Emeralds and Aquamarines

Contributed by Administrator
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Emeralds and aquamarines originate from the same mineral. Chemically, they consist of four elements, beryllium, aluminum, silicon, and oxygen, which have entered into a complex combination to form the mineral beryl. Whether the resultant stones are emerald green, aquamarine blue, or even pink or yellow once again depends upon the extent of the chemical impu¬rities present in the crystals.

The value of the emerald does, of course, depend largely upon its color. Indeed, unless it is a vivid green it cannot be classed as an emerald at all. If the mineral is pale green and the crystal clear, it is not an emerald but simply green beryl. Once, a beryl crystal was found in Norway that measured more than 5 feet in length and weighed over 2 tons, but unfor¬tunately it was not an emerald nor was it even transparent. It was simply the mineral beryl, in its commonest form (see Fig. 41). Huge opaque crystals of beryl have been found in various parts of the world.

Emeralds and aquamarines occur in nature as beautifully formed hex¬agonal crystals (see Fig. 10). They have a hardness of 7%, which is only just sufficient to protect them from undue wear and tear when worn as jewelry. This may seem confusing at first, since 7% seems quite high up on the hardness scale. There is, however, a mineral known as quartz, which possesses a hardness of 7. In its commonest form it is found almost every¬where. Much of the sand on the beaches, as well as the materials used for making roads, contains it, while fine particles of it float all around us in the air as part of ordinary dust. As such, it comes into contact with everything, including jewelry, and in the course of time it will scratch and wear away those materials that are softer than itself. It is wise, therefore, when purchasing jewelry, to know the hardness of the gems it may contain. Dis¬appointment will be great if you buy a ring containing a beautiful gem stone that, after a short period of wear, loses its polish and shows signs of scratching.

A good example of this is the stone known as strontium titanate, SrTi03. This is a man-made gem synthesized in the laboratory, and it resembles the diamond in almost every detail. It sparkles even more beautifully than the diamond, but its hardness is only 6, and it is therefore liable to lose its polish quickly if frequently worn, especially in rings where the stone comes into contact with many objects during wear.

Unlike other gem stones, emeralds are not generally found in sands and gravels but are mined almost always from the parent rock. The reasons for this are that emerald is a relatively light stone and therefore more likely to be washed away by rivers and streams. The crystals are often fractured owing to geological upheavals that the parent rock has undergone.

Today, the most important source of emeralds is at Muzo in the Republic of Colombia in South America. It is here that the largest and most beauti¬ful stones are found. The mines are exceedingly old and were known to the ancient civilization of the Incas. The Spanish conquerors seem to have been the first Europeans to learn about the Colombian emerald treasures. After having plundered many magnificent stones possessed by the native popula¬tion, they set about searching for their source and eventually, in 1558, dis¬covered some of the mines.

Emeralds are also found in the Ural Mountains of Russia, in Egypt, and in India, and recently, some very fine stones have been mined in Southern Rhodesia. Even in Europe, where few gem stones originate, there is an area in the Austrian Alps, known as Habachtal, where emeralds occur. Unfor¬tunately, it is not very productive and is rarely worked.

Very few emeralds are completely clear and transparent, but such stones are immensely valuable. The gems usually contain certain irregularities known scientifically as inclusions. These inclusions may consist of cavities of tiny bubbles of gas, or they may be tiny foreign mineral crystals that were trapped in the crystal when it was originally formed. Inclusions are of great interest to the gemmologist, for in some cases they form a guide as to the origin of the stones. For example, if a certain stone when examined under the microscope revealed toothed cavities, as shown in Fig. 43, it could be deduced immediately that it came from emerald mines in Colombia, where stones with these inclusions are found.

Aquamarine, unlike the emerald, is normally found in clear, transparent crystals. Indeed, the value of these stones is much reduced if they contain irregularities. Principal sources are an area known as Minas Gerais in Brazil, Madagascar, and Ceylon. Color varies from pale blue to greenish blue, and the value of aquamarines as gems will largely depend on their transparency, color, and size. Blue-green stones can be changed to blue, the ideal color, if carefully heated; but this operation must be left to the skilled technician, otherwise the stone may be spoiled. Similar color changes in a number of minerals can be induced by careful heating.
Other kinds of beryl used in jewelry are its pink form, known as mor-ganite, and its yellow-green form, known as heliodor. The former is found in California and Madagascar, and the latter in the United States, West Africa, and Ceylon.

Like diamonds and rubies, emeralds, too, enjoy great popularity as gem stones, and, for many years, more or less successful attempts have been made to synthesize them in the laboratory. Today, they are mostly pro¬duced in San Francisco by the chemist Carroll S. Chatham. The exact process employed by him is still shrouded in secrecy, but the principle employed is believed to be an improvement of the flux-melt method in which the components are dissolved in a crucible, and, when the tempera-

ture is carefully reduced, a crystal forms, sinks to the bottom of the crucible and continues to grow there.
Another method of making emeralds is similar in many ways to the pro¬duction of synthetic quartz crystals. The principal apparatus employed consists of a chamber known as an autoclave, or bomb, capable of with¬standing enormous pressures. This chamber is filled with water and some fragments of quartz crystals. It is then tightly shut and the bottom portion is heated by means of an electric current to a temperature of 365° centi¬grade. This is more than three times the temperature at which water boils, but the nature of quartz is such that it requires this high temperature before it will dissolve freely in water.

In order to grow the quartz crystals, the top of the vessel is kept at a lower temperature than the bottom, and, as the solution is circulated from the bottom to the top, the water at the top of the autoclave can no longer hold the quartz in solution, and it is deposited in the form of crystals. These crystals grow very slowly, and the process takes a number of weeks to complete.

Synthetic emerald crystals fortunately can be .distinguished from the natural stones by careful examination and testing, but the outward appear¬ance of the synthetic stones can be most attractive and is in most ways similar to the natural stones. The metal beryllium has great industrial importance. A white metal that does not occur in nature in a pure state, it is obtained by the electrolysis of its fused compounds. Lighter than aluminum, it is used in the production of special alloys together with copper, iron, and nickel. The ore from which beryllium derives is beryl in its impure form.