doped surface layer. Trogler (1998) further states: “The ratios of the wt.% values of the nonoxygen element is [sic] probably most meaningful. Pure topaz has an Al:Si ratio of 1.92, whereas the green stones (treated topaz) have a ratio of 1.41. This suggests extensive substitution of Al by cobalt in the surface layer. The weight percentage of the silicon sug-

gests it is perturbed the least, and so the ratios relative to silicon are most useful.”

The properties of the 14 samples of blue-to-green surface-treated topaz that we examined are summarized in the table. The most important identifying feature is a spotty surface coloration that was best observed by placing a translucent white glass or plastic diffusion filter over the light well of the microscope. A lack of color at the facet junctions was also noted in many of the samples. In addition, on several stones the surface was chipped, thus revealing the colorless topaz beneath the colored layer.

Perhaps the most unusual gemological characteristic of these surface-enhanced topazes were the anomalous R.I. values. When tested on a standard gemological refractometer, the table facet displayed “normal” R.I.’s (i.e., a distinct shadow edge at 1.608–1.620), whereas the pavilion facets showed a broad, diffuse band, or measured above the 1.81 limit of the refractometer. Thus, it appears that portions of the topaz surface might be transformed into mullite, glass, or other substances (Day et al., 1995). According to Phillips and Griffen (1981), mullite has a refractive index in the range of 1.634–1.690, while glass can be higher or lower. However, the transformation of the surface layer into either mullite or glass would not explain the wide range of R.I. readings. It is more likely that the high concentration of cobalt near the surface is responsible for the high R.I. readings, whereas variations in the depth of post-enhancement polishing could account for the

other anomalous R.I. readings. Indeed, our testing showed that a single stone can produce a variety of R.I. readings, depending on which facet is tested.

With gemstone enhancements so common in today’s colored stone market, we can expect to see more such novel treatments in the future. Fortunately, in the case of this cobalt-diffused topaz, the identification is rather simple.

#### REFERENCES

- Day R.A., Vance E.R., Cassidy D.J. (1995) The topaz to mullite transformation in heating. *Journal of Materials Research*, Vol. 10, No. 11, November, pp. 2963–2969.
- Johnson M.L., Koivula J.I. (1998) Gem news: Surface-treated topaz. *Gems & Gemology*, Vol. 34, No. 2, pp. 143–144.
- Hodgkinson A. (1998) Scottish gem lab news. *Australian Gemmologist*, Vol. 20, No. 4, pp. 154–158.
- Phillips W.R., Griffen D.T. (1981) *Optical Mineralogy: The Nonpaque Minerals*. W.H. Freeman and Co., San Francisco, 677 pp.
- Trogler W.C. (1998) *Preliminary evaluation of green versus blue topaz*. Private report prepared for Charles Lawrence, CL Laboratories, 4 pp.

## DIAMONDS

### Diamond Deposits of Angola

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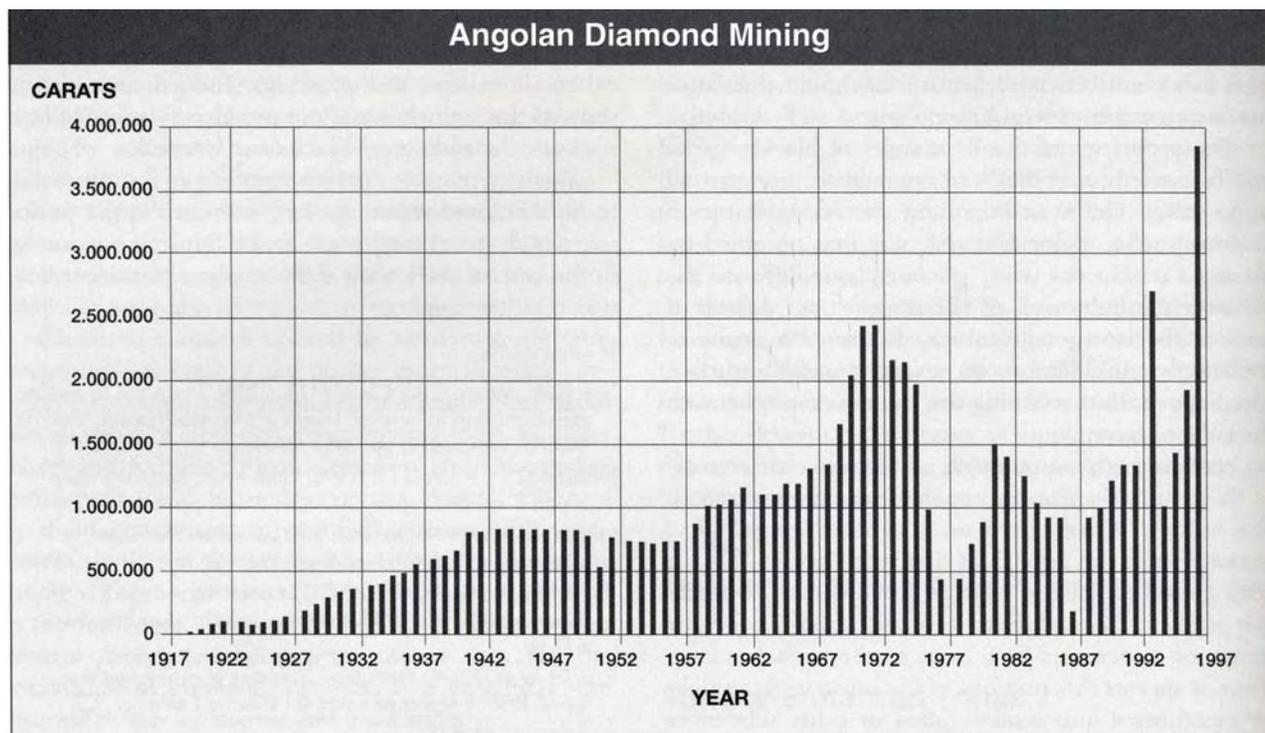
Angola has been an important and consistent source of rough diamonds, a high proportion of which are good-quality gems, for much of this century (see figure). Since independence from Portugal in 1975, Angola’s diamond production has been erratic. The diamond mining industry is currently recovering from the country’s internal political turmoil, and should enhance its relative position in the world’s rough diamond trade with even greater production in the next decade.

The main diamond-producing region is located in the Lunda Norte area (northeast Angola), with most of the production coming from alluvial deposits in the Cuango River valley. Activity by unlicensed miners has grown dramatically in recent years, in tandem with civil strife; however, the importance of this component of Angolan diamond production appears to have reached its peak and is expected to decline with the arrival of political stability.

There are at least 700 known kimberlite pipes in Angola, and the potential for the discovery of additional pipes is high. Only a few of these have been thoroughly evaluated and, at present, production from these primary sources is minor compared to that from the

#### Properties of blue to green surface-treated topaz.

Color	Blue to greenish blue to green
Color distribution	Even to the naked eye, patchy surface coloration seen with magnification, often with green spots; white facet junctions/chips visible against a white diffusion filter
Luster	Resinous subadamantine luster on polished surfaces
Pleochroism	None to faint; possibly two different shades of blue
Optic character	Doubly refractive; biaxial, positive to undeterminable
Refractive index	
Table facet	$n_{\alpha} = 1.608\text{--}1.610$ ; $n_{\beta} = 1.610\text{--}1.614$ ; $n_{\gamma} = 1.618\text{--}1.620$ (birefringence = 0.009–0.010)
Pavilion facets	Anomalous or diffuse readings; often above 1.81
Specific gravity	3.50–3.63
UV fluorescence	
Long-wave	Inert to very faint red
Short-wave	Inert to faint yellowish green or very faint red
Visible spectrum	Cobalt spectrum: bands at approximately 560, 590, and 640 nm; strongest in blue stones, weaker in green stones
Magnification	Strings of parallel particles; crystals or negative crystals with tension fractures
Chelsea filter	
Green stones	Pinkish purple
Blue stones	Red



alluvial deposits. Mining started on the first kimberlite, Catoca, in 1997, and others presently being evaluated include Camafuca-Camazamba, Camatchia, and Camagico. Nevertheless, for the near future, the main diamond production, and especially value, will still come from the alluvial deposits in the Lunda region.

At present, diamonds are the second most important mineral resource in Angola (after oil). Every effort, including favorably revised mining laws, is being made to encourage foreign investment in this sector. This endeavor has been successful, as numerous foreign companies (from, e.g., South Africa, Russia, Brazil, Canada, and Portugal [SPE, through a 49% interest in SML—Sociedade Mineira do Lucapa]) are now exploring for, and developing, diamond mines. Toward this end, fundamental geologic and other scientific knowledge of Angolan diamonds and their deposits (e.g., determining the most effective exploration methods, cataloguing all the deposits, and determining the grade and quality of stones in various deposits and districts) is being assembled.

### Studies of the Pink and Blue Coloration in Argyle Diamonds

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A suite of 13 pink and three blue diamonds from the Argyle deposit were examined using electron spin res-

onance (ESR), Fourier-transform infrared spectroscopy (FTIR), luminescence, and other techniques in an attempt to identify the color centers responsible for their coloration. Seven of the pink samples had saturations ranging from low to high, whereas the other six pink diamonds showed similar moderate saturation. The blue samples showed high saturation.

No new or unique ESR centers were observed in the pink samples, indicating that the color center responsible for their pink color was not ESR active. Some correlation was apparent between the ESR P1 center (single uncharged nitrogen) and the saturation level of the pink diamonds: The intensity of the P1 center increased with the strength of the pink color. This correlation is obviously not direct, however, as the P1 center is also present in non-pink diamonds.

A striking relationship was observed during photo- and thermo-chromic experiments, in which the color saturation of the pink diamonds was altered with UV radiation or heat treatment. These color changes were reflected by modifications to the concentrations of P1 and other nitrogen centers in the specimens. The darker heat-induced colors were accompanied by a substantial reduction in the P1 levels.

A possible explanation for these observations is that the pink color center exists in more than one charge state, only one of which gives rise to the pink color. The P1 center is a strong donor (of electrons) and will affect the Fermi level in a diamond. This level will, in turn, determine the population of the charge state of

the center that causes the pink coloration. UV radiation or heat treatments may thus induce charge transfers between pink color centers and nitrogen defects.

Photo-luminescence (PL) spectra of pink diamonds using 633 nm excitation revealed several sharp lines. One set, comprising lines at 1.871, 1.817, and 1.693 eV, showed a strong correlation to the depth of pink coloration. Specimens that did not conform to this correlation exhibited atypical IR spectra for Argyle pink diamonds, which mostly have low levels of nitrogen. Some of the PL peaks were at energies very similar to those that have been reported (Sittas et al., 1996) for Ni-Si catalyzed synthetic diamonds.

Electron paramagnetic resonance (EPR) and electron nuclear double resonance (ENDOR) analysis of the blue diamonds showed the NE2 center, which has been observed in synthetic diamonds for which the center has been proposed to be an  $\text{Ni}^+$  ion with three neighboring nitrogen atoms (Nadolinny and Yelisseyev, 1994). A previously unreported EPR center was observed, which is consistent with an  $\text{Ni}^-$  ion in a substitutional site with a  $\text{N}^+$  ion on a fourth nearest neighbor site. This defect is found exclusively in Argyle blue diamonds. The presence of high concentrations of nitrogen and hydrogen has also been reported in Argyle blue diamonds (Fritsch and Scarratt, 1992), but it is not clear how they are related to the nickel centers observed or to the color.

The presence of nickel in Argyle blue diamonds and the PL observations for the pink diamonds suggest that nickel may be involved in the pink coloration.

#### REFERENCES

- Fritsch E., Scarratt K. (1992) Natural-color nonconductive gray-to-blue diamonds. *Gems & Gemology*, Vol. 28, No. 1, pp. 35–42.
- Nadolinny V., Yelisseyev A. (1994) New paramagnetic centers containing nickel ions in diamond. *Diamond and Related Materials*, Vol. 3, pp. 17–21.
- Sittas G., Kanda H., Kiflawi I., Spear P. (1996) Growth and characterization of Si-doped diamond single crystals grown by the HTHP method. *Diamond and Related Materials*, Vol. 5, pp. 866–869.

## The Revolution in Cut Grading

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In the 19th century and earlier, diamonds were cut in a variety of ways, with no generally accepted standards of comparison. In the 20th century, many cutters adopted the “ideal” proportions predicted by a mathematical model for a round brilliant diamond. The attractiveness of this model was that it provided a set of proportions

that, if carefully executed, seemed to consistently yield the most pleasing final beauty—or at least so it was assumed, because there was no way of measuring the results.

It is probable that if cutters of the past had at their disposal means of measuring the beauty that results from cutting, they would not have cut diamonds to match a model based on external proportions. Results of cutting can be better comprehended with a simple understanding of diamond’s most attractive feature—the reflection of light. All the bright light we see in a polished diamond originates from above the girdle and is reflected back to the viewer overhead. Advances in computer-aided light analysis reveal the behavior of light in a diamond in ways previously only suspected. If a diamond is to be an efficient reflector of light, the cut must minimize light leakage through the pavilion. Computer-aided mapping helps the cutter understand how to use a combination of angles to minimize light leakage. Although only the first step in analysis of cut, measurement of light leakage is fundamental to understanding light return.

The efficiency with which a diamond returns light back to the viewer is also a measure of the precision of its cutting. Since the viewer blocks some incoming light, a diamond’s facets must work as a team to return light that is coming from around the viewer back to the viewer. Reflective symmetry that is chaotic is much less efficient in light return to the viewer. High cut symmetry, at traditional “ideal” or near-“ideal” angles, provides some of the best return of light as measured using computer-aided light analysis. Such analysis enables a new understanding of diamond cut—by letting light speak for itself.

## Detection of Irradiated Diamonds

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The recent availability of low-cost spectrophotometers with high optical resolution has led to the development of personal computer-based spectrophotometer systems (i.e., SAS2000; see <http://www.SAS2000.com>). When optimal Kalman filter data-processing techniques are used with such systems, it is possible to automatically check transmittance or absorbance data for the existence of radiation damage. It has been shown repeatedly that visible absorption spectra taken at room temperature are sufficiently accurate to enable the detection of the radiation damage that is characteristic of irradiated diamonds, even in cases where that damage is not readily apparent with standard spectrophotometric techniques.

With these new systems, the entire analysis can be accomplished in about one minute, in contrast to the lengthy examination procedures sometimes required by current gemological techniques. In addition, these new systems may have eliminated the need for cryogenic freezing of the samples in the vast majority of cases. For example, the transmission spectra (collected at room temperature) of treated yellow diamonds reveal spectral features indicative of radiation damage when the data are processed using a Kalman filter—a doublet at 741–744 nm, which is not visible using conventional spectroscopy, and peaks at 478, 497, 503, and 595 nm. When standard spectrophotometric techniques are used at room temperature, the visibility of these latter peaks, as with the 741 nm peak, depends on the extent of annealing after irradiation. The SAS2000 system was also used to detect—for the first time—a diagnostic absorption band at 701 nm in red type Ib color-treated Russian synthetic diamonds (see Weldon, 1999). This optical center was probably missed by other spectroscopists because of the common use of absorbance mode displays, rather than the primary SAS2000 transmittance mode of analysis. A peak at 638 nm is also characteristic of these treated synthetic diamonds.

#### REFERENCE

Weldon R. (1999) With a tweak and a smile. *Professional Jeweler*, Vol. 2, No. 3, pp. 26, 28.

## Exploring Cut and Diamond Appearance with the Virtual Diamond

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We have combined modern computer graphics techniques, a mathematical description of the exact shape of a round brilliant, and equations for the properties that govern how light travels through diamond to produce a “virtual” diamond—a computerized tool for detailed and thorough exploration of how cut affects diamond appearance. Tracing light through a virtual diamond of any chosen proportions yields either an image of that diamond (see figure), or a numerical result related to its appearance, such as brilliance, fire, or scintillation. Modeling diamond appearance with a computer allows us to control, and separately vary, each of the many proportion, lighting, and observation variables.

The virtual diamond is three-dimensional, faceted all over (including the girdle), and (at present) colorless, flawless, and with perfect symmetry and polish.

Dispersion of light is incorporated with a wavelength-dependent refractive index. We account for partial reflection and refraction by calculating the polarization state of each ray as it moves through the virtual diamond. Millions of rays of different colors are traced between the modeled light source, the virtual diamond, and the modeled observer, and each ray is followed until 99.99% of its energy has exited. Most rays follow a complex three-dimensional path, with more than three reflections; and rays of different colors entering the same spot at the same angle generally disperse, exiting the virtual diamond along entirely different paths.

We have developed a numerical measure for brilliance called *weighted light return* (WLR), which uses a diffuse hemisphere of white light and a weighted-average observer (Hemphill et al., 1998). This lighting condition emphasizes brilliance over the other appearance aspects, and the observing condition captures the light returned to a predominantly, but not strictly, face-up position. WLR was calculated for over 20,000 proportion combinations, to explore primarily variations in crown angle, pavilion angle, and table size. Variation of one parameter alone yields results in general agreement with previous work on this question, such as that of Marcel Tolkowsky (1919). However, variation of two or three proportions together shows that WLR depends more strongly on the combination of proportions than on the exact value of any one of them.

*Various appearance aspects of the virtual diamond can be emphasized by modeling different kinds of lighting. This computer-generated image shows how diffuse lighting emphasizes brilliance, while minimizing contrast, extinction, and fire.*



WLR values do not form a “bull’s-eye” around some set of best proportions. Instead, rather wide ranges of proportions, in the right combinations, produce very similar WLR and a similarly bright appearance to the eye. For example, with a pavilion angle fixed at 40.5°, combinations as different as a 23° crown angle with a 65% table, and a 35° crown angle with a 53% table, yield different image patterns but similarly high WLR values. WLR also shows a complex dependence on some of the other proportions, particularly the length of the star facets.

The development of a numerical expression for fire is the next step in this research. Despite the way that diffuse light reduces fire, images made with that lighting show some dispersed light. These results suggest that the amount of this fire, as well as its position and nature, vary with proportions in a complex way.

#### REFERENCES

- Hemphill T.S., Reinitz I.M., Johnson M.L., Shigley J.E. (1998) Modeling the appearance of the round brilliant cut diamond: An analysis of brilliance. *Gems & Gemology*, Vol. 34, No. 3, pp. 158–183.
- Tolkowsky M. (1919) *Diamond Design: A Study of the Reflection and Refraction of Light in a Diamond*. E. & F.N. Spon Ltd., London, 104 pp.

## Describing Diamond Colors with Common Names

**Stephen Hofer** ([stephenhofer@netscape.net](mailto:stephenhofer@netscape.net)), *Fancy Color Consultants, Stockbridge, Massachusetts*

Common names such as *canary*, *lilac*, *champagne*, and *cognac* have been used for more than two centuries in the diamond industry as a simple and effective method for communicating colors (Hofer, 1998). These basic color terms are essentially part of the vocabulary of everyday life, and over the years they have gradually established themselves as part of the color nomenclature spoken by diamond professionals.

In the modern diamond trade, the utility and simplicity of common names is slowly being pushed aside in favor of color-measuring instruments and numerical color-grading systems that aspire to describe diamond colors with greater accuracy and precision. However, when used correctly, common color names offer the retail jeweler a subtly sophisticated method for describing diamond colors that incorporates the three elements that all colors possess—hue, lightness or darkness (also known as tone), and saturation—into a single word.

The purpose of a common color name is to communicate the appearance of a given color, or to enable someone to “think in color.” Therefore, the common name chosen must be so characteristic of the color’s

appearance that it is readily understood by others. Since our environment is the source of many colors, it is here that we must look for objects of typical colors, objects for which we already have names and which can be used to describe a specific diamond color.

The essence of effective color communication is simplicity: the simpler the color-naming system, the easier it is for someone to comprehend the message. With colored diamonds, the naming of colors begins with color by analogy. Lilac, for example, is derived from the analogous color of the flowers of the hearty shrub (*Syringa vulgaris*), denoting a purple hue, with light to dark tone and moderate saturation.

#### REFERENCE

- Hofer S.C. (1998) *Collecting and Classifying Coloured Diamonds*. Ashland Press, New York.

## Is *Ideal* Really *Ideal*? How the Cut Affects the Beauty of Diamonds

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For many years, diamond cutters have been debating and investigating the requirements necessary to create the most attractive diamond. Various instruments have been developed to assess diamond appearance. Probably the most significant tool is an instrument (Sarin BrilliantEye) that measures the facet angles on the finished diamond. This allows cutters to refine their faceting and improve the repeatability and quality of their cuts.

Various studies have focused on defining the “Ideal” cut that will best maximize the qualities of the diamond. These projects have resulted in much of the industry assigning a particular arrangement of facets as being most desirable, although many others disagree with this “assignment.”

An alternative approach is to actually measure a stone and quantify its light performance. How well does the stone disperse white light into its color components? How well does it return light from within the crown? How bright does the stone appear? Using new technology (BrillianceScope Analyzer by GemEx Systems Inc.), all of these characteristics can now be quantified. Certain facet arrangements result in greater dispersion, others result in brighter stones, and still others result in more scintillation.

This evaluation method can be applied to all diamond shapes, not just round brilliants. The results are more easily understood than through comparison to a particular geometric arrangement. By providing multiple illumination conditions and angles in the measure-

ment process, the instrument does not unfairly reward a single facet arrangement, and overall appearance quality can be assessed. Using this measurement technique, lapidaries are able to refine their cuts for any particular characteristic desired: brilliance, brightness, dispersion, or scintillation.

## GENERAL GEMOLOGY

### Visions of Gems: The Photodocumentation of Gemological Subjects

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**John Koivula**, *GIA, Carlsbad, California*

In the field of gemology, it would be very difficult for lecturers and teachers to present information without the aid of photography. So too, in the publication of gemological information, does the visual presentation of appropriate photo-images add greatly to any article or book. This is because color and form are intrinsic to gemstones and gemology, and they are not easily described with words alone. For cases where color is not critical, black-and-white reproductions are inexpensive to publish and can be very informative (see figure).

Just imagine how “dry” a gemological speech would probably be, or how lifeless an article would appear, without photographs. Photo-images break the monotony of a “talking heads” presentation, or page-after-page of text. Good-quality photographs draw people into a speech, book, or article, and help to maintain their interest. In gemology, a picture truly is worth a thousand words . . . and quite often much more.

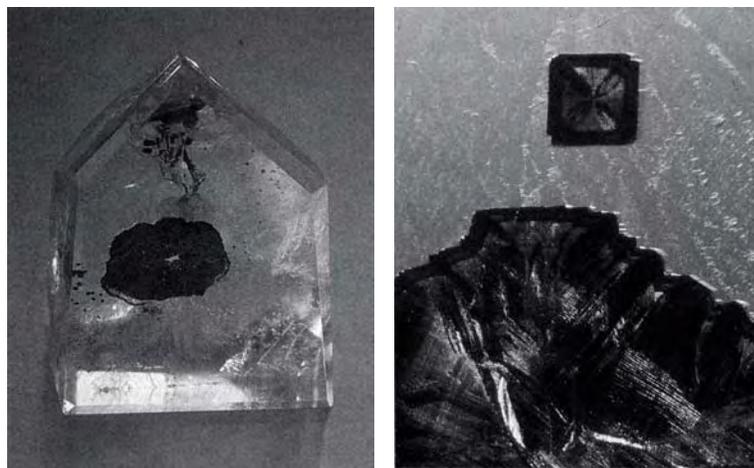
Gemological photography involves both art and sci-

ence. The photographer must have scientific knowledge of a subject in order to bring out significant details, but he or she also must be able to present those details artistically, in a pleasing photograph. Gemological photographs can be divided into two distinct categories: macrophotography and photomicrography (again, see figure). Macrophotography deals in the “macro world.” In this arena, the gem photographer prepares images of objects such as jewelry pieces, suites of gemstones, or gem rough. This is in essence a presentation of what the human eye would see without the aid of instrumentation. Photomicrography, on the other hand, is concerned with the “micro world.” The photomicrographer explores the surfaces and interiors of gemstones with a gemological microscope, and prepares photomicrographs as illustrations useful for conveying gemological information that is normally hidden from view. Although these two disciplines have their differences in the areas of subject preparation, film types, lighting, and photographic equipment, they often work hand-in-hand to complete a gemological picture of a particular subject.

### Laser Ablation–Inductively Coupled Plasma–Mass Spectrometry: A New Way of Analyzing Gemstones

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Energy-dispersive X-ray fluorescence (EDXRF) spectrometry has been used for years by some gemological laboratories to determine nondestructively the trace-element composition of faceted rubies and sapphires. However, because of the limited sensitivity for many



*The macrophotograph on the left dramatically illustrates the partial oxidation of a discoid pyrite inclusion within a polished sample of Brazilian quartz (43.54 × 29.07 × 17.54 mm); photo by Maha DeMaggio. On the right, a close-up of the pyrite inclusions reveals the angular edging and structure of the pyrite inclusions; the square outline of the smaller satellite crystal exemplifies its isometric nature. Photomicrograph by John I. Koivula; magnified 40×.*

elements, the EDXRF technique is capable of measuring only a few trace elements that are useful for geographic origin determination—especially for blue sapphires, for which very few diagnostic elements are detectable by EDXRF. Laser ablation–inductively coupled plasma–mass spectrometry (LA–ICP–MS) is a powerful analytical technique for chemically analyzing a wide variety of solid materials. It has been used for many years at laboratories around the world, in fields other than gemology. However, largely because of improvements in equipment design, LA–ICP–MS now has significant potential application to gemological materials. It could provide accurate chemical data for determining (1) natural versus synthetic origin, (2) origin of color, and (3) country-of-origin determination for several gemstones, including ruby, sapphire, emerald, alexandrite, and perhaps even diamond.

LA–ICP–MS has several advantages over EDXRF, such as improved detection limits and comparatively few spectral and nonspectral interferences. Therefore, all of the trace elements of interest in gem materials—including light elements—not only are detectable, but also are measurable to parts per million or even parts per billion, by LA–ICP–MS. New generations of ICP mass spectrometers make it possible to analyze major, minor, and trace elements within a single analysis.

Although LA–ICP–MS is locally destructive, the extent of damage can be kept to a minimum (i.e., a few nanometers of sample per laser pulse). A preliminary study using blue sapphire samples revealed that the very minor damage is difficult or sometimes impossible to see with 10× magnification. The data from this study indicated that it should be possible to distinguish sapphires from different geographic locations using LA–ICP–MS. However, for this technique to be useful in gemology, several challenges must be overcome. An extensive database of LA–ICP–MS analyses must be obtained from a sufficiently large and credible collection of gemstones of known geographic origin or, as appropriate, synthesis. Gemological application will also require specialized computer programs for multivariate analysis to recognize meaningful correlations among the large quantities of data that this technique generates.

## The Gem & Mineral Council

**Danusia Niklewicz**, *Former President—Gem & Mineral Council, Los Angeles County Museum of Natural History, California*

The Gem & Mineral Council of the Natural History Museum of Los Angeles County, founded in 1985, is the world's foremost gem and mineral museum support and public programming organization. Members have

many opportunities to advance their knowledge and enjoyment of gems and minerals through a variety of programs, including exciting field trips, educational lectures, and exclusive social events. Examples of some organized trips that the Council has sponsored include (1) a trip to Russia that revolved around the theme of Russia's gem heritage, (2) several trips to Brazil that included opportunities to visit mines and meet dealers in pursuit of gems and minerals, and (3) field trips to several important mineral localities in the U.S. Proceeds from annual dues, field trips, and fund-raising activities support the museum's Mineral Science Section, allowing it to maintain and expand its world-class gem and mineral collection and gallery, organize special exhibits, undertake mineralogical and gemological research, and generally benefit the gem and mineral community and the public at large.

The Gem & Mineral Council and the Mineral Sciences Section recently initiated an intriguing fund-raising effort entitled "Adopt-a-Mineral." This program gives members of the public a way to have a direct impact on the growth of the Museum's gem and mineral collection, and at the same time to offer a means of dedicating a specimen to the person of their choice. To further its educational outreach, the Council recently produced the highly useful *Photo-Atlas of Minerals* CD-ROM. The Council encourages other museums and groups to emulate its methods of promoting education about gemstones and supporting related projects.

## Shedding a New Light on Medieval Darkness

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The treasury of Basel Cathedral in Basel, Switzerland, is fascinating not only for the artistic quality and richness of its pieces, but also for its long history. Through donations and occasional purchases during the 500 years from the early 11th century until the advent of the Reformation in the early 16th century, several hundred goldworks were collected in the cathedral of the Bishopric of Basel. These crosses, monstrances, and various other religious artifacts were used during Mass. Before the Reformation, Basel Cathedral had the richest church treasury in the region that is today southern Germany and Switzerland.

The treasury had, until 1996, only been described in terms of its historical, cultural, and artistic importance. Since 1996, the SSEF Swiss Gemmological

Institute, in collaboration with the Historisches Museum Basel, has examined the gem materials in 14 selected items using the nondestructive techniques of optical microscopy and laser Raman microspectrometry (see, e.g., Hänni et al., 1998). We were surprised to find so many gemstone imitations, such as glass and doublets with colored layers, in historic pieces of art with outstanding metal work. Among the natural gemstones we encountered were several varieties of quartz (rock crystal, amethyst, citrine, carnelian, agate, and chrysoprase), dark blue and light blue sapphires, ruby, red almandine garnet, diamond, and turquoise. In two important objects we identified gemstones that were presumably unusual for that period, such as peridot, spinel, fluorite, aquamarine, and emerald.

The study demonstrated that Raman microspectrometry is a reliable method for nondestructively identifying gem materials in historical objects. We hope that art historians will consider employing this useful analytical technique in the future.

#### REFERENCE

- Hänni H.A., Schubiger B., Kiefert L., Häberli S. (1998) Raman investigations on two historical objects from Basel Cathedral: The Reliquary Cross and Dorothy Monstrance. *Gems & Gemology*, Vol. 34, No. 2, pp. 102–113.

## Dynamic Earth: Inco Ltd. Gallery of Earth Sciences

**Terri Ottaway** (terrio@rom.on.ca) and **Fred Wicks**,  
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Planet Earth as a *System of Systems* is the theme of the new 14,000 square foot Gallery of Earth Sciences at the Royal Ontario Museum. The main system is plate tectonics, which provides a simple but powerful story line that links geologic processes across and within the globe, and blends them into a unified version of the earth.

With the emphasis on process, rather than on simple observation and classification, rocks and minerals are displayed according to their geologic environments in four large cases that dominate the mineral hall. Spectacular gem crystals and materials are particularly powerful tools for highlighting stories of mineral formation. Large crystals of aquamarine, topaz, and tourmaline illustrate the pegmatite environment, associated with minerals derived from molten rock in a case called “Chilling Out.” Agates and amethyst, in a case called “In and Out of Hot Water,” are some of the more familiar minerals precipitated from aqueous solutions. Garnets, jade, and sapphires are among the beautiful products of metamorphism found in the “Under

Stress” case, and colorful minerals such as malachite and azurite delve into the mysterious world of secondary minerals and chemical alteration in the “Changing Identity” case.

The Gallery also takes a fascinating look at the role that life, especially microbial life, has played in transforming Earth into a blue planet—in contrast to its lifeless cousins Venus and Mars. Increasingly, life is being recognized as a geologic force, not only creating and sustaining our atmosphere and oceans, but also creating rock formations (i.e., limestones) and participating in the genesis of many important mineral deposits. Among these are the diamonds found in eclogites from Russia and emeralds from the black shales of Colombia.

It is hoped that the Gallery of Earth Sciences will inspire all visitors with the wonders of our planet, and provide a better understanding of what transpires beneath our feet.

## A Color Communication System for Gemstones

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A method that quantifies the color of a gemstone and is accepted by the gem trade has long been an elusive goal. There are obvious advantages to such a color communication system in the commercial side of gemology. For example, any parameters obtained by the system could be included on colored gem certificates in much the same manner as color grade is included on diamond certificates. In addition, the numerical color data could be used in inventory control, buying and selling, repairs, appraisals, and for communication through the Internet, which has become an important medium for the global gem trade. Moreover, researchers of color treatment could use such a system for the description of gems before and after treatment.

The color communication system suggested here is based on  $L^*a^*b^*$  color space (see, e.g., Billmeyer and Saltzman, 1981), and the determination of several parameters that are derived from spectrophotometric measurements of a gemstone. The parameters used, and their definitions, are:

$L^*$ —Metric lightness function

$a^*$ —Colorimetric values on the red-green axis of  $L^*a^*b^*$  color space

$b^*$ —Colorimetric values on the yellow-blue axis of

L\*a\*b\* color space  
U'—Metric chromaticity coordinates of CIE 1976 (CIE L\*U\*V\*)  
V'—Metric chromaticity coordinates of CIE 1976 (CIE L\*U\*V\*)  
x,y—Chromaticity coordinates of CIE 1936, where  $x = X/(X+Y+Z)$  and  $y = Y/(X+Y+Z)$ ; X,Y,Z = tristimulus values

The objective of this research project was to construct a color communication system for gems that describes color characteristics in the form of numbers for the values a\*b\*, as derived from spectrophotometric measurements obtained with an Image Spec spectrophotometer. The parameters U' and V' are calculated from a\*b\*, which may be correlated to established color systems such as the Munsell system. By means of computer programming developed by EMPA, St. Gallen, Switzerland, 56 pages of tables have been produced for converting the x,y chromaticity coordinates of CIE 1936 into a\*b\* and U'V' values for each color chip in the Munsell system. Munsell color chips of the same value were systematically located in the U'V' diagram and L\*a\*b\* color space according to their color coordinates. The conversion tables, the adapted U'V' diagrams, and the a\*b\* color chart serve as the communication tools by which a gem's color characteristics are correlated to established color systems in order to provide a visual representation.

#### REFERENCE

Billmeyer F.W. Jr., Saltzman M. (1981) *Principles of Color Technology*, 2nd ed. John Wiley & Sons, New York.

## Reflection and Scattering Spectroscopy for Nondestructive Gem Identification

L. I. Tretyakova, *Russian Mineralogical Society, St. Petersburg, Russia*; N. B. Reshetnyak, *All-Russian Geological Institute, St. Petersburg*; and Y. V. Tretyakova, *Russian Ocean Geology Research Institute, St. Petersburg*

Three spectroscopic methods can be used to analyze nondestructively the vibrational and electronic spectral properties of gem materials. Reflectance infrared spectroscopy and laser Raman microspectrometry are relatively simple methods for obtaining vibrational spectra, which can be used to identify the gem or mineral species. Electronic spectra are obtained by diffuse reflectance spectroscopy in the ultraviolet/visible/near-infrared (UV/Vis/NIR) range, 200–2500 nm; the absorption lines are related to impurity or defect-impurity color centers. The spectra obtained by all

three techniques can be measured from any surface that is 0.01–1 mm<sup>2</sup>. The authors have established a database of reflectance infrared and Raman spectra for 250 natural and synthetic materials; this database is supplemented by diffuse reflectance spectra in the UV/Vis/NIR range for several color varieties of these minerals.

These methods may be used either singly or in combination to identify gem materials, differentiate natural gems from their synthetic counterparts, and detect gemstone treatments. For example, the techniques can provide a clear distinction between natural and synthetic diamonds, and can also identify filled diamonds. The samples do not require special preparation, or removal from jewelry or (if rough) from their matrix. Accordingly, these methods are particularly useful for the investigation of archeological specimens, antiques, historical and religious objects, museum specimens, and mounted jewelry where destructive techniques or the unmounting of the stone from its setting are unacceptable.

## Gem Quality Index (GQI)

T. E. Tashey Jr. (tt@gqi.com), *Gem Quality Institute, Chicago, Illinois*

Evaluating a gemstone by using the 4Cs of color, clarity, cut, and carat weight can be carried one step further by considering a fifth important attribute—*rarity*. There is a complex interrelationship between the 4Cs and rarity. The Gem Quality Index (GQI) is a proposed system that rates the relative importance of color, clarity, cut, and carat weight, with respect to the rarity factor, to produce a single, overall quality rating for any particular gemstone. Essentially it assigns different percentages to the different attributes, by rating their relative importance. Different varieties of the same gemstone will obviously receive a different mix of percentages for their attributes.

Examples are illustrated in the accompanying figure. Part A shows how the rarity factor is determined for white and off-white diamonds, in terms of weighted percentages for carat weight, color, clarity, and cut. Such diamonds weighing 0.01–1.19 ct (part B) are weighted at 25% for color and 15% for rarity. In contrast, fancy-colored yellow diamonds of the same size range (part C) have increased factors for color (45%) and rarity (25%). Further, as the size of a gemstone increases, the rarity factor also increases (e.g., to 30% for white and off-white diamonds weighing 3.00–3.99 ct; part D). Accordingly, the rarity component based

## Gem Quality Index (Sample Tables)

### A Rarity factor (white and off-white diamonds)

Size (carat weight)	Color	Clarity	Cut
65%	10%	15%	10%

### B White and off-white diamonds (0.01–1.19 ct)

Color grade & appearance	Clarity grade & appearance	Cut grade & appearance	Rarity factor
25%	35%	25%	15%

### C Fancy-color yellow diamonds (0.01–1.19 ct)

Color appearance	Clarity grade & appearance	Cut grade & appearance	Rarity factor
45%	15%	15%	25%

### D White and off-white diamonds (3.00–3.99 ct)

Color grade & appearance	Clarity grade & appearance	Cut grade & appearance	Rarity factor
25%	25%	20%	30%

### E Colored gemstones (ruby, emerald, alexandrite; 0.01–1.49 ct)

Color appearance	Clarity grade & appearance	Cut grade & appearance	Rarity factor
45%	15%	15%	25%

*These charts show how the various attributes (i.e., color, clarity, cut, and carat weight) of a gem can be rated with respect to rarity using the Gem Quality Index.*

on size increases to a maximum of 65% when a white to off-white diamond weighs over 100 ct. The GQI system can also be applied to colored stones, as illustrated in part E.

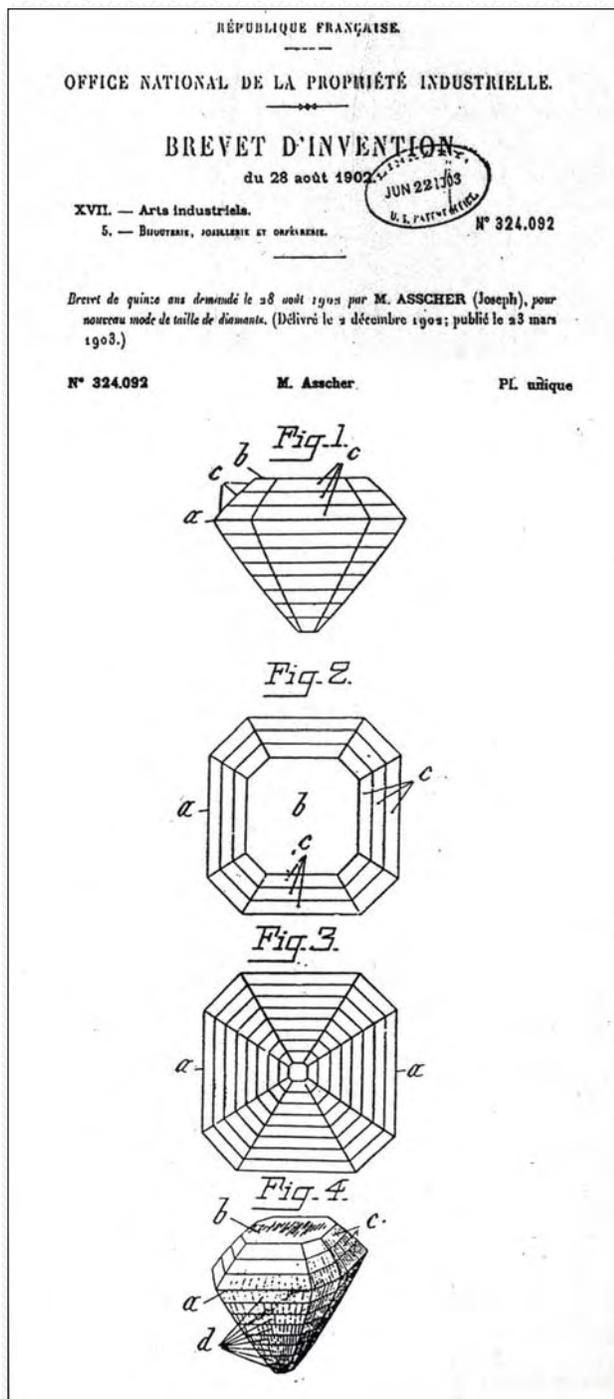
The intent of the Gem Quality Index is to create a meaningful scale from 0 to 10, with 10 being the top quality and designated as Exceptional. Subsequent grades will be designated as Top Gem<sub>1</sub> and Top Gem<sub>2</sub>; Gem<sub>1</sub>, Gem<sub>2</sub>, and Gem<sub>3</sub>; Commercial<sub>1</sub> and Commercial<sub>2</sub>; and finally, Promotional<sub>1</sub> and Promotional<sub>2</sub>.

## GEMSTONE MARKETING

### Achievements from Patents, Designs, and Trademarks Relating to the Gem Trade

*Nicholas Delre, GIA Gem Trade Laboratory, New York*

Intellectual property, a concept that began about four centuries ago, consists in part of industrial properties (e.g., utility patents, design patents, and trademarks).



Diamond faceting styles have been patented for decades. This partial example of a patented diamond cut by M. Asscher (Joseph) was issued in 1902 and made public in 1903.

These safeguards offer certain rights and protection that allow the inventor to exclude others from making, using, or selling the same invention, usually for a limited period of time.

### Main classifications of jewelry items within patents and trademarks.

	U.S. system	International system
Utility patents	Class 63	Class A44
Design patents	Class D11	Class 11
Trademarks	Class 14	Class 14

Source: *Patents Assist* CD ROM (U.S. Department of Commerce, Patent and Trademark Office, Washington, DC, March 1999).

Generally speaking: (1) a utility patent protects the way an article is used and how it works; (2) a design patent protects the way an article looks; and (3) a trademark is an identifying word, phrase, symbol, or design that distinguishes the goods or services of one party from those of others. As more countries have become involved in developing and producing industrial properties, particularly in the latter half of this century, there has been an explosion in the number of these properties. The accumulated patent literature offers an extensive reservoir of probably the most up-to-date source of information on technological progress for new products and processes in every technology. In addition, industrial properties have become sources for new innovations and improvements on old concepts.

Industrial properties are primarily grouped under classes and subclasses found within major classification systems (i.e., the U.S. and international patent classification systems; see table).

Persons wishing to view the classification system in depth and obtain patents or trademarks, should contact the U.S. Patent and Trademark Office, General Information Services, at 800-786-9199 or visit their Web site at <http://www.uspto.gov>.

### Gem Enhancements and Their Effect on Pricing

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The latter part of the 1990s was a critical time for the gem industry, due to controversies over gemstone enhancements and disclosure. Because of consumer uncertainty over disclosure, the industry saw many setbacks in gemstone pricing.

Emeralds were hardest hit by the enhancement issues. Consumer awareness of emerald enhancements (such as Opticon) reduced confidence levels and

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brought dramatic price decreases. On average, the price of extra-fine-quality one-carat emeralds dropped by 23% from their high in 1995, and good- to fine-quality emeralds declined by about 50%. The abundance of commercial-quality, heavily treated emeralds resulted in a price decrease of about 65% for this material during this four-year period.

Partly as a result of enhancement issues, ruby prices declined over the past eight years. The initial drop in price resulted from an abundance of supply, as new material from Mong Hsu (Myanmar) flooded the market. The attractive appearance, low price, and large supply of the (commonly heat treated) material contributed to an overall reduction in ruby prices. Questions regarding the acceptability of the glass filling present in some of the heat-treated rubies caused prices to drop further over the past two years. Overall, the price of extra-fine-quality rubies has fallen approximately 36% since 1991; fine quality is down about 45%, good quality is down 51%, and commercial quality dropped 54%. As in the case for emeralds, the lower quality grades suffered a greater price decrease.

If the industry is to survive the aggressive technological advances of gemstone enhancement, we must push for greater education and full disclosure. Through these means, confidence can be restored and profitability will return.

## **Better Understanding of Gems and Daylight for Enhanced Work and Business Success**

**Manfred Eickhorst** (info@eickhorst.com), *System Eickhorst, Hamburg, Germany*

In the wholesale gem business, buying and selling customarily take place under conditions of natural daylight, at north-facing windows. Alternatively, fluorescent lighting is used, with the color of the light as similar to natural daylight as possible. For both near-colorless and colored diamonds, bulbs with a color temperature of approximately 6,500 kelvin (K) traditionally are used, whereas for colored stones, 5,500 K bulbs are preferred. The wholesale gem business, therefore, employs different kinds of artificial light depending on the gemstones involved.

Jewelers, however, typically sell all of their gems using one kind of light, a halogen lamp with a color temperature of approximately 3,000 K. This light is appreciably more yellow than natural daylight and, accordingly, “falsifies” the color of gemstones. Although halogen light may enhance the color of rubies, it is detrimental to the color of sapphires, emeralds, and near-colorless diamonds. As a rule, the jewel-

er feels it is more important to promote optical effects such as brilliance, dispersion, and dichroism, which are enhanced by halogen lighting. Consequently, jewelers rarely use daylight-equivalent illumination to display the “true” color of gems.

The use of daylight-equivalent lighting is encouraged to bring out the best color appearance of gemstones in the retail environment. The following lighting factors should be taken into consideration when designing the most effective lighting system.

- The amount of incident luminous intensity is referred to as *illuminance* (measured in lux or foot-candles).
- The daylight-equivalent color of the light, oriented to international standards, is D 55 and D 65 (i.e., 5,500 K and 6,500 K, respectively).
- Color rendering in comparison to natural daylight is designated by the Color Rendering Index (C.R.I.).
- Accent lighting and single-point lighting may be used to enhance the appearance of light reflected by gemstones.
- Daylight-equivalent supplementary lighting may be used in combination with halogen lamps.
- For optimal eye comfort, flicker can be eliminated from fluorescent lamps with electronic ballast devices.
- Jewelers should have the ability to dim the brightness of fluorescent lamps to meet requirements for effective presentation.

A better understanding of the versatility of modern fluorescent lamps and other light sources will enable sellers to demonstrate the unique color beauty of gemstones, and thus decisively contribute to the success of their business.

## **Software Management Systems for Jewelers**

**Don Greig** (profit@armsusa.com), *ARMS USA, Henderson, Nevada*

The biggest problem facing retailers is poor liquidity, caused by a lack of management ability, lack of profit, excessive investment in stock, and a majority of stock that just doesn't sell. In other words, “No retailer ever had problems with stock that sells with the right profit margins and the right quantities!”

If retailers are to control their business, rather than be controlled by their business, four critical areas need attention: stock, suppliers, staff (sales), and self (management decisions). To be successful, jewelers need to:

1. Recognize and manage fast- and slow-selling inventory.
2. Understand the factors that affect profit, and learn how to implement profit-enhancing techniques into the business.
3. Initiate a refined reordering system that ensures that the best-selling merchandise is always in stock.
4. Create usable management plans that work.
5. Implement training and plans to enhance the staff's cohesiveness as a team.
6. Learn how to effectively manage suppliers and create stronger working relationships, and learn to develop the store in the areas that are not performing to defined expectations.
7. Control debt.

A good software management system will help manage a retailer's physical stock efficiently. It will allow access to information and reports that identify strengths and weaknesses, and it should become the retailer's tool for producing more profit by buying right and marking up correctly.

## Publicity and Profits vs. Advertisements and Expenses

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How can retail jewelers achieve bigger and faster sales while conserving advertising expenses? How can they stand out from the competition and find greater name recognition, both in the jewelry industry and in the community? By developing communication skills with the media, retailers can increase their exposure without financial expenditure.

Many second- and third-generation jewelers can trace their retail roots to a relative who was in the watch repair business. As the economy boomed after World War II, watch repairers gradually found themselves selling more diverse jewelry products. Because business was steady, and most of the advertising was by word of mouth, they never really had to concern themselves with paid advertising or publicity. They had little time or need to develop communication skills with the media.

The times are changing . . . and quickly! Today's

retail jeweler has never faced more diverse, intense competition from so many new sources. At the same time, advertising costs have skyrocketed and the number of media outlets has multiplied, further diluting the power of advertising dollars.

Communication—as distinct from advertising—means getting free coverage by the media: TV, radio, and print. You don't need money, power, or a particular position to take advantage of media marketing. Media coverage *is* media marketing—simply receiving media coverage creates importance. Rather than spending big money to create elaborate brochures, jewelers and manufacturers should take advantage of media marketing. Strategies should be designed to enhance the image of products, persons, and events. By maintaining a local focus, a company can create synergy among the media.

Media-savvy promotions are entertaining and exciting. The hardest part is “hooking” or catching the media's attention—you can do this with creativity.

A lack of understanding of how the news media operates explains why so many promotions fail. The media strives for more distinction, greater circulation, and higher ratings. In the jewelry trade, products and services can be marketed with the same goals in mind.

For example, Swiss jeweler Bucherer generated some of its best colored gemstone sales on minimal advertising in 1988. The results were achieved through media interest in an 18.50 ct cat's-eye alexandrite that was toured through a half dozen of Bucherer's stores and promoted as the rarest, most spectacular jewel in the world. The company's size and money were important, but not as important as their creativity and packaging.

Advertising and editorial coverage involve different values. Indeed, advertising often incites the adversary mode in each of us. However, carefully placed media marketing creates and packages ideas that will be interesting to reporters and exciting to the audience, and that will produce measurable results.

## Building a Profitable Appraisal Business

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Appraising has developed into an important profession within the jewelry industry. Today qualified individuals are finding more career opportunities in appraising—either independently or through retail jewelry establishments or franchise opportunities—provided

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they take the necessary steps to build their credentials and develop effective marketing strategies.

Consumers are becoming more aware of professional credentials, and will seek out appraisers who have them. Building credentials can increase consumer confidence, while adding to an appraiser's knowledge base. After completion of gemological coursework, an appraiser's training should be continued in any of a number of specialty appraisal courses available, specifically in valuation science.

In order to generate business, effective marketing strategies include print, electronic, and other media advertising. Counter displays that detail your services can be distributed and displayed at jewelry stores that benefit from your association with them. Sales personnel at these stores will gladly recommend your professional services as a qualified appraiser.

A new frontier in the appraisal profession is the concept of franchising. The advantages of franchising include proven marketing strategies, financial and business planning and support, protected territories, name recognition, and group benefits to independent business owners. The "while you watch" philosophy of the appraisal franchise appeals to a growing number of clients who are uncomfortable leaving jewelry in the possession of jewelers or appraisers whom they do not know. The *Jewelry Judge Appraisal Centers* are currently the only such franchised offering. Centers are now operating, and are expanding into all major markets in the U.S. and Canada.

## **Jewelry Appraising: Professionalism in the New Millennium**

**Anna M. Miller** (4013@polygon.net), *Master Valuer International, Pearland, Texas*

Education in valuation science is the foundation of professional jewelry appraising, and the number one element in an appraiser's long-term success. Completion of a program of structured, academic valuation study is the most important of the many qualifications necessary to becoming a professional jewelry appraiser. The call for full professional appraiser status comes from an international demand for intelligent and ethical valuations, logical data analysis, and skilled use of current valuation procedures. To answer this need, comprehensive diploma courses in gem and jewelry appraising have been developed and are now being given worldwide in workshops, college residence classes, and by correspondence. These advanced jewelry appraising courses have

introduced new systems, procedures, and ways of communicating in valuation science.

Rapid global change requires appraisers to understand markets outside of their own, while thinking beyond the boundaries of current resources. Since change brings opportunity for growth, the professional anticipates and adapts to change. A competitive edge is acquired by the appraiser who has expertise in value methodologies, an understanding of current appraisal standards, and the willingness to investigate a novel approach to establishing value in specialty markets (e.g., jadeite, antique and estate jewelry). Also, a professional appraiser must be comfortable working in international markets and have a sound understanding of how global economics impact valuations. Although some appraisers turn to prepared price lists to estimate values, this approach will be inadequate in the future. Precise pricing and value justification will be best conducted with the aid of global networking between educated professionals sharing the same goals, standards, and exacting market research.

## **What Does That Emerald Look Like? How to Communicate Color and Appearance across Continents**

**Randall M. Wagner** (gerandyw@gemex.com),  
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Communicating the color and appearance of gemstones across distances is a complicated problem. Although various color communication systems have been developed, using color samples—such as those in the GIA GemSet, GemDialog, or World of Color packages—to describe a gemstone's color neglects many of the aspects that are integral to the stone's appearance (i.e., color uniformity, windowing, extinction, brilliance, and scintillation). Photography can provide useful images of gemstones, but the color rendered in a photo is complicated by several factors during the exposure and development process. Although electronic cameras can significantly reduce the effort involved in capturing and transmitting images, they face the same problems as conventional cameras. Just as each film type records color differently, each camera records its own "version" of color; just as the development process affects the stone's color, each computer monitor displays color differently. Although the camera and monitor can both be calibrated for acceptable color representation, this adjustment is lost on another user's system.

However, if an imaging spectrophotometer is used to measure the complete spectral response of a gemstone, the corresponding image can be consistently displayed on any monitor in the world, provided the chromaticity coordinates for that monitor are known. The spectrophotometer measurement is used to adjust the color of the image on the computer screen. As a result, the Internet can now be used to communicate both the color and appearance of a gemstone across continents in minutes.

## JEWELRY

### Engraved Gems: 6000 BC–2000 AD

**Ute Klein Bernhardt, Wausau, Wisconsin**

The art of gem carving, which is as old as civilization, had a humble, utilitarian beginning 8,000 years ago with the carving of clay stamp seals. During this time, known as the Protoliterate Period, there was no written language and the carved seals functioned as signatures for contractual purposes and for identifying personal property. As religion evolved, the carved seals took the form of decorative and functional amulets. Although the amulets continued to serve as readily available signatures, they also were used as protection against malaise.

Five thousand years ago, a major change occurred when carvers began to create cylindrical seals using very soft gems instead of clay. Later, as written language came into being, carvers began using harder, more precious gems for their seals. Gem materials carved into a multitude of different designs (e.g., stamps, amulets, or cylinder seals) have been coveted by the elite through the centuries.

Historically, gem carving has been a cyclical art. With each reemergence the art reached a higher level, attaining perfection (even by current standards) during the Greek, Etruscan, and Roman periods. After the Roman period, very little gem carving was done until the early Renaissance, when the art was rediscovered and enjoyed great popularity for the next 200–300 years. During this time, members of the nobility (such as Italy's Medici family) owned studios and were the employers and patrons of the artisans. Very fine work was produced by a number of masters. These royal gem collections were housed in "Treasure Rooms," which became the forerunners of today's museums.

At the onset of the 18th century, Russia had two

active carving centers. However, interest and appreciation of carved gems soon waned, and the output reduced to a trickle, notwithstanding contributions from the Fabergé House in the late 19th and early 20th centuries. During the 1700s and 1800s, gem carvers were scarce in most major European cities.

After the Franco-Prussian War ended in 1871, gem carving took hold in the region of Idar-Oberstein, Germany. For the remainder of the 19th century until the present time, gem carving has been an important part of the jewelry industry in Germany, as carvers took full advantage of the Industrial Revolution.

Octavio Negri, an Italian-American trained in Rome, was influential in New York during the early part of the 20th century. Beth Benton Sutherland apprenticed with him from 1921 to 1926, becoming a very accomplished carver over the next 30 years; her favorite medium was moonstone.

In Europe after World War I, August Rudolf Wild of Idar-Oberstein was considered the best carver in the world; he received a Gold Medal in the category of Fine Art at the 1937 World's Fair in Paris. During the 1950s, Richard Hahn's Idar-Oberstein studio began reproducing great Greek and Roman cameos in the Renaissance style. His work was purchased primarily by American collectors, who created a revival of carved gems in the U.S. This in turn brought about the evolution of self-taught gem carvers in America.

Today, Bernd Munsteiner of Stipshausen, Germany, carves gems into abstract and revolutionary designs. He is a major influence on the many young carvers who will lead gem carving into the next millennium.

### Products of Endangered and Threatened Species Used in Jewelry

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The use of animal products in jewelry and decorative arts has brought about steep declines in the populations of many species, the greatest of which occurred in the 1970s and 1980s. In response to this ecological calamity, the United Nations drafted the Convention on International Trade and Endangered Species (CITES). Cross-border trade in *endangered* species—those presently in danger of extinction—was banned by 123 signatory nations under the terms of CITES in 1989. By most measures, the CITES ban has been a success, as populations of some endangered species are recovering to the point that affected countries are calling for a

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controlled loosening of the ban and a resumption of trade in the related animal products.

Among the numerous endangered or threatened species are many whose products are encountered in jewelry, including ivory producers (elephant, walrus, hippopotamus, and whale), corals, and turtles. Some *threatened* species—those that will become endangered at current rates of exploitation—are part of the pearl industry (e.g., specific species of oyster, abalone, and conch).

In the environmentally aware 1990s, fashion has also had an effect, as demand has diminished in some cultures for those products associated with the indiscriminate and unsustainable hunting or harvesting of animal species. At the same time, the market is adapting by finding alternatives such as vegetable ivories (tagua/corozo and doum nuts), plastics, and other manufactured materials.

Most governments recognize the importance of rebuilding and maintaining the natural resources and the bio-diversity of their region. Eco-tourism, a growing industry in many developing nations, has encouraged this philosophy. Balancing the survival of the various species with centuries-old traditions of trade in their products is the challenge that we face at the beginning of the new millennium.

## Jewelry with a Purpose

**Susan Eisen** (lifetag@worldnet.att.net), *Susan Eisen Inc., El Paso, Texas*

Jewelry is treasured as a symbol of love and emotion, and serves as an adornment or fashion item to convey beauty, pride, or celebration. At the same time, jewelry may serve a functional purpose. Besides the most common example of time keeping (i.e., wristwatch or pocket watch), jewelry has been used for the following purposes:

- Identification of medical conditions
- Passing down heirlooms in families (royal or otherwise)
- Secretly communicating love and admiration
- Commemorating important sporting events
- Exalting the crowning of a king
- Commemorating a trade treaty agreement
- Providing an extravagant representation of a country (e.g., royal regalia)

Over the centuries, many such items have held symbolic or historical significance, and are therefore preserved in museums worldwide. Such pieces are held in high esteem not only because of their beauty and craftsmanship, but also for the important place they

hold in the history of a country or a family. Even today, items such as portrait jewelry (as in cameos), “mother’s rings” (with the birthstones of the children), class rings, and sports championship rings continue the tradition of jewelry with a purpose.

## Platinum—The Metal of the Millennium

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Worldwide demand for platinum jewelry has increased tremendously over the last five years. In 1998, the jewelry industry accounted for 2.4 million ounces (or 40%) of the platinum consumed worldwide—up from 1.6 million ounces in 1993. In the U.S., domestic net platinum jewelry usage has soared from 20,000 ounces in 1991 to 220,000 ounces in 1998. China is the world’s fastest growing platinum jewelry market, with 620,000 ounces consumed in 1998—representing a 70% increase over 1997.

The bridal market continues to drive international demand for this rare and precious metal. In Japan, platinum accounts for 95% of the engagement ring category and 80% of the wedding band category. In the U.S., platinum is now a key element of the bridal market, accounting for a 25% market share.

In its purest form, platinum is soft, so it needs to be alloyed for jewelry purposes. Platinum/cobalt is a fine casting alloy. Platinum/iridium is a versatile alloy that is suitable for fabricating, as well as casting. Platinum/ruthenium is used when machining properties are desired. Many other specialty alloys, such as heat-treatable alloys, are being developed.

New technology is improving the workability of platinum. The laser welder has become the preferred tool for performing the most intricate welding without damage to surrounding diamonds or colored stones.

Because of its natural white color, durability, and flexibility, platinum lends itself to a multitude of designs, and can be used to enhance the beauty of gemstones—especially diamonds. As a result, it has become increasingly popular among the world’s top jewelry designers. The tremendous growth in the popularity of platinum over the last few years has truly made it the metal of the millennium.

## Designing Colored Diamond Jewelry

**Etienne Perret** (etienne@etienneperret.com), *Etienne Perret & Co., Camden, Maine*

Natural fancy-color diamonds are the celebrities of the diamond world. Almost everyone knows of the blue Hope diamond and the “canary” yellow Tiffany dia-

mond. Only the elite of the diamond jewelry designers have had the good fortune to design jewelry set with these exceedingly rare gems. Most often these colored diamonds were set in museum-like pedestal settings.

For the designer wishing to incorporate colored diamonds into jewelry, color-treated diamonds offer a solution to the rarity and expense of natural-color diamonds.

**Past Color Treatment of Diamonds.** Diamonds have been color treated for almost 100 years. The first diamonds were color treated by Sir William Crookes in 1905 by exposure to radium salts, which caused them to turn dark green. However, the diamonds were highly radioactive and took many years to “cool down” enough for jewelry use.

**Today's Diamond Color Treatments.** Nowadays most diamonds are color treated in an electron accelerator, where exposure to a beam of electrons causes them to turn a greenish hue. Then, through annealing, the diamonds are colored yellow, orange, or brown. The diamonds do not become radioactive and therefore can be used in jewelry immediately after treatment. In addition to green, yellow, orange, and brown, color-treated diamonds are currently available in red, purple, blue, and black colors.

**Painting with Color.** Color-treated diamonds offer the designer the versatility of color combined with the brilliance, durability, and caché of diamonds. Designers can now use colored diamonds in the same way that painters use paint on a canvas. If they want to cover an area with blue, then blue diamonds can be pavé set or invisibly set in whatever shape is desired. If they are looking for a stripe of purple, then a row of channel-set purple diamonds are in order.

**Today's Designers.** A handful of innovative German designers used color-treated diamonds in the early '90s. More recently, however, I have found only a few designers who use color-treated diamonds as a major design element in their jewelry, despite searching the large tradeshows in Basel, New York, Tokyo, and Las Vegas. In the new millennium, perhaps more designers will enjoy the increased opportunities—and sales—afforded by color-treated diamonds.

## Gem Artists of North America: The Renaissance of Modern Lapidary Art

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Gem Artists of North America (GANA) was formed in

1996 to increase awareness and appreciation of gem art through education, promotion, and marketing, and to support the needs of gem artists and related professionals. The specific objectives of GANA are:

- To facilitate a closer communication between all segments of the gem art, colored stone, and jewelry industries
- To educate members by sharing information
- To educate the public about gem art
- To establish, promote, and maintain the highest ethical standards among its members and throughout the gem art industry
- To protect the gem art industry and ultimate consumer from fraud, abuse, misrepresentation, and deceptive advertising

Artist members must demonstrate substantial commitment to the medium of “hard gemstone” (i.e., 5 or above on the Mohs scale), and must have demonstrated the development and execution of unique and original concepts, including but not limited to facet, sculptural, and carving designs. They also must have demonstrated originality of artistic form and excellence of technique in the execution of the designs.

The 25 current artist members of GANA work in a wide variety of styles encompassing multiple disciplines, both singly and in combination, including sculpture, carving, faceting, and intarsia. Their extraordinary creations are the culmination of each artist's working for years in relative isolation, coupled with the recent unification of their talents through GANA. The formation of GANA signals the birth of a modern renaissance in lapidary art. In the next millennium, both those who produce and those who appreciate gem art will grow dramatically in numbers. GANA will be at the forefront of this growth. For more information, visit the Web site <http://www.gemartists.org>.

## PEARLS

### Natural Abalone Pearls: Rare Organic Gems

**Sarabeth Koethe**, *Gem Sciences International, Inc., Deer Park, California*; and **K.C. Bell**, *San Francisco, California*

Dr. T. Nishikawa noted that pearls were used in Japan for ornamental purposes more than a thousand years ago (Kunz and Stevenson, 1908). There is evidence

that at least some of these pearls were abalone pearls: Large abalone pearls, for example, are found in images of Buddha made in 300 A.D.

The *Haliotis* abalone pearl has a long and turbulent history. These abalones are distributed along areas of the Pacific Coast from Alaska to Mexico. There are actually eight pertinent species: *Haliotis fulgens*, *Haliotis rufescens*, *Haliotis cracherodii*, *Haliotis discus*, *Haliotis kamschatkana*, *Haliotis corrugata*, *Haliotis sorenseni*, and *Haliotis walallensis*. Gem-quality abalone pearls are quite rare, with estimations of one gem pearl per approximately 500,000 commercially gathered animals.

Unlike the direct relationship between mollusk color and resulting pearl color of both the *Pinctada radiata* and *Pinctada martensii*, the various species of abalone can yield pearls of multiple distinct colors within the same univalve mollusk. Theories relate this phenomenon to diet and water temperature.

#### REFERENCE

Kunz G.F., Stevenson C.H. (1908) *The Book of the Pearl*. Dover Publications, Mineola, New York.

## "A Pearl Circus": Origin, Variety, and Enhancement of Pearls

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Pearls have been known for centuries as the "Queen of Gems." To understand this majestic yet gentle gem, one must know her origin, her many varieties, and her enhancements. Nineteen species of fresh- and saltwater mollusks were presented in the "Pearl Circus," including corresponding natural and cultured pearls from some of these species. Special "guest stars" included a 2 pound (about 1 kg) mollusk that was approximately 70 years old; a 21.7 mm round shell bead nucleus for pearl culture; imitation "conch pearls," with the same chemical properties as their natural counterparts; an 18.35 mm roundish natural abalone pearl; and a 185.5 ct natural "Melo Pearl."

Pearl dissection is one way to examine the thickness of the nacre in bead-nucleated cultured pearls, and the distinctive growth structure of tissue-nucleated cultured pearls. Some enhancements, such as dye and irradiation, are also readily apparent with pearl dissection. Considerable advances have been made in irradiation from 1981 to the present.

Natural pearls form when an irritant (a shell-like or organic protein substance) is introduced by chance into the soft tissue of a mollusk. It is a myth that a grain of sand (an inorganic substance) begins a pearl. Cultured pearls form when an irritant (a shell-like or organic protein substance) is introduced by human intervention.

According to the U.S. Federal Trade Commission (FTC), it is deceptive to use the unqualified word *pearl* to identify any type of cultured pearl. Ninety-five percent of "pearls" sold today are cultured, yet most of the language in the pearl and jewelry industries does not include the word *cultured* when referring to cultured pearls.

## Cultured Abalone Mabé Pearls from New Zealand

Liz McKenzie (pearls@empress.co.nz), *Empress Abalone Ltd., Christchurch, New Zealand*

While abalone produce pearls naturally, these are very rare, exceedingly costly, and irregular in shape, color distribution, and surface. New Zealand's indigenous abalone, *Haliotis iris*, produces beautiful multi-hued cultured abalone mabé pearls. These cultured blister pearls feature symmetrical shapes, spectacular luster, saturated color, and improved surfaces.

At Empress Abalone Ltd., abalone mabé pearls are grown at an on-shore aquaculture facility located on Stewart Island, across the Foveaux Strait from the South Island of New Zealand. Abalone stock for implantation is obtained annually from three sources: the company's natural fishing quota, other companies' annual quotas, and spat culture.

Abalones are hemophiliacs—they have no clotting mechanism in their blood. However, they do have extremely strong muscular viscera, and are very mobile even when confined. Thus, it was very difficult to perfect the technical procedure of implanting these univalve gastropods with hemispherical beads.

After the nuclei have been implanted, the abalone are placed in grow-out tanks of clean, circulating seawater, where they are monitored. Once every three days, the abalone are fed a fresh mix of seaweed, gathered from the Great Southern Ocean.

Two years after implantation, a mabé of 0.3–0.6 mm thickness forms on the inner surface of the abalone's shell. The abalone is harvested, and the blister is cut from the shell with a special surgical instrument. Following removal of the nucleus, the blister is filled with polymer and fitted with a back of polished abalone (*paua*) shell. The finished cultured abalone mabés, which range from 9 to 20 mm in diameter, are next ready for grading and marketing.

The abalone mabés are marketed in "Gem," "A," and "B" grades. Colors range from a most-valued "azure" through blue, green, purple, lavender, magenta, pink, orange, and "silver." The luster of the multi-hued nacre ranges from a mirror-like surface to a dull sheen. Surface smoothness also varies.

## Synthesis and Enhancement of Gems in Russia in the Second Half of the 1990s

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In the second half of the 1990s, Russian laboratories produced both traditional and new synthetic gems and simulants, and Russian manufacturers also performed many gemstone enhancements. In particular, Russian producers grew commercial quantities of synthetic ruby, sapphire, emerald, alexandrite, spinel, malachite, opal, and turquoise; as well as synthetic amethyst, citrine, and brown, blue, green, and pink quartz. They also produced large amounts of the simulants yttrium aluminum garnet (YAG), gadolinium gallium garnet (GGG), cubic zirconia (CZ), and yttrium aluminum oxide. Russian scientists used treatment methods to change the color of topaz (from colorless and brown to blue), beryl (from yellow-green heliodor to blue aquamarine), agate (from gray and white to red, yellow, green, blue, and black), chalk-like turquoise (from white to “sky” blue), lazurite (from green to dark blue), nephrite (from brownish to pale green, green, and white), and quartz (from colorless to “smoky” and greenish yellow).

New developments in Russia during the second half of the 1990s include the production of yellow (up to 4 ct) and colorless (up to 1 ct) synthetic diamonds; blue and red synthetic beryl; colorless and colored synthetic moissanite; pink synthetic quartz, synthetic amethyst-citrine (ametrine), synthetic amethyst-green quartz, and polychrome synthetic quartz; as well as synthetic aventurine and bright yellow-orange synthetic “langaisite” (lanthanum gallium silicate). Virtually on hiatus since the 1960s, Russia is again seeing the commercial production of flux and hydrothermal synthetic ruby and sapphire. Russian scientists also have developed new technologies for the surface-coloring of both colorless and pale-colored sapphires to appear blue, of topaz to appear blue and bright green, of quartz to appear blue and pink, and of CZ to appear black and opaque white. Of particular interest today is the development of technology to lighten the color of yellow-to-brown natural diamonds.

At the same time, there has been considerable change in the structure and volume of production of synthetic and enhanced gems within the last five years. Although the largest enterprises for producing crystals for technical applications (synthetic colorless quartz,

ruby, sapphire, alexandrite, and garnets, among others) continue to be run by the government, practically all other kinds of synthetic and enhanced gems were produced by private companies, including some supported by a combination of domestic and foreign capital. In the second half of the 1990s, several dozen such joint ventures were created. The competition between them led to overproduction and, ultimately, an abrupt drop in prices, so that many of these companies were forced to go out of business. This was particularly the case with synthetic amethyst, opal, emerald, and alexandrite, as well as with enhanced topaz. The next decade should witness the production of larger synthetic diamonds (both colored and colorless), as well as hydrothermal synthetic ruby, sapphire, and alexandrite. New methods of gem enhancement will also be developed.

## An Imitation of Black Diamond: Artificial Black Cubic Zirconium Oxide

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Black as a color has been in vogue for the past several years. This trend has reached the jewelry trade and, as a result, large quantities of black diamonds have been set in various types of jewelry. In 1998, SSEF checked more than 3,000 carats of purported black diamonds for color authenticity. During these examinations, several pieces of artificial black zirconium oxide (cubic zirconia—CZ) were identified.

Black diamond usually occurs as single crystals with numerous black graphite inclusions (see, e.g., Kammerling et al., 1990). Carbonado is a natural sintered polycrystalline aggregate of minute diamond crystals with a granular-to-compact structure. It is always opaque and may be black, brown, or dark gray; less commonly, it is “brick” red to pale purple and light green. Bort is a black polycrystalline form of diamond (Haggerty, 1998). Carbonado and bort are sometimes called “black diamond” by the trade.

Faceted black CZ can be easily separated from black diamond by its rounded facet junctions, absence of inclusions, dark brown appearance when viewed with a powerful fiber-optic light, and specific gravity (Kammerling et al., 1991). For round-brilliant-cut samples, a comparison of the diameter to the weight is sufficient to distinguish black CZ from black diamond.

X-ray fluorescence (EDXRF) analyses were performed on several of the suspect black specimens. The analyses revealed a predominance of zirconium, with lesser amounts of yttrium and hafnium, which confirmed that these samples were CZ.

## REFERENCES

- Haggerty S.E. (1998) Diamond-carbonado: Geological implications and research—industrial applications. *Proceedings of the 5th NIRIM International Symposium on Advanced Materials (ISAM '98)*, Tsukuba, Japan, pp. 39–42.
- Kammerling R.C., Kane R.E., Koivula J.I., McClure S.F. (1990) An investigation of a suite of black diamond jewelry. *Gems & Gemology*, Vol. 26, No. 4, pp. 282–287.
- Kammerling R.C., Koivula J.I., Kane R.E., Fritsch E., Muhlmeister S., McClure S.F. (1991) An examination of non-transparent “CZ” from Russia. *Gems & Gemology*, Vol. 27, No. 4, pp. 240–246.

## Educating the Jewelry Industry about Lab-Created Moissanite

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C3 Inc. began worldwide distribution of laboratory-created moissanite gemstones (henceforth all references to moissanite or moissanite gemstones are to laboratory-created materials) in mid-1998. Because some of the physical and optical properties of diamond and moissanite are similar, especially those that are commonly used for identification purposes in gemology (e.g., refractive index), the possibility of misidentification exists.

Charles & Colvard is positioning moissanite as a unique synthetic gemstone, with high brilliance, fire, and luster, that is very durable and exclusive through its limited availability. Most importantly, though, the company expects full disclosure, so that moissanite is sold and purchased as moissanite. As the volume of moissanite in the marketplace grows, accurate identification throughout all channels of the jewelry industry will become even more important. Charles & Colvard is expanding its extensive education program for the jewelry trade through new initiatives by both international distributors and selected U.S. retailers.

To better understand the awareness level of moissanite in the jewelry industry, in May 1999 members of the C3 sales team surveyed 19 retail jewelry stores in North Carolina: 10 department stores, three franchised jewelry chains, and six independent jewelry stores. Representatives of only eight stores were able to reach a conclusion on the identity of a near-colorless round brilliant set in jewelry, and five of them mistakenly identified the moissanite as diamond. Eleven stores had no testing instrumentation (including thermal probes) available. In addition, less than 5% of the 200+ total participants at three of C3's moissanite educational seminars this spring had ever seen moissanite gems.

These observations, while a concern, are not

unusual. At the 1999 JCK Orlando Show and the AGS Conclave in New Orleans, C3 personnel demonstrated the doubly refractive nature of moissanite, one of the most fundamental and easiest means of identification. It was impressed upon the participants that care must be taken to ensure that the inside of the stone is viewed from several directions so that the one singly refractive direction in the stone is avoided. Other identifying features demonstrated include the high dispersion, specific gravity (3.20–3.24), polished girdles, and needle-like inclusions (see, e.g., Nassau et al., 1997; Nassau, 1999). The vast majority of participants observed moissanite for the first time and left with greater confidence in their ability to identify it with a loupe.

## REFERENCES

- Nassau K. (1999) Moissanite: A new synthetic gemstone material. *Journal of Gemmology*, Vol. 26, No. 7, pp. 425–438.
- Nassau K., McClure, S.F., Elen, S., Shigley J.E. (1997) Synthetic moissanite: A new diamond substitute. *Gems & Gemology*, Vol. 33, No. 4, pp. 260–275.

## Colors of High-Pressure Synthetic Diamonds

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It is well known that yellow and blue synthetic diamonds are synthesized in the presence of nitrogen and boron, respectively, by conventional high-pressure techniques. Other colored synthetic diamonds also can be produced by the introduction of certain elements, such as nickel and cobalt, into the diamond lattice.

When nickel and cobalt impurities are incorporated into the diamond lattice during growth, they can become optically active centers, giving rise to a variety of absorption and luminescence bands. These bands are related to the concentrations and structure of nitrogen present in the synthetic diamonds. The nitrogen impurities are incorporated in a single substitutional form, but they are aggregated with heat treatment. The nitrogen concentrations can be controlled by the composition of the metal alloy in which the diamonds grow.

A nickel impurity produces a brownish yellow color when high concentrations of nitrogen are present in the crystal. With decreasing concentrations of nitrogen, the color changes to green and then to brown. When the nitrogen-containing crystals are heated at temperatures above 1500°C under high-pressure conditions, both the brownish yellow and the green colors also become brown. The heat-treated diamonds luminesce intense green to UV radiation.

A cobalt impurity does not have a strong absorption band, so no characteristic color results from the incorporation of this element into the diamond structure, although luminescence is produced. Diamonds that have high concentrations of nitrogen and contain cobalt are yellow due to the nitrogen impurity. When such diamonds are heated, the color will fade, but strong yellow luminescence will be observed with UV radiation. Selected references on these topics are presented below.

#### REFERENCES

- Collins A.T., Spear P.M. (1982) Optical active nickel in synthetic diamond. *Journal of Physics D. Applied Physics*, Vol. 15, No. 12, pp. L183–L187.
- Collins A.T., Kanda H., Burns R.C. (1990) The segregation of nickel-related optical centers in the octahedral growth sectors of synthetic diamond. *Philosophical Magazine B*, Vol. 61, No. 5, pp. 797–810.
- Kanda H., Lawson S.C. (1995) Growth temperature effects of impurities in HP/HT diamonds. *Industrial Diamond Review*, Vol. 55, No. 565, pp. 56–61.
- Lawson S.C., Kanda H. (1993) An annealing study of nickel point defects in high-pressure synthetic diamond. *Journal of Applied Physics*, Vol. 73, No. 8, pp. 3967–3973.
- Lawson S.C., Kanda H., Watanabe K., Kiflawi I., Sato Y., Collins A.T. (1996) Spectroscopic study of cobalt-related optical centers in synthetic diamond. *Journal of Applied Physics*, Vol. 79, No. 8, pp. 4348–4357.

## Bluish Green, Light Green, and Pink Synthetic Chrysoberyl

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Gem-quality yellow, colorless, and color-change synthetic chrysoberyl (synthetic alexandrite) have been available for some time in the gem trade. Here we present the first gemological data on bluish green (one sample), light green (three samples) and pink (three samples) synthetic chrysoberyl. The light green and the pink samples were donated to SSEF by Kyocera Corp., Japan.

Microscopic investigations revealed that the bluish green and light green synthetic chrysoberyls were practically inclusion-free. Minute bubbles or particles were found only in the pink samples. Growth structures were not observed. With long-wave UV, the bluish green and light green samples showed a weak red fluorescence, whereas their natural counterparts may show a strong red glow due to traces of chromium; the pink samples did not fluoresce.

The bluish green and light green synthetic chrysoberyls closely resembled the natural chrysoberyl that

has reportedly been found near Tunduru, Tanzania; their color was attributed to traces of vanadium (Johnson and Koivula, 1996). Chemical analyses (EDXRF) revealed approximately 0.18 wt.%  $V_2O_3$  in the light green synthetic stones, which is similar to that found in the natural light green chrysoberyl. However, only the natural stones contain additional trace elements (such as Fe, Ga, and Sn) in detectable quantities. The iron content (0.2–0.3 wt.%  $Fe_2O_3$ ) seems to influence the depth of color in the natural light green chrysoberyl. The bluish green synthetic sample contained much more vanadium than its natural equivalent (approximately 1.5 wt.%  $V_2O_3$  versus 0.3 wt.%  $V_2O_3$ ).

A pink color in chrysoberyl is attributed to the incorporation of titanium (approximately 0.2 wt.%  $TiO_2$ ), probably into the aluminum lattice sites. As is the case for synthetic pink sapphire (e.g., “Ti-sapphire”; Johnson et al., 1995), we suggest that the pink color of synthetic chrysoberyl is caused by trivalent titanium ( $Ti^{3+}$ ). Since trivalent titanium is rarely found in natural terrestrial environments, this might explain why natural pink chrysoberyl has not yet been found.

#### REFERENCES

- Johnson M.L., Mercer M.E., Fritsch E., Maddison P., Shigley J.E. (1995) “Ti-sapphire”: Czochralski-pulled synthetic pink sapphire from Union Carbide. *Gems & Gemology*, Vol. 31, No. 3, pp. 188–195.
- Johnson M.L., Koivula J.I. (1996) Gem news: Nonphenomenal vanadium-bearing chrysoberyl. *Gems & Gemology*, Vol. 32, No. 3, pp. 215–216.

## New Hydrothermal Synthetic Gemstones from Taurus, Novosibirsk, Russia

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Hydrothermal synthesis resembles the process of natural gemstone formation more closely than any other synthesis technique (e.g., flame-fusion, Czochralski, flux). Yet, until the early 1990s, synthetic emerald and different colors of synthetic quartz were the only hydrothermally grown gem materials that were commercially available on the world market. Since 1990, however, Taurus has been developing hydrothermal methods of commercially producing several varieties of corundum and beryl (other than emerald).

Sapphires doped with Cr and Ni were the first hydrothermal synthetic gemstones to be commercially produced by Taurus. The addition of varying amounts

Gemological properties of Tairus hydrothermal synthetic sapphires and aquamarine.

	Cr-Ni hydrothermal synthetic sapphire	Fe-Ti hydrothermal synthetic sapphire	Hydrothermal synthetic aquamarine
Color	Almost any color	Very dark violetish blue	Light to dark greenish blue
Coloring agent	Ni <sup>2+</sup> , Ni <sup>3+</sup> , and Cr <sup>3+</sup> in different combinations	Fe <sup>2+</sup> -Ti <sup>4+</sup> charge transfer, possibly Ti <sup>3+</sup>	Fe <sup>2+</sup> and Fe <sup>2+</sup> -Fe <sup>3+</sup> charge transfer
Pleochroism	Weak to strong; in some cases, none	Strong	Weak to strong
R.I. (N <sub>o</sub> )	1.765–1.769	1.767–1.768	1.578–1.580
R.I. (N <sub>e</sub> )	1.757–1.761	1.759–1.760	1.571–1.577
Birefringence	0.007–0.010	0.008	0.004–0.008
S.G.	3.98–4.03	4.00	2.65–2.70
Luminescence to UV radiation	Inert to moderate (depending on color)	Very weak to short-wave UV; inert long-wave UV	Inert
Inclusions and optical inhomogeneities	Clean, or abundant dark flake-like crystalline inclusions; “fingerprints” and swirl-like graining	Gaseous inclusions surrounded by fissures; patchy color distribution	Cellular or linear graining; flake-like aggregates of pyrrhotite or pyrite and topaz; “fingerprints”
Visible spectra	377, 556, and 599 nm bands due to Ni <sup>2+</sup> and Ni <sup>3+</sup> ; 469, 475, and 690 nm lines due to Cr <sup>3+</sup>	386 and 589 nm bands due to Fe <sup>3+</sup> absorption and Fe <sup>2+</sup> -Ti <sup>4+</sup> charge transfer	800 and 375 nm bands due to Fe <sup>2+</sup> and Fe <sup>3+</sup> ; shoulder at 650 nm due to Fe <sup>2+</sup> -Fe <sup>3+</sup> charge transfer; line near 400 nm due to Ni <sup>3+</sup>

of Cr<sup>3+</sup>, Ni<sup>2+</sup>, and Ni<sup>3+</sup> to the corundum crystal structure results in a broad spectrum of attractive colors (see Thomas et al., 1997, for details). The most important diagnostic features of Cr-Ni hydrothermal synthetic sapphires, as well their gemological properties, are shown in the table.

The first dark blue and violetish blue hydrothermal synthetic sapphires with a coloration caused by Fe-Ti impurities (the elements that cause the blue color in natural sapphires) were produced in mid-1998. These synthetic sapphires (again, see table) can be readily distinguished from natural sapphires through microscopic observation of their patchy color distribution and their distinctive gaseous inclusions.

Synthetic hydrothermal aquamarine was also first grown by Tairus in the mid-1990s. Like its natural counterpart, synthetic aquamarine owes its light greenish blue color to the presence of small amounts of Fe<sup>2+</sup>

and to Fe<sup>2+</sup>-Fe<sup>3+</sup> charge transfer. Synthetic aquamarine (again, see table) can be distinguished from its natural counterpart by its characteristic growth patterns and, sometimes, by the presence of flake-like aggregates of Ni-pyrrhotite and Ni-pyrite. Traces of Ni<sup>3+</sup> are consistently present in the synthetic aquamarine, from contamination by the growth environment. The Ni<sup>3+</sup> does not affect the color significantly, but it can be detected by a low-intensity absorption peak near 400 nm.

The synthetic gemstones recently produced by Tairus are significant to the trade, and foreshadow the importance of hydrothermal synthesis in the future.

REFERENCE

Thomas V.G., Mashkovtsev R.I., Smirnov S.Z., Maltsev V.S. (1997) Tairus hydrothermal synthetic sapphires doped with nickel and chromium. *Gems & Gemology*, Vol. 33, No. 3, pp. 188–202.

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