I Historical Information

Alexandrite was discovered near the city of Ekaterinburg in Ural Mountains of Russia. The year of discovery varies to be either 1830 or 1831 according to several sources (1834 according to the Russian sources). It is said to have been discovered on Czar Alexander II's birthday hence the name Alexandrite. The name was also appropriate because the gem color changed from red to green, which happened to be the Russian imperial colors.

The gemstone was highly desired by Russian royalty and aristocrats. Many Russians also considered alexandrite to be a good luck charm. Alexandrite can be found in the jewels of the period as it was a favorite of George Kunz of Tiffany. Tiffany has produced many pieces featuring alexandrite during the late nineteenth and early twentieth century.

Alexandrite has gone to become the birthstone for June and the anniversary stone for the 45th and 55th years of marriage. Because of price and availability, it is often substituted with green tourmaline or smoky quartz.

Alexandrite represents the sign of the Scorpio and is credited with many mystical and healing powers. Its mystical properties include assisting one in centering the self, reinforcing self-esteem, and augmenting one's ability to experience joy. Cunningham's Encyclopedia of Crystal, Gem & Metal Magic states that when alexandrite is worn on the left hand, it helps to inhibit undesirable energies from other people's emotion. When worn on the chest, alexandrite balances one's intense emotional states. Alexandrite's healing properties are said to work on the nervous system.

II Locations

Alexandrite was first discovered in an emerald mining area in Russia. Around the tern of the XXth century, deposits were found in Sri Lanka and later Brazil. Those alexandrites showed very little dramatic color change. In 1987, a new deposits were found in Brazil at Hematita. This alexandrite shows a striking color change from raspberry red to bluish green. This new find started a renewed interest in alexandrite. At present the major sources of alexandrite continued to be the alluvial gem fields of Sri Lanka and the pegmatite districts of Brazil. Efforts were underway to reopen some of the classical occurrences of alexandrite in Russia's Ural Mountains, but so far there has been only limited production from mine dumps. The most exciting new source of alexandrite is the Tunduru region of southern Tanzania, which produces an amazing variety of colored stones. Since late 1998, significant amounts of alexandrite have also been recovered from the Ilakaka alluvial deposit in southern Madagascar. Towards the end of the past decade, sources in India (both in Orissa and Andhra Pradesh) provided new discoveries of alexandrite.

III Chemical and Physical Properties

Alexandrite is a color changing variety of the mineral chrysoberyl. The chemical composition of chrysoberyl is BeAl2O4 and it occurs in granitic pegmatite and mica schist. This is a rare oxide mineral that has two very rare varieties. The first is the color changing alexandrite and the second is the cat's eye chrysoberyl.

Some physical properties of chrysoberyl are as follows:

Chemical composition: BeAl2O4
Crystal system: Orthorhombic
Habit: Tabular or prismatic; also trillings (repeated twinning producing pseudohexagonal crystal with re-entrant angles)
Cleavage: Distinct (prismatic)
Fracture: Conchoidal to uneven
Hardness: 8,5
Toughness: 8
Specific gravity: 3,72

IV Optical properties

Optical properties of chrysoberyl are as follows:

Lustre: Vitreous
Refractive index: 1,746 – 1,755
Double refraction and optic sign: 0,008 – 0,010, positive
Dispersion: Low (0,015)
Pleochroism: Strong in alexandrite (green, yellowish, pink – in daylight; red, orange-yellow, green – in filament light).
Luminescence: Red fluorescence in LW UV, weak red in SW UV.
Absorption spectrum: Alexandrite has chromium lines in the red (doublet plus two other lines), a broad band in the yellow-green and two narrow bands in the blue.

The most dramatic feature of alexandrite is the color change. This effect is caused by combination of factors. The presence of the chromium in combination with the fact that alexandrite is doubly refractive and bi-axial allows alexandrite to possess three different refractive indexes in its three different optical direction. Each of these has a strongly different absorption spectrum, causing different color to be seen. Daylight contains high proportions of blue light, so the stones appear green. Incandescent light contains a higher portion of red light, so the stones appear red. Many variances of the shades of the colors seen occur because each alexandrite can absorb light of different wavelengths many different ways.

V Synthetic alexandrite and simulants

Alexandrite is a beautiful, rare gemstone. It is very difficult to find natural alexandrite of a big size. Most alexandrite on the market are synthetic. Natural alexandrite is so rare because it is found in so few places and then what is found may not be gem quality. Also, the limited availability is a function of cost and demand. Few suppliers want to tie up a great deal of money in alexandrite.

Because of the rarity, many imitations and synthetics have been created. Other gemstones that have the color change effect are often sold as being "alexandrite". Some of these are diaspore (pastel green to light rose), color changing sapphire (violet-blue to purplish-red), and andalusite (yellowish-green to reddish-brown, because of strong pleochroism). There are also some synthetic gemstones which are said to be "alexandrite-like".

Synthetic corundum is a synthetic sapphire with a color change. This material is primarily made in Switzerland by the flame fusion method. It is made in large quantities for under a dollar per carat, distributed to every nation on this planet, and can be easily obtained in large sizes over 15 carats. It is estimated that this material has been produced since the beginning of the 1900's. It is doped with vanadium to give it an Alexandrite-like color change.

This material has characteristics that make it easy to identify once you have seen a few. These stones are light to medium in tone and have a mauve color in incandescent light and a pale greenish/blue color in daylight. It is common to see fairly large 5 carat to 15 carat stones. All stones are clean to the eye. In general the cutting is very symmetrical and the polish usually is poor. This is because the stones were mass produced. A Gemologist should carefully check the refractive index of the stone: 1.762 - 1.770. He will look through a microscope at about 20X to observe the curved striae (color zoning). These are tiny concentrations of color that were created in the flame fusion process and are reminiscent of grooves in a record. Spherical bubbles may also appear.

With a long-wave ultraviolet light, most stones show a distinctive mustard-colored glow. With a spectroscope, the Gemologist will observe a tell-tale narrow absorption line at 475 nm.

Synthetic Alexandrite (synthetic chrysoberyl made in the laboratory), is much more difficult to distinguish from the natural Alexandrite since the basic chemical and optical properties are the same. The main differences are the characteristic inclusions. Namely, what is in there that should not be there. Synthetic Alexandrites have been made by both the flux-fusion method and by the Czochralski "pull" technique. Those stones grown by the flux-fusion method contain the twisted veil-like feather inclusions caused by flux that is commonly associated with this method. These stones will contain an occasional metallic inclusion with a triangular or hexagonal outline (as seen with the aid of a binocular microscope under 20X to 60X). These are tiny bits of the platinum crucible used to contain the melt. Natural Alexandrites have not been found to contain either of these inclusions. Stones made by the pulling method may show curved striae of a kind associated with slow rotation during the crystal pull.

In each case the clear-cut absorption lines associated with chromium are seen in the spectroscope. Since there is usually a lack of iron oxide, there is a strong red

fluorescence which occurs under ultra-violet light. The color change shown by these man-made stones is, as might be expected, more pronounced than that found in most natural examples. The traces of Chromium added to form the synthetic are able to display these clear colors un-suppressed by the presence of iron. It would not be economical to synthesize an "average" gemstone. The synthetic manufacturers try to imitate only the top gem qualities.

Synthetic Spinel is familiar to most of us as the synthetic stone commonly used for class rings and synthetic "birthstone" jewelry. This stone is easily separated from natural Alexandrite by the professional. Synthetic Spinel has a refractive index of 1.728, which is considerably lower than the 1.746 - 1.755 of Alexandrite. Spinel is singularly refractive whereas Alexandrite is doubly refractive. This means you will not see doubling of the back facets when viewed in sharp focus though a microscope. Spinel will not show two colors when viewed in the dicroscope. Since Synthetic Spinel is manufactured by the millions you will see characteristics of mass production. All stones will be eye clean and come in standard mass-produced cuts from .05 carat to 10 carats. The symmetry will be good but the polish fair to poor. Under the spectroscope the Synthetic Spinel may show a vague cobalt spectrum with three broad bands in the orange, yellow and green respectively. Even to the novice, the color in synthetic Spinel does not really change, but is just a mixture of lavender/bluish.

Natural Andalusite can easily be separated from natural Alexandrite by the experienced gem enthusiast. Andalusite has a refractive index of 1.634 - 1.643 which is considerably lower than Alexandrite. The specific gravity is 3.17 which means it will float in 3.32 heavy liquid (methylene iodide) while Alexandrite (3.72) will sink. Andalusite's colors do not change and are usually an olive green body color with brownish orange gleams seen at the edges of the stone. This is because of its strong pleochroism (multi-colors). Natural Andalusite is a rare and beautiful gemstone in its own right.

Natural Sapphire with "Alexandrite-like" properties has recently (1990's) been mined in Eastern Africa (Tanzania). Usually the color changes from a brownish green to a brownish red. A natural Alexandrite with a similar color change will command more money so it is important to make an accurate diagnosis. The Sapphire will have a refractive index 1.762 - 1.770 which will conclusively separate it from Alexandrite. Natural Sapphire will not have any of the curved striae or bubbles associated with synthetic sapphire as discussed earlier. You can expect moderate inclusions and possibly native cutting with the Tanzanian Sapphire.

IV Alexandrite prices in the 1990s

Long a collector's stone, alexandrite has never been in plentiful supply. When Brazilian miners hit a pocket of alexandrite in 1991, supply increased and, contrary to what was expected, prices went up. Since then, the prices of lower-to-middle grades have remained fairly constant (at about $4,500/ct for 2 ct "good" stones), whereas finer-quality gemstones strengthened in price (from an average low of $5,700/ct in 1990 to 8,000/ct in 1999 for 2 ct "fine" stones).

Bibliography

Antoinette L. Matlins and Antonio C. Bonanno (1998) Jewelry and Gems (The buying guide);

Cally Hall (1995) Gemstones

Peter G. Read (1999) Gemmology

Richard Druker (2000) Gem Prices in the 1990s

Anderson, J., Alexandrite: A Russian Christmas Tale, http://www.jewelryexpert.com

Gambhir, R., Gem profile: Alexandrite http://www.canjewel.polygon.net

Gem and Minerals Miners Inc., http://www.mineralminers.com

Mineral Data, http://www.webmineral.com