

# Aa.



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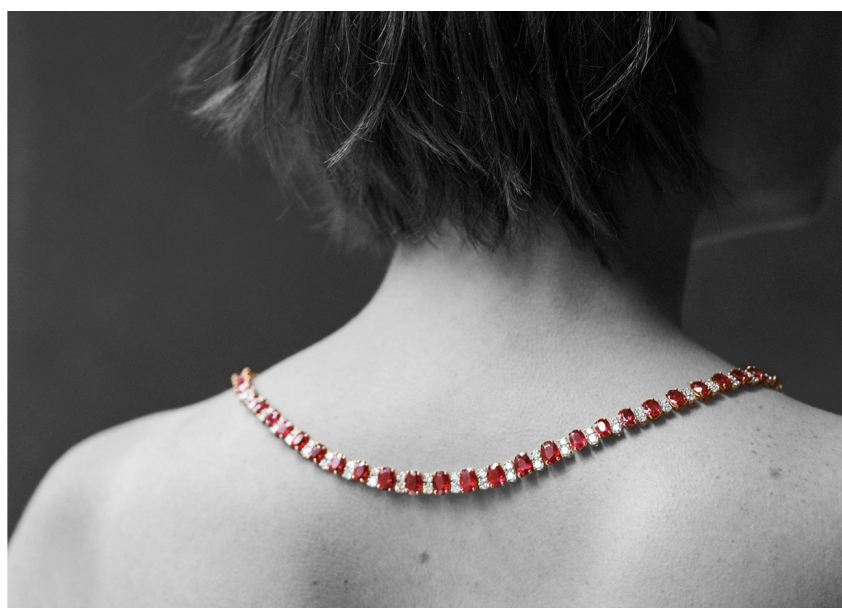
SHOES

BAGS

JEWELRY

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## SCIENCE OF STONES: RUBY



OSCAR HEYMAN GOLD/PLATINUM RUBY &  
DIAMOND NECKLACE

Photographed for Accessories Almanac by [Sally Griffiths](#).

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MINERAL: Corundum // CHEMICAL COMPOSITION:  $\text{Al}_2\text{O}_3$  // COLOR: Red  
// REFRACTIVE INDEX: 1.762 to 1.770

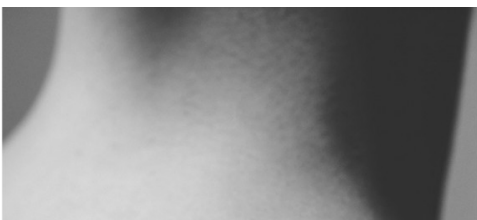
BIREFRINGENCE: 0.008 to 0.010 // SPECIFIC GRAVITY: 4.00 (+/- 0.05) // MOHS  
HARDNESS: 9

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A good part of our mission at Aa. is to educate, whether it's through in-depth articles with industry professionals about the financial success of an accessory category or the latest news. This column marks the start of our latest exploration into the science of stones. We found in our research that despite enjoying jewelry, most people don't know all that much about its origins; what a gemstone is made of or what makes it valuable. Here, we'll take a deep dive into the birthstone of each month, beginning with rubies in July.

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There's a reason red cars feel faster and red dresses command more attention. Red is the color of our most intense emotions: love, anger, passion, and fury. Hence, of all the colored stones, rubies are the most expensive, demanding the highest per-carat price. The word ruby comes from *ruber*, Latin for red. Early cultures believed rubies held the power of life because of their similarity to blood, and rubies are mentioned four times in the Bible, associated with attributes like beauty and wisdom. Rubies are also one of the cardinal stones (amethyst, sapphire, emerald, and diamonds make up the others), gemstones which have traditionally been considered precious above all others.



Rubies are scientifically known as corundum, a rock-forming mineral and crystalline form of aluminium oxide which is two aluminium atoms and



OSCAR HEYMAN  
PLATINUM RUBY  
DIAMOND BRACELET

three oxygen atoms ( $\text{Al}_2\text{O}_3$ ) in a close packed hexagonal structure. Corundum typically contains traces of iron, titanium, vanadium and/or chromium. All colored gems have a corundum base which on its own is naturally transparent, but the transparency begins to display various colors when these trace elements are present. Chromium imbues corundum with its red color and forms what is commonly known as a ruby. Chromium gets its name from the Greek word  $\text{chrōma}$ ,

meaning color because many chromium compounds are intensely colored. A chemical element on the periodic table with symbol Cr and atomic number 24 it is a metal that appears grey and lustrous, as well as being hard but brittle it has a melting point over 3,400 Fahrenheit and resists tarnishing.

Geologists have been studying the formation of gems for some time and have discovered that most gem-grade corundum occur in metamorphic rocks (rocks that have formed due to high pressure and heat) such as schist or gneiss and igneous rocks (rock formed from lava flows that have cooled and solidified) such as basalt or syenite. The highest quality rubies typically form in marble. Marble is a metamorphic rock that forms when heat and pressure from inside the earth's crust contacts limestone deposits during mountain formation. The low iron content in marble allows it to produce rubies with especially intense red colors. Marble also produces the much prized fluorescent rubies. When iron interacts with corundum it produces a blue color. Blue corundum is better known as a Sapphire. With minimal iron, the chromium's red is not interrupted by the iron's blue. Basalt rocks have also been known to host ruby deposits but unlike marble, Basalt contains much more iron and this combines with the chromium to produce rubies that are a darker, less vibrant red.



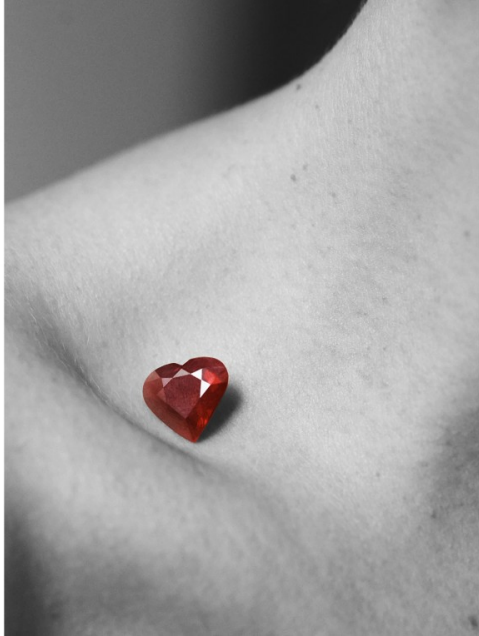
The most sought after rubies are mined in Myanmar (Burma) where rubies were once placed beneath the skin of tribal warriors to make them invincible in battle. Mozambique, Thailand and Madagascar have all been known to produce impressive ruby deposits. If you study these locations on a map it's very interesting the way that they all surround the Indian Ocean and when pushed together the regions where rubies are found today can all be referenced back to a time when the tectonic plates created the super continent Pangea. At that time, all of

these regions were aligned with one another. As the development of rubies takes 20-30 million years, tectonic movements of the earth's plates separated them into the continental shapes of today, all the while producing their ruby deposits in isolation. The Mogok Valley in Burma was the world's main source for rubies for centuries. That region produced some very fine rubies, but in recent years few good rubies have been found as the mines have been depleted. Rubies are rarely mined directly from the marble or basalt in which they form. Mining the small gems from these hard rocks is possible but very expensive, and many rubies end up broken during the mining process. Fortunately, rubies are very hard, registering a 9 on the Mohs scale, (diamonds are a 10, for comparison) they are also resistant to weathering by wind and water so in many mining areas, natural weathering and erosion over long periods of time end up freeing the stones from their rock bases. The rubies are then carried into streams and today are mined from stream sediments. Most rubies and sapphires are produced by washing the gravels of these stream deposits. Similar to panning for gold, this work is done by hand because the deposits are small and irregular in shape and character which means the stones can easily be missed if attention is not carefully paid. Due to the manual nature of this work, the long hours and the large amounts of human



OSCAR HEYMAN  
PLATINUM RUBY  
DIAMOND EARRING

capital necessary to operate a mine, these deposits are often located in countries where wages are low and artisanal mining is prevalent.



OSCAR HEYMAN  
7.30cts HEART  
SHAPE RUBY

When grading a ruby, the color and clarity are the most important attributes a gemologist will use to calculate value, followed by the ruby's weight in carats and then the cut. The ruby's color primarily depends on the amount of chromium present although the color can be affected by the inclusions and the amount of fluorescence it displays. Many marble hosted rubies will fluoresce, emitting their own light after absorbing ultraviolet light, even that of sunlight. This of course intensifies their color and increases their value.

The color of a ruby will subsequently divide into three components: hue, saturation and tone. Hue refers to colors as we normally use the term. Saturation refers to how much brown or gray masks the hue in the stone. Tone refers to the amount of color in the ruby, ranging from very light to very dark. Transparent colored gemstones occur in what is called "pure spectral hues" of red, orange, yellow, green, blue, violet. That is to say we see the colors of the stones as a single color. However, in nature, there are rarely pure hues, so when speaking of the hue of a gemstone, we speak of primary and secondary and sometimes tertiary hues. A ruby's primary hue is red. The most common secondary hues are orange, purple and pink. Of the three, purple is preferred because it reinforces the red, making it appear richer. Purple also occupies a position on the color wheel halfway between red and blue. When a purplish-red ruby is set in yellow (as is the case with yellow gold), the yellow neutralizes its complement blue, leaving the stone appearing to be pure red in the setting. The color of the finest gems are a pure, vibrant red to slightly purplish red. A ruby described by

gemologists to have the color of “pigeon’s blood” is the rarest and most expensive ruby per carat.

Following color, the clarity of a ruby is most important. Similar to diamonds, a transparent stone will command a premium, but a ruby without any rutile needle (silk) inclusions indicates that the stone is synthetic or has been overly treated. These thin mineral inclusions are present in intersecting groups called silk. The needles might be short or long and they might appear to be woven tightly together. Some inclusions can actually contribute positively to a gem’s appearance. The presence of rutile silk causes light to scatter across facets that might otherwise be too dark. This adds softness to the color and spreads the color more evenly across the ruby’s crown. The asterism displayed in the Oscar Heyman star ruby ring is an example of silks adding value and beauty to a stone. People in the trade expect rubies to have at least some inclusions because inclusion-free rubies are practically nonexistent. Ruby value depends on how visible the inclusions are. If large and prominent inclusions are located they greatly diminish the transparency, brilliance, and thus, value of the stone. Inclusions can also limit a ruby’s durability. Significant surface-reaching fractures can pose durability threats.

Rubies are commonly fashioned as mixed cuts, which have brilliant-cut crowns and step-cut pavilions. Several factors affect the cut and proportion of rubies on the market. The crystal shape in a ruby dictates its suitability for certain cuts. To accommodate these crystals, the most common shapes of fashioned rubies are ovals and cushions, with brilliant-cut crowns of kite-shaped and triangular facets, and step-cut pavilions with concentric rows of rectangular or square facets. A cabochon, a gem without facets can also be cut to show





off the special star asterism that can occur in the silks of certain rubies. These asterisms are sensitive to points of light and will glide across the ruby

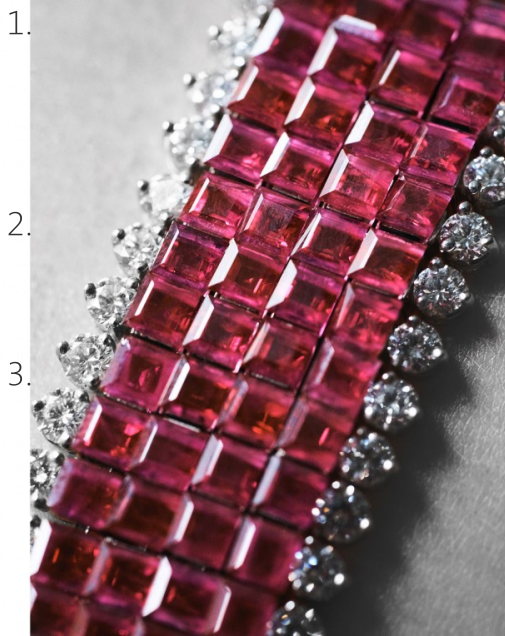
OSCAR HEYMAN  
GOLD/PLATINUM  
STAR RUBY RING

following the point of light as it moves, it is a marvel to observe. Pleochroism—the appearance of different colors in different crystal directions—is another factor that influences cut. In ruby it typically appears as red to purplish red in one crystal direction and orangey red in the other. Cutters can minimize the orangy-red color by orienting the table facet perpendicular to the long crystal direction. Even so, it's not always possible to orient a ruby for ideal color return because the potential loss of weight would be too great.

Fine-quality rubies over one carat are very rare and price goes up significantly as size increases. The price per carat goes up significantly for ruby as it increases in size. For example: A commercial-quality 5-carat ruby might sell for about twice as much per carat (10 times total stone value) as a commercial-quality 1-carat ruby, while a fine-quality 5-carat ruby sells for over five times more per carat (25 times total stone value) than a fine-quality 1-carat ruby.

Improving the quality of gemstones by treating them is common practice. Some treatments are used in almost all cases and are therefore considered acceptable. Improvements used include color alteration, improving transparency by dissolving rutile inclusions, healing of fractures (cracks) or even completely filling them. The most common treatment is the application of heat. Many rubies at the lower end of the market are heat treated to improve color, remove purple tinge, blue patches, and silk. Heating will help to improve the color of the stone and bring out the best of what nature had intended. Many rubies start off brown and heating brings them to the familiar red color we more commonly associate with the ruby. These heat treatments typically occur around temperatures of 1800 °C (3300 °F). Some rubies undergo a process of low tube heat; when the stone is heated over charcoal of a temperature of about 1300 °C (2400 °F) for 20 to 30 minutes. The silk is partially broken, and the color is improved. Usually, the rough stone is heated before cutting. Another treatment, which has become more frequent in recent years, is lead glass filling. Filling the fractures inside the ruby with lead glass (or a similar

material), dramatically improves the transparency of the stone, making previously unsuitable rubies fit for applications in jewelry. The process is done in four steps:



OSCAR HEYMAN  
PLATINUM RUBY  
DIAMOND BRACELET

The rough stones are pre-polished to eradicate all surface impurities that may affect the process

The rough (uncut stone) is cleaned with hydrogen fluoride.

The first heating process during which no fillers are added. The heating process eradicates impurities inside the fractures. Although this can be done at temperatures up to 1400 °C (2500 °F) it most likely occurs at a temperature of around 900 °C (1600 °F) since the rutile silk is still intact.

4. The second heating process in an electrical oven with different chemical additives. Different solutions and mixes have shown to be successful, however mostly lead-containing glass-powder is used at present. The ruby is dipped into oils, then covered with powder, embedded on a tile and placed in the oven where it is heated at around 900 °C (1600 °F) for one hour in an oxidizing atmosphere. The orange colored powder transforms upon heating into a transparent to yellow-colored paste, which fills all fractures. After cooling the color of the paste is fully transparent and dramatically improves the overall transparency of the ruby.

If a color is to be added, the glass powder can be "enhanced" with copper or other metal oxides as well as elements such as sodium, calcium or potassium. The second heating process can be repeated three to four times, even applying different mixtures. The treatment can be identified by noting bubbles in cavities and fractures using a 10x loupe.



We would like to thank our friends at [Oscar Heyman](#) who aided in our research and allowed us to photograph their exquisite jewelry. Thank you.

Styling and Words by [Paul-Simon Djite](#)

**BY AA.**