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GEMMOLOGY IN ANCIENT INDIA

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Gemmology, the science of gems, despite its having a commercial aspect, is a subject of absorbing interest to one and all alike. In Sanskrit, a precious stone is known by the name *ratna*, a term which denotes an object of delight or a coveted object. Precious stones are treasured not for their beauty and value alone but for their magic efficacy on the person as well, since some germs are used in components of medical preparations, while all gems have their curative faculties in psychic therapy.

From very ancient time, knowledge pertaining to gems was widespread in India, which is well-known as a source-spot of various types of precious stones. In course of time, the entire knowledge was systematised and given the status of *śāstra* or science. We find innumerable data pertaining to gemmology lying scattered in the vast expanse of Sanskrit works. An attempt has been made in this paper to present a brief discussion of the various aspects of gemmology found in various Sanskrit texts and thereby to establish its scientific importance. An enumeration of the main Sanskrit works on gemmology is followed by a presentation of the origin and classification of gem-stones, effects, methods of testing gems, source-spots, manufacture of artificial gems, etc., with illustrations mainly from the descriptions of diamonds and rubies.

In conclusion, an attempt has been made to establish that our gemmologists also gave importance to most of the properties of gems like cohesion, hardness, lustre, specific gravity, etc. in classifying and testing gems as it is done by gemmologists of the modern day. Ancient Indians studied gemmology in a systematic manner and cultivated the same as an independent science.

INTRODUCTION

Jewellery in India, which is as spectacular as it is valuable, comprises a large variety of ornaments made of gold and silver and studded with a variety of precious gems in exquisite patterns. In Sanskrit, a precious stone is known by the name *ratna*, which is derived from the root 'रम्' and which denotes an object of delight or a coveted object. The earliest available literary utterance of this word occurs in *Ṛg Veda*, where *Agni* is invoked as *Ratnadhātama*[1], the greatest conferer of all desired objects. Subsequently, anything that is precious was denoted by the term '*ratna*' on account of its excellent qualities[2]. Precious stones like diamonds, rubies, sapphires, etc. are treasured not only for their beauty and value but also for their effects on planetary attractions and their magic efficacy on the person of the wearer. Gems have their role to play in medical sciences as well, since some gems are used in components of medical preparations, while all gems have their curative faculties in psychic therapy.

India is well-known as a source-spot of various types of precious stones. From the past several centuries, our country is renowned as one of the greatest trading centres for

precious stones. The vast mass of our ancient literary works contains hundreds of allusions to precious gems which throw light on the fact that from very ancient time, knowledge pertaining to precious stones was widespread in ancient India. In course of time, probably, the entire knowledge was systematised and given the status of *'śāstra'* or science which became popular by the name *'Ratnaśāstra'*. Of course, ancient Indians were well-known for their cultivating any branch of knowledge as an independent science and studying the same in a systematic manner.

Ancient Works on Gemmology

We come across innumerable data pertaining to gemmology lying scattered in the vast expanse of ancient Sanskrit literature. Kauṭilya has mentioned *'Ratnaparīkṣā'* (Gemmology) in *Arthaśāstra* (II.2), while Vātsyāyana has included the same in the list of 64 subsidiary arts (*Kāmasūtra,* I.3.6). Vyāsa, Agastya, Aṅgīrasa, Varāhamihira and a host of sages and great writers of ancient India are mentioned as having composed works on *Ratnaśāstra.* Apart from ancient works like *'Ratnaśāstra', 'Utpalaparimala', 'Vāhata',* Candeśvara's *'Ratna Dīpika'* and Buddha Bhaṭṭa's *'Ratnaśāstra'*, several other compilations like *Viśvakarmīya, Smṛtisārasaṅgraha, Bṛhatsaṁhītā, Yuktikalpataru* of Bhoja Deva, *Manasollāsa* of Somadeva and *Śivatattvaratnākara* of Basava Bhūpa also contain sections giving detailed accounts of gems. *Śukra Nīti, Agnipurāṇa, Skandapurāṇa (Hālāsya Māhātmyam* in *Agastya Saṃhitā),* etc. supply very useful information pertaining to precious stones.

Origin of Gems

Generally, these works on gemmology contain sections dealing with legendary stories related to the origin of different gems, their source-spots and mines, characteristic features like colour, density, weight, etc., flaws and defects, method of weighing, evaluation, good or bad effects of wearing flawed gems, different varieties of each gem, etc. Like many other Hindu branches of learning, the science of gems is also interlinked with a good deal of mythological and legendary lore. Different legendary versions are given about the origin of gems which only serve the purpose of glorification of gems. Despite this, we come across many verses in these treatises which prove that ancient Indians were in possession of the knowledge that gems are stones caused by the nature of special types of rocks.

भूस्वभावाद्धि रत्नानि जातानि विविधानि तु।
उपला रत्नरुपत्वं प्राप्ताः कालान्तरेण वा॥

— ईश्वर दीक्षितीये रत्नपरीक्षा — 83

पुरा पृथिव्या रत्नानि गर्भे त्वासन्हि सर्वशः।
रत्नगर्भा इति सा भूमिः रव्याताभूद् भुवनत्रये॥

— स्मृति सारोद्धारे रत्नपरीक्षा — 8

Sages of ancient India were aware that gemstones are minerals and are found in different types of rocks. According to sage Aṅgīrasa, diamonds are produced by the brilliance of lightning in a place called Kuddāla, in Mahārāṣṭra[3].

Classification

Gems are broadly classified as *Mahāratna* and *Uparatna* (precious and semi-precious stones). Among the nine well-known precious gems *vajra* (diamond), *muktā* (pearl), *māṇikya* (ruby), *indranīla* (sapphire), *marakata* (emerald), *vidruma* (coral), *gomeda* (jacinth), *puṣparāga* (topaz) and *vaiḍūrya* (Lapiz lazuli), the first five are classified as *mahāratna* and the last four as *uparatna*[4]. *Utpalaparimalā*, an ancient treatise on gemmology, enumerates 22 varieties of gems, adding the following 13 precious stones to the popular list of nine gems: *karketana, rudhirākṣa, vipula, vimalaka, rājāmaṇi, sphaṭika, chandrakānta, śaugandhika, śaṅkha, mahānīla, brahmamaṇi, jyotirasa and sīvyaka. Sūryakānta and tārākānta* are also mentioned in some texts[5]. *Agnipurāṇa*, in its short chapter on precious stones, enumerates 36 gems, including the well-known nine gems. The other gems enumerated are: *mahānīla, gandhasasya, chandrakānta, sūryakānta, sphaṭika, pulaka, karketana, jyotirasa, rājapaṭṭa, rudhirākṣa, bhallātaka, dhūli, tuṣyka, śīsa, pīlu, pravāla, girivajra, bhujaṅgamaṇi, vajramaṇi, ṭiṭṭibha, bhramara, rājamaya, saugandhikā, gañja, śaṅkha and brahmaṇya*[6]. Some of the these gems may be only different types of the main gems, depending on the source-spots, colour, hue, refraction, etc. *Agnipurāṇa* has also enumerated and described the characteristics of 30 different *sālagrāma* stones, which are worshipped as different deities like Vāsudeva, Saṅkarṣaṇa, etc. They are classified according to their colours, marks on the surfaces, shapes, pits, holes, etc.

The Diamond

All the texts dealing with gems begin with a description of diamonds. It is the hardest stone known to man. In Latin it is called '*adamas*' or the invulnerable. In Sanskrit, it is known as *vajra*, which means hard. This quality along with its brilliance and fire makes the diamond reign supreme over other gems.

Kaliṅga and Kosala in *Kṛtayuga*, Himālaya and Mātaṅga mountains, in *Tretāyuga*, Pauṇḍarīka and Surāṣṭra in *Dvāparayuga* and Vairākara and Souvīri in *Kaliyuga* have been named by the ancient gemmologists as the find-spots of diamonds[7]. Though in most of the regions diamonds are not found at present, it is likely that some ancient diamond workings have been abandoned, or it is quite probable that some of the places referred to in these works had been centres of export trade in diamond. Variākara (Wairgadh) appears to have been famous for its excellent diamonds, as it is mentioned in almost all texts dealing with gemmology.

The characteristics of an ideal diamond as described in ancient treatises are: six-pointedness, purity (without stain), being well formed octahedron (8 facets) with pronounced sharp edges and lightness.

षट्कोणत्वं लघुत्वं च समाष्टदलता तथा
तीक्ष्णाग्रहा निर्मलत्वं इति पञ्च गुणाः स्मृताः ॥

– रत्नपरीक्षा, 10; शिवतत्त्वरत्नाकरः VI. 17.6.7.

Bṛhatsaṁhitā describes a perfect diamond thus: It should be so hard that it cannot be pierced by any other substance, light in weight when compared to its volume and capable of floating in water, brilliant, glossy with the reflection of lightning, fire and rainbow (*Ratnaparīkṣādhyāya* 14). Diamond is described as the hardest among all the gems.

पृथिव्यां यानि रत्नानि ये चान्ये लोहधातवः ।
सर्वं तद्विलिखेद्वज्रं वज्रं तैर्न विलिख्यते ॥

– हालास्य माहात्म्यम्

Generally, five good qualities, five defects and four shades of colour are enumerated while describing the characteristics of diamonds. Diamonds that have scratches like crow legs, that have lines, dirt, dots and those that are chipped off are classified as flawed ones[8]. Varāhamihira has enumerated a few more defects: scratches like crow legs, flies or hair, mixed with clay or gravel, broken double-faceted, burnt, deformed colour, devoid of lustre, perforated, bubbles or spots, truncated on points, flat, unduly elongated (*Bṛhatsaṁhitā, Ratnaparīkṣādhyāya,* 15 16).

Among the six defects of diamond, '*mala*' or dirt is the deformation of colour found in certain parts of the precious stone. It is believed that these flaws in different parts of the gem would cause different ill-effects. '*Bindu*' or dots found in diamonds are flaws and four types of this flaw are described. *Bindu* is a red round spot, *āvarta* is a small spot slightly turned towards the left, *parivarta* is a deep red circular spot and *yava* is a flaw in the form of a small barley corn, which is generally found in red, yellow and white colours. Different types of the flaw *rekhā* (lines) are also mentioned[9].

Diamonds are classified as *brāhmaṇa, kṣatriya, vaiśya* and *śūdra* in accordance with the four shades of colour — white, red, yellow and black[10].

Gemmologists of ancient India have classified diamonds (almost all gems) as masculine, feminine and neuter. Round diamonds with flat surface, very brilliant and devoid of any scratches or spots are classed as masculine gems, the excellent ones. Those with spots and lines are classified as feminine. Triangular and elongated ones are grouped as neuter[11]

In ancient India, the custom of attributing gems of different colours and shapes to different deities was widely prevalent. It was believed that a hexagonal white diamond is presided over by Indra. A dark diamond, shaped like a serpent's mouth, is presided over by Yama, and so on[12].

Leaving aside the magico-religious aspects of diamonds mentioned by gemmologists of ancient India, from the aforesaid brief account of diamonds, it is

evident that even in the early centuries, Indians knew that diamond is the hardest mineral found in rocks and that importance was given to its unsurpassing hardness, lightness, brightness, shape, etc. The five principal virtues, five defects and the four shades of colour are acceptable to the modern gemmologist also.

RUBIES

Māṇikya is the general term used to denote rubies and at times the term *padmarāga* also is used for the same. *Māṇikya* is divided into four classes in accordance with the region of origin, Simhala, Kālapura, Andhra and Tumbura. The red rubies found in Simhala are excellent ones and are known as *Padmarāga*. Rubies which originate in Kālapura are of yellow tinge and are called *Kuruvinda*. Rubies obtained from Andhra are called *Saugandhika* and are of the colour of the leaves of *Aśoka*. The fourth variety, called *Nīlagranthi*, is of blue tint and is available in Tumbura. Among these rubies, those from Simhala are valued as the best[13].

In some texts, rubies are divided into three classes according as their origin lies in *saugandhika* (sulphur), *kuruvinda* (cinnabar) and *sphaṭika* (crystal)[14]. *Saugandhika* has the lustre of bees, collyrium, lotus, or the juice of the rose-apple fruit. *Kuruvinda* is grey, while rubies born of rock-crystals are brilliant, of many shades and pure[15]

Rubies have also been divided into four classes by ancient sages as *Brāhmaṇa, Vaiśya, Kṣatriya* and *Śūdra. Padmarāga*, which is also known as *Jātaraṅga*, is a *Brāhmaṇa* ruby, which is found in 10 slightly varying shades, i.e., colour of lotus, of kalhāra flower, of fire flies, of fire, of the eyes of cuckoo bird, of the shine of light, of the colour of pomegranate seeds, of the sun, of pomegranate flowers and of *indragopa* (an insect)[16]. *Kuruvinda* is a *Kṣatriya* ruby, which is generally found in eight hues — that of *lodhra*, of *kiṁśuka*, of *bandhūka*, of *japākusuma*, of *guñja*, of the blood of hare, of *sindūra* and of heated iron[17]. The *Vaiśya* ruby *Saugandhika* is also found in six different shades. *Nīlagranthi*, also known as *gavaṅga*, is *Śūdra* gem, which is found in four different shades of red and pink[18]. According to some texts, rubies can be obtained in 16 different shades of colour[19]

It is interesting to note that ancient gemmologists of India were capable of distinguishing nearly 28-30 different rubies based on different shades of colour.

Rubies are further classified as superior, ordinary and inferior, according to the rays emitted upwards, downwards and sideways[20]. Eight types of defects and four types of good qualities are described. *Dvicchāyam* (with two distinct tinges), *dvirūpa* (split), *bhinna* (broken), *śarkara* (mixed with gravel), *lasunapātam* (looks as if smeared with milk), *komala* (tinted with the hue of honey-drop), *jaḍa* (devoid of colour), *dhūmra* (having smoky tint) are the eight flaws that are generally found in rubies. Dazzling hue, weight, purity and deep red colour are the four good characteristics of rubies[21]

While lightness is a good quality of diamond, weight is a good quality of ruby[22]

A method of intensifying the redness of ruby also is mentioned. If a ruby is placed for some days in a bronze vessel containing orange juice, the colour of the ruby will be brightened[23]. A similar method using indigo is prescribed to intensify the blue colour of *indranīla* (sapphire)[23a].

In some texts, the eight defects or flaws of *māṇikya* are enumerated: *Randhra* (holes), *karkaśa* (roughness), *mālinya* (dullness), *raukṣya* (ugly appearance), *vaiśadyam* (chipped), *cipiṭam* (flatness), *laghu* (devoid of weight), *vakram* (crooked)[24].

The ill-effects caused by wearing flawed gems and the good effects caused by wearing perfect gems are also exemplified.

In a similar manner, other precious stones, sapphire, pearl, emerald, coral, *puṣparāga, gomeda, sphaṭika, vaiḍurya*, etc. are described in Sanskrit texts dealing with gemmology. In *Utpalaparimala*, some rare gems like *Karketana* and *Rudhirākṣa* are described. *Karketana* is a gem devoid of all flaws, having perfect shine, weight and density, slightly yellow in colour. If this gem is wrapped in gold-filament and kept in fire, it will look very bright. Even after cooling, its brightness will not diminish. This is a very valuable gem[25]. *Rudhirākṣa* is a gem which is white at the centre, has pure colour and has dazzle of *Indranila* all over[26]. *Ratnasārasaṅgraha* has mentioned a mineral *vaikrānta* that possesses qualities comparable to those of diamond. It is six-pointed, has eight facets and eight sides, solid, weighty, having good uniform or slightly mixed colour. It is so hard that it will break other stones and is used in place of diamond to cut other gems[27].

Viśvakarmīya Ratnaśāstra has devoted a brief section to describe the good and bad qualities of gems caused by the five elements, earth, water, light, air and ether. For example, even surface, fragrance, remaining free from dust, sand, etc., freedom from pits, etc. are caused by the element earth, while glossiness, smoothness, purity, beauty, coolness, etc. are caused by the element water. Similarly, different types of flaws are caused by the five elements in gems[28].

Gemmologists of ancient India have enumerated five qualities and five defects which are found generally in all the gems.

Weight, purity, brightness and hardness are the general qualities of all gems. Lightness is a quality peculiar to diamond only and is of no value in other gems.

गौरवं स्वच्छता कान्तिः काठिन्यं रत्नजा गुणाः
विहाय वज्रं नान्येषु लाघवं शोभनं भवेत्।

– रत्न परीक्षा, पृ. 43.

Paleness, being broken or chipped, dots, lines and bubbles are the general flaws found in all gems.

Methods of Testing Gems

It is almost impossible to differentiate the genuine stones from an artificial one without expert aid. In these texts on gemmology are found a few methods to differentiate the natural from the synthetic product.

Diamond should be pounded by another. If genuine, it will remain unbroken, while artificial ones break. Synthetic pearls get destroyed in saline water. Genuine rubies are radiant with lustre, while artificial ones are not lustrous. When rubbed, if softness is seen in a stone, it is synthetic. Gems like rubies when rubbed on a stone or when boiled, if genuine, retain their lustre[29].

Thus, importance was given by our gemmologists to difference in lustre, difference in hardness, low specific gravity, solubility, etc. as diagnostic features in testing gems.

Methods for testing superior type of gems are also given.

One should stand facing the sun by holding an emerald in the palm. Genuine emerald will emit its green rays towards the side of the person. When the gem *indranīla* (sapphire) is placed in milk and if its blue tinge is reflected in the milk, the gem is valued as an excellent one. If a ruby emits rays upwards, it is of superior type, if downwards it is of ordinary type and if the rays are emitted sideways it is of inferior type[30].

Vaiḍūrya (cat's eye) is a gem endowed with light and dark shades, even, pure, heavy, clear and impregnated with a moving white covering. It is classified as superior, ordinary and inferior, depending on the number of *brahmasūtra* (plumblines) reflected around the gem when placed on a mirror. Two or three lines indicate that the gem is superior. Four, five or many lines indicate that the gem is of ordinary type. Half a line, scattered ones, impregnated ones, or six lines indicate the inferior nature of *Vaiḍūrya*[31].

Since planetary attractions are attributed to each precious stone by our ancient astrologers, it is strongly believed that each gem is specially associated with a particular day of the week. Hence, it has been advised that rubies should be tested on Sundays, pearls on Mondays, corals on Tuesdays, emaralds on Wednesdays and so on[32].

Conclusion

A deep study of the ancient works dealing with gemmology clearly reveals that importance was given to the three cardinal virtues of gem-stones, viz., beauty, durability and rarity. Beauty of a gem was judged by the transparency and depth of

colour (as in emerald), by its purity and fire (as in diamond), by its play of colour (as in opal), etc. The second cardinal value, durability, is governed by the hardness of minerals. Since gemstones are in general minerals and since a cut-stone should be able to resist abrasive influences that tend to destroy its lustre, gemmologists of the past gave importance to the hardness of precious stones and were aware of the degrees of hardness of different gems. By describing different types of flaws and defects of various gems it has been brought out that flawless gems are rare and particularly flawless emerald of fine colour is exceedingly rare.

As pointed out earlier, the ancient texts declare that gemstones are minerals and are found in rocks. Many occur naturally in geometrical forms bounded by plane surfaces which are termed crystals. Our gemmologists were able to discriminate various types of gems from each other, because they were guided by the knowledge of crystal shapes and physical and optical effects caused by the orderly arrangement of molecules in crystals from which nearly all gems are cut. Hence, it becomes clear that study of crystals was prevalent in those days as it is today, because it is of fundamental importance and is of value in gem-study. Crystal-study is very important in gem-testing also. It is essential for the lapidary who cuts a stone from a crystal for ascertaining the different effects of light passing through a crystal.

Geologists of modern times have observed the physical properties of gem-stones, viz., cohesion, hardness, specific gravity, transparency (ability of a substance to transmit light), lustre (appearance of a stone in reflected light), sheen (reflection from within the stone), etc. Gemmologists of ancient India have noticed and have examined the above-mentioned physical properties of each and every gem. Density, spectrum, refractive index, weight, microscopic examination of lines, bubbles, etc., minutest difference in colour, etc., were the main factors in identifying different gemstones.

Cleavage is a very important factor in modern gemmology. It is a direction of weakness along which if force is applied a body will get easily split. Gems like diamond, topaz and emeralds have strong cleavages. Even though this is not mentioned in any of the available works on gemmology, ancient sages were aware of it, as they have mentioned about cutting of gems, etc.

Despite its extreme hardness, diamond will readily cleave under a heavy blow in its four directions of cleavage. When the western countries had not known that diamonds could be cleaved, Indian lapidaries had known even in the earlier centuries that diamonds could be split, even though it is by far the hardest substance in nature. Diamond mines in India were visited by the French travellers and jewellers. Tavernier, in 16th century, has made observation on dimond lapidaries in India[33].

Smṛtisāroddhāra contains a section which deals with the manufacture of synthetic gems. Methods of preparing artificial corals, sapphires, etc. are also given[34].

Present-day gemmologists have distinguished several species of gems, such as corundum, beryl, quartz, etc., each having different varieties with more or less the

same physical properties but varying in shades of colour. We find in the texts of Hindu *Ratnaśāstra* different varieties of gems mentioned under each of the gem-species. It is indeed remarkable that even in the early days when equipment was not there, Hindu gemmologists could distinguish different species, each with its several varieties in slightly different but equally magnificent shades. Incidentally, it may be mentioned here that the word corundum might have emerged from the Indian word '*kurunda*' or '*kuruvinda*' because of the fact that the gem first introduced in Europe originated from India.

The gems enumerated in Hindu texts are of mineral origin, while a few like pearls and corals are of animal origin. Hence, a thorough knowledge of gemmology requires at least some fundamental knowledge of mineralogy, geology, botany and zoology. The scientific achievements of our ancient ancestors in all fields of knowledge are well known. The foregoing study also reveals that from the early period, knowledge of gemmology also was of a very high order and scientific methods were followed in collecting, testing, cutting and polishing gems.

References

1. *Rg Veda* अग्निमीळे पुरोहितं यज्ञस्य देवमृत्विजं। होतारं रत्नधातमम् I.1.1
2. द्विपहयवनितादीनां स्वगुणविशेषण रत्नशब्दोऽस्ति।
   इहतूपलरत्नामधिकारे वज्रपूर्वकम्।
   – *Bṛhatsamhitā*, Ratnāparīkṣādhyāya – 2.
3. महाराष्ट्रे तु कुद्दालो नाम देशोस्ति तत्र तु
   वज्रस्य प्रभया तत्र वज्रमुत्पाद्यते स्फुरत्।
   आङ्गीरसमतम् – रत्नपरीक्षा – 84.
4. वज्रं च जलबिन्दुश्च पद्मरागेन्द्रनीलके
   गारुत्मतेन संयुक्तं स्यान्महारत्नपञ्चकम्॥
   पुष्परागं च वैडूर्य गोमेधं स्फटिकं तथा।
   पञ्चोपरत्नान्येतेषां प्रवालं पञ्चमं स्मृतम्॥
   – *Śivatattvaratnākara* (*STR*) VI. 17. 127-28
5. हिमाद्रौ हिमसंकाशं स्वच्छं कान्तियुतं भवेत्।
   सूर्यकान्तं चन्द्रकान्तं ताराकान्तं तथाऽपरम्॥
   – *Ibid*, VI. 17. 130
6. *Agnipūraṇa*. Ch. 246
7. *Ratnaparīkṣā*– p. 9, also *STR* VI.17.4-5
8. *STR*, VI. 17.6.21; *Abhilaṣitārtha Cintāmaṇi* 1.2.407.
9. *STR*, VI. 17.6.21.
10. *Abhilaṣitārtha Cintāmaṇi*. I.2.410, *STR* VI.17.9, etc.
11. *STR*, VI.17.22-24.
12. *Ibid*, VI.17.25-26.
13. *Ibid*, VI.17.62-66.
14. *Bṛhat Saṁhitā* – Padmarāgalakṣaṇādhyāya. 1-2.
15. *Ibid*, 1-2.
16. *STR*, VI.17.79-82.
17. *Ibid*, VI.17.79, 80, 83.
18. *Ibid*, VI.17.79, 80, 84-85.

19. माणिक्यस्य समाख्यता अष्टौ दोषा मुनीश्वरैः।
गुणाश्चत्वार आख्यताः छायाः षोडश कीर्तिताः॥

– *STR*, VI.17.67

20. ऊर्ध्वरश्मिरधोरश्मिः पार्श्वरश्मिरिति क्रमात्।
पद्मरागाः सुविज्ञेया उत्तमाधममध्यमाः॥

– *STR*, VI.17.87

21. *Ibid*, VI.17.68-74.
माणिक्यस्य गुणाः प्रोक्ताश्चत्वारो मुनिपुङ्गवैः
स्निग्धंछाया गुरुत्वं च नैर्मल्यमतिरक्तता।

– 74

22. लघुवज्रं प्रशंसन्ति गुरुत्वं पद्मरागके - -

–*रत्नपरीक्षा* p. 86. (हालास्यमाहात्म्यम्)

23. *STR*, VI.17.91-92.
23. (a) *Ibid*, VI.17.112.
नीली रसे बीजपूररसमिश्रे निवेशिते।
कास्यपात्रे तु नीलस्य वर्णोत्कर्षः प्रजायते।
24. *Ratnaparīkṣa* p. 12-60.
25. *Ibid*, p. 58.
26. *Ibid*, p. 59.
27. *Ibid*, pp. 68-69.
28. *Ibid*, Sloka 70-79 (from विश्वकर्मीयम्)
29. *Ibid*, p. 43.
वज्रेण वेद्ययेद्वज्रं कृत्रिमं चेद्विभज्यते।
कृत्रिमं मौलिकं नश्येत् क्षालितं लवणाम्भसा।

(*स्मृतिसारोद्धारः*)

30. *STR*, VI.17.124, 110.
31. *Ibid*, VI.17.151-154.
32. *Ibid*, VI.17.171-173.
33. Herbert Smith, G.F., *Gemstones*. p. 246. London. 1950.
34. *Ratnaparikṣā*, pp. 46-48.