

## **MinSoc October 2002**

### **Noel Kennon – Gemstones**

#### **Gemstones: What are they and Why?**

The word 'gemstones' presumably conjures up for most people thoughts of diamond rings, opal pendants, emerald brooches, sapphire earrings, rubies, garnets topaz etc whilst people more familiar with jewellery may also think of some less well-known substances such as andalusite, orthoclase, zoisite, iolite and many others from which jewellery can be made.

Noel Kennon stressed that the term gemstones includes both the rough material found in nature and the object of beauty which may be fashioned from it by the various processes of cutting and polishing which are used to enhance the appearance of the natural material. In his lecture the speaker intended to concern himself only with the mineral itself in describing what is a gemstone and why. Referring to a dictionary definition of a gemstone the reader would find that "Gemstones are artificially polished fragments of certain minerals used for decorative purposes mainly in jewellery. Gemstones are hard, relatively free of cleavage and occur as transparent crystals". Another definition –"A general term for any precious stone". The OED, (Oxford English Dictionary), - "A precious stone of any kind especially when cut and polished".

According to the Fleischer Glossary of Mineral Species there are several thousand mineral species known whereas only about a hundred of these are generally regarded by jewellery and gem cutting authorities as having those characteristics which qualify them to be defined and used as gems.

So what are these characteristics?. The consensus of opinion is that there are four qualities that distinguish a gemstone. The substance has to be precious, rare, durable and beautiful. The speaker referred to a list which he displayed of about a hundred gem materials indicating the 'big four', - diamonds, emeralds, rubies and sapphires and other groups of generally less value but stressed that all gemstones are precious with some being more precious than others.

Gemstones are rare. In kimberlite which is the source rock from which diamonds are extracted there is about one carat in about 3.6 tonnes of rock or about one part in eighteen million. In alluvium there is about one carat in sixteen tonnes or about one part in eighty million. Whilst over the millennia various geological processes have provided localized concentrations of certain gem materials which have awaited the lucky prospector or mining company recovery of gemstones in any quantity has usually involved searching through and processing a very large volume of host rock or material.

Gemstones are durable, a characteristic which includes the features of hardness, toughness, wear-resistance and chemical stability and which is due mainly to the atomic structure with co-valent bonding providing much more durability than ionic bonding. Substances such as diamond with a co-valent interlocked molecular structure and the jades with a fibrous interlocking structure are much tougher than emerald which has a near-ionic-bonded molecular structure which tends to leave the mineral brittle. Emeralds are not found in quantity in alluvial deposits since the alluvial process will have worn and broken them up much more so than harder gemstones. By reference to the standard hardness scale the speaker

stressed that most gemstones and particularly the most valuable are harder than quartz at hardness 7 which is the most common mineral in the environment and most likely to be the cause of abrasion of any gem material of a lesser hardness.

Beauty is very subjective and cannot be as easily quantified as the first three characteristics. Almost without exception beauty in a gemstone is related to optical effects and to colour. Colour in gemstones is either pseudochromatic, idiochromatic or allochromatic. Pseudochromatism is due to any of a variety of optical effects that a material may exhibit which alters or enhances the nature of the light being transmitted back to the observer from it and includes light diffraction, reflection or refraction, iridescence, interference, chatoyancy, opalescence, adularescence and asterism. These features appear in stones such as fire opal, labradorite, quartz 'catseyes', chrysoberyl, opal, moonstones, and star sapphires.

Idiochromatism refers to the natural intrinsic colour of the mineral, diopside and malachite would always be green, azurite always blue or marcasite always yellow. Allochromatism refers to stones which are coloured by impurities such as where ruby and emerald are coloured red and green respectively by containing about 1-2% chromium when the pure corundum or beryl would be colourless. The appearance of stones either naturally coloured or by impurities may be enhanced by the features of refractive index or colour dispersion and this point led the speaker to touch on a description of the nature of light and its interaction and reaction with solid, reflective or transparent substances. The speaker then spent some considerably more time discussing the various colour-producing or enhancing impurities and the reasons why different colours are caused by reference among other factors to the interaction of various ions in the atomic structure of the mineral.

Referring to the feature of refractive index in gem materials led the speaker to describe the rationale for cutting stones to particular designs, explaining the reason for the brilliant style of cut for diamond which has been intended to bring out the best 'fire' or dispersion of light when the stone is viewed.

Noel Kennon's lecture was very thorough and went into considerable detail. It was clearly very appreciated by the members present and provoked many questions. At the conclusion he was prevailed upon to answer a number of these until the President called for an end to the evening's formal program.