Review Article

An Analysis of Dhatu-Varga in Bhava Prakasha Nighantu

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Abstract

The roots of *Rasashastra* that existed in the *Ayurveda* classical texts, gained importance and developed as an independent science from the 7th century C.E onwards. By the 16th Century C.E. all concepts pertaining to this subject had been firmly established. *Bhava Prakasha Nighantu* is one amongst the *Laghutrayi* of *Ayurveda* and written in 16th century C.E. by *Bhavamishra*. This book is an important landmark in the history of Indian medicine as it stands at the cusp of the medieval and modern periods. The book also proved to be a turning point for the future course of *Ayurveda* because of the fact that the author had revived the style of *Samhitas* and contributed a good deal towards the various aspects of indigenous medical portfolio by adding new ideas and information on contemporary drugs. It is renowned for *Ayurvedic* pharmacopeia mostly of plant origin along with a concise description of drugs of metal and mineral origin with processing techniques and therapeutic uses. This research article aims to focus on drugs of metals and mineral origin explained in the eighth chapter of *Bhava Prakasha Nighantu* along with the adaptations and establishments of *Rasa* concepts. Mendeleev's Periodic Table is used as a reference point for analysis and understanding of the use of metals, ores, alloys and compounds in therapeutics by the *Rasashastra* authors.

Key words: *Ayurveda, Bhava Prakasha Nighantu, Metals, Minerals, Rasashastra*

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Introduction

Rasashastra **(RS)** is an integral part of *Ayurveda* which deals with the drugs of metal and mineral origin. It describes their varieties, characteristics, purification, processing techniques, properties, therapeutic uses, indications, contraindications, and their management in detail. The use of metals for therapeutic purposes has been in vogue right

from the Vedic period. Utilization of metals in the field of medicine was known during the *Samhita* period going by the references to some metals in the *Brihattrayi*. The roots of RS that existed in the *Ayurveda* classical texts, developed as an independent science from the 7th century C.E. RS texts, describe various *Parthiva* (mineral origin) categories such as *'shakti-rasa', 'rasa', 'maharasa', 'upa-rasa','sadharana-rasa', 'loha', 'ratna', 'upa-ratna'* and *visha*[1]. RS revolves around *'rasa'* theory or mercury-Hg. *Maha-rasas* are described in most RS texts and their importance lie next only to *rasa*. The *upa-rasas* are supportive compounds of herbo-mineral preparations involving *rasa* and *maharasas*. *Dhatus* which are mentioned in all the texts are clearly natural metal elements. *Upa-dhatus* have lesser importance than the *dhatus* and not even categorised in some RS texts. *Ratnas* and *upa-ratnas* were discovered to have medicinal properties and find mention in some texts.

Bhava Prakasha Nighantu **(BPN)**, although not a *Rasashastra* text has briefly but precisely explored most of the *dravyas* used in RS treatises. It is one of the *Laghutrayi* of *Ayurveda* and written in 16th century C.E. by Bhavamishra. By this time RS was a highly developed science and hence found a place of importance even in a *nighantu* treatise. BPN is renowned for *Ayurvedic* pharmacopeia mostly of plant origin along with a concise description of drugs of metal and mineral origin with processing techniques and therapeutic uses. The categorization of metals and minerals in the text is similar to that of other contemporary RS texts. It is likely that *Bhavamishra* adapted and established all concepts of RS in *Bhava Prakasha*. This paper is an attempt at studying and analysing the aspects of RS from a predominantly herbal materia medica text, BPN, and their comparison with prevalent RS texts of the time.

Materials and Methods

Research articles on RS available in the form of hard and soft copies were considered for study. Not much work has been found on the *Dhatu-varga* of *Bhava Prakasha Nighantu.* The first widely recognised modern categorization of elements, the Mendeleev's periodic table (1869) was used as a reference at analysing and understanding the knowledge of RS authors with regard to the use of metals, minerals and their use for therapeutic purposes. The textual references were rendered from *Ayurveda Samhitas*. The target text BPN was examined for all concepts of RS. RS aspects are described in two chapters, (1) *mishraprakarana* and (2) *dhatvadi-shodhana-marana prakarana.* The present study is limited to *Dhatu-varga* of the eighth chapter *mishra-prakarana*. The similarities and differences between BPN and RS texts with respect to the mention of metals and minerals were drawn in a comparative study.

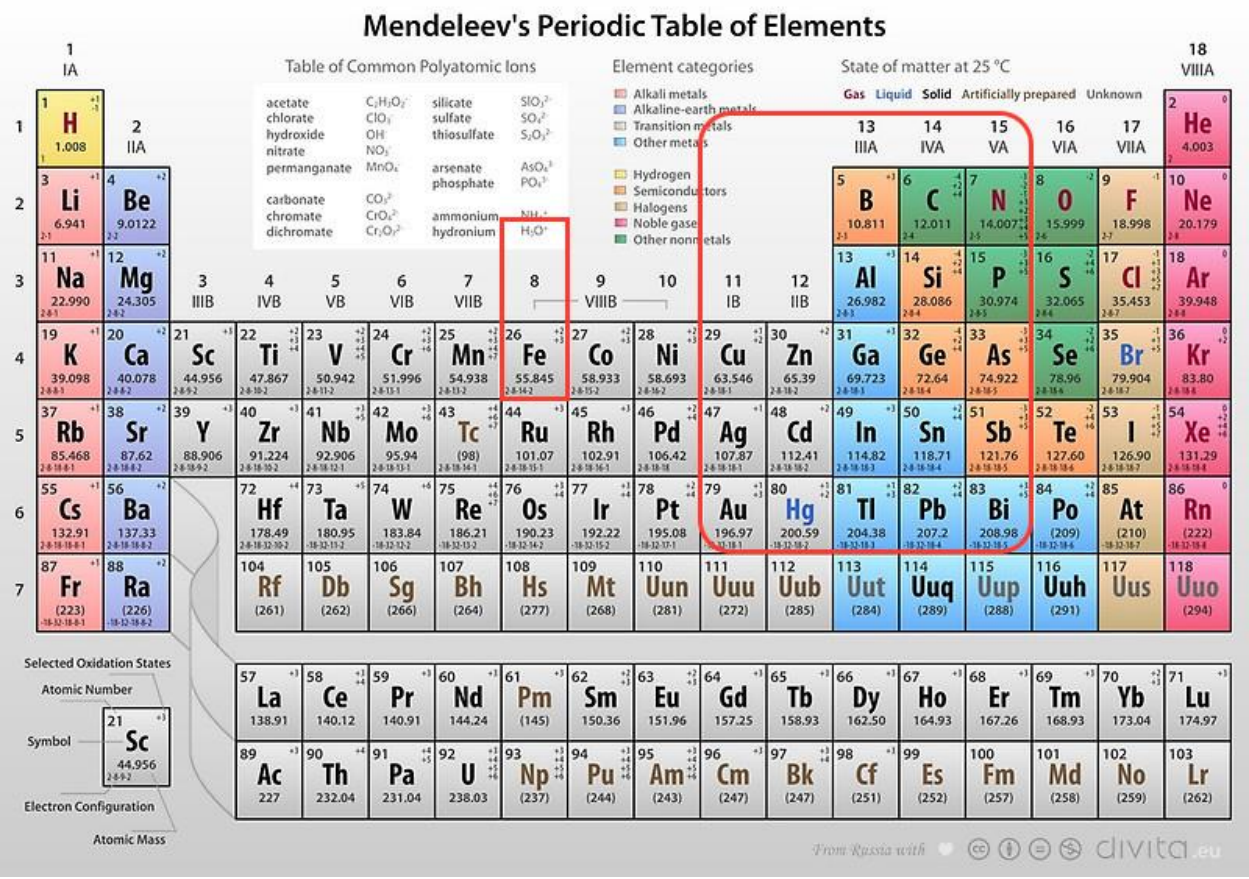
Bhava Prakasha Nighantu

'BPN' is considered as one of the primary texts for understanding *Dravya-guna*, the Indian materia medica. This book is an important landmark in the history of Indian medicine as it stands at the cusp of the medieval and modern periods. It also proved to be a turning point for the future course of *Ayurveda* because of the fact that the author had revived the style of *Samhitas* and contributed a good deal towards the various aspects of indigenous medical portfolio by adding new ideas and information on contemporary drugs. Bhavamishra was the pioneer of *Abhava-pratinidhi dravyas* (substitutes). It is considered as a '*karmaushadhi pradhana nighantu'* (Dictionary of drugs with therapeutic action). The drug index of *Ayurvedic* clinical pharmacology is based on *Bhava Prakasha*. *BPN* is a well-organised and compact representation of earlier classics [2]. There are about 10,268 verses of varying meters. Amongst the *Ashtangas* of *Ayurveda*, *Kaya Chikitsa* is given importance. Out of the whole text, a large section is devoted to the *Nighantu* part. Around 800 drugs are described in 23 chapters [3]. Although BPN is a *Samhita* text, it described the mineral origin drugs precisely in two chapters. One is *Dhatvadi-varga* of *mishra-prakarana* (1.6.6) and the other being *dhatvadi-shodhana-marana-prakarana*. In *Dhatvadi-varga*, metals and minerals are explained along with their place of origin, characteristics, and therapeutic uses in six categories such as *'Dhatu', 'Upadhatu', 'Rasa', 'Uparasa', 'Ratna',* and *'Uparatna'* respectively.

Dhatus (Metals)

Dhatus are given primary importance in BPN and the section on RS is also titled *dhatu-varga* in the chapter. Unlike other RS texts, that describe *maharasas* after the description of *rasa*, BPN takes a different route mainly due to it being a '*Nighantu pradhana grantha*.' It does not comment on the goals of RS but the underlying essence of the goals comes through in the description of the *dhatus*. Therapeutically, these metals were employed to prevent aging problems and other diseases by protecting the body of men, hence called as *dhatus* (*dadhati deham iti*). Moreover, each metal can also be used in multiple diseases[4]. RS developed with two major aims – *Lohavedha* (transmutation of metals) and *Dehavedha* (rejuvenation of mind, body and spirit). The latter made this subject an integral part of *Ayurveda*, while the former developed alchemical techniques for transformation of lower metals like copper, silver and lead into higher metals like gold. Considering the twin aims of RS, it is interesting to note the metals that were used extensively for these purposes in the periodic table were placed in close proximity to each other or in same group. Russian chemist Dmitri Mendeleev published the first widely recognized periodic table in 1869. He developed this table to illustrate periodic trends in the properties of the then-known elements. He arranged the elements in the increasing order of their atomic weight. From the Mendeleev's periodic table of elements

given below it may be observed that the *dhatus*, *tamra* (Copper-Cu) *raupya* (Silver-Ag), *svarna* (Gold –Au) were part of Group IB elements; *yashada* (Zinc-Zn) and *rasa* (mercury-Hg) were in Group IIB' *vanga* (Tin-Sn) and *sisa* (Lead-Pb) were in Group IVA elements and *loha* (Iron-Fe) belonged to group VIIIB. Since mercury is a liquid metal, and it has the ability to consume other metals, it has been termed *Rasa*. It is also known as '*Parada*.'



The table below describes the metals and their therapeutic uses[5].

Table-1: *Dhatus* and their Therapeutic uses

Dhatu	**Types of *Dhatu***	**Therapeutic uses with their possible English equivalents: in order of first appearance in brackets**
Svarna (**Gold-Au)**	-	*Rasayana* (rejuvenative) *netra-rogahara* (relieves eye diseases), *medhovrddhi* (improves intelligence), *smriti-prada* (improves memory), *buddhi-prada* (promotes intellect), *balya* (strengthening), *hridya* (cardiac tonic),

		*vishahara (*detoxifier), *kshaya-rogahara* (relieves wasting*), unmada-rogahara* (relieves insanity*), tridosha-hara* (relieves tridosha imbalance)
Raupya (**Silver-*Ag*)**	-	*Vayassthapana* (anti ageing), *vata-pitta-hara* (relieves vata and pitta imbalance*), lekhana* (has scrapping action), *pramehadi-rogahara* (relieves urinary diseases including diabetes)
Tamra **(Copper-Cu)**	-	*Kapha-pittahara* (relieves kapha and pitta imbalance) *vrana-ropaṇa* (wound healer), *lekhana, pandu-jvara-kushtha-kasa -shvasa-kshaya-pinasa-rogaghna* (relieves diseases like Anemia, fevers, skin diseases, cough, breathlessness consumption and sinusitis)
Vanga **(Tin-Sn*)***	*1. Khuraka (uttamam)* *2. Mishraka (adhamam)*	*prameha-kapha-krimi- pandu-shvasa-rogaghna* (relieves prameha, phlegm, microbes and parasites, anaemia, asthama), *netraroga-hara* (relieves from eye diseases)
Yashada **(Zinc-*Zn*)**	-	*Kapha-pitta-hara, netraroga-hara, prameha-pandu-shvasarogaghna* (relieves phlegm, bile, eye diseases, prameha, anaemia and asthma)
Sisa **(Lead-Pb*)***	-	*prameha-kapha-krimi- pandu-shvasa-roga-hara, netraroga-hara* (relieves prameha, phlegm, microbes and parasites, anaemia, asthma and eye diseases)
Loha **(Iron-Fe*)***	*saraloha, kantaloha, kittaloha*	*Netraroga-hara, lekhana, kapha-pitta-hara, shula* (pain)-*shotha* (edema or inflammation)-*arsha* (piles)-*pleeha* (spleen)-*pandu (*anaemia)-*medoroga* (obesity)-*meha-krimi-kusthaghna* (meha, microbes and parasites and skin diseases)

Upadhatus (Ores and Alloys)

Upadhatus are not pure elements. The *upadhatus*, exhibit the same properties as that of *dhatus* but are of lesser importance in therapeutics. Like *dhatu*s, the *upadhatus* are also used to treat multiple diseases. *Svarnamakshika* (Copper pyrites-$CuFeS_2$), *tara-makshika* (Iron- pyrites-FeS_2), *tuttha* and *kamsya* are commonly useful in eye diseases. S*varna-makshika* (Copper pyrites-$CuFeS_2$) and *tara-makshika* (Iron pyrites-FeS_2) are useful in urinary diseases and diabetes. *Sindhura* is unique and is useful in promoting union of fractured bones. On observation from the periodic table they basically refer to ores and

alloys involving elements of group, IB (Copper-Cu, Silver-Ag), IIB (Zinc-Zn), group IVA (Tin-Sn, Lead-Pb) and VIIIB (Iron-Fe) elements. Accordingly, there are seven minor metals for seven major metals such as *svarna- makshika, tara- makshika, tuttha, kamsya, riti, sindhura, shilajatu* respectively. The whole list of *upadhatus* is presented below in tabular form [6].

Table-2*: Upadhatus* and their Therapeutic uses

Upadhatu	**Therapeutic uses with their possible English equivalents: in order of first appearance in brackets**
Svarnamaksika **(Copper pyrites-$CuFeS_2$)**	*Rasayana, netraroga-hara, vasti-shula* (pain in the bladder)-*kushtha-pandu-prameha-visha-udara* (abdominal diseases)-*arsha-shotha-kandu* (itching) *rogaghna, tridosha-hara*
Taramakshika **(Iron- pyrites-FeS_2)**	*Rasayana, netrarogahara, vastishula -kusta-pandu-prameha-visha-udara-arsha-shotha-kandu-rogaghna, tridosha-hara*
Tuttha **(Copper sulphate- $CuSO_4$)**	*Vamaka* (emetic), *lekhana, bhedana* (cutting action), *shitala* (cooling), *netraroga-hara, kapha-pitta-hrit, visha-ashmari* (urinary calculi)-*kustha-kandu- rogaghna*
Kamsya **(Bronze -alloy) Cu:Sn :: 8:2**	*lekhana, vishada, netraroga-hara, ruksha* (drying), *kapha-pitta-hrit* (relieves kapha and pitta)
Riti **(Brass-alloy) Cu:Zn :: 2:1**	*Pandu-rogaghna, krimighna*
Sindhura **(Red oxide of lead-Pb_3O_4)**	*kuṣhṭha-kandu-vishahara, bhagna-sandhana-jananam* (promotes union of fractures), *vrana-shodhana-ropana* (wound cleansing and healing)
Shilajatu **(Bitumen)**	*Rasayana, chedi* (piercing), *yogavahi* (synergistic)

Rasa (Mercury)

Rasa (*Parada* or mercury-Hg)[7] is so called because it consumes metals that come into contact with it. Mercury is a liquid metal. It has been termed as *dhatu* in BPN and it is used as a *rasayana*. *Parada* is symbolized with semen of Lord *Shiva*. It is of four kinds based on the region of land where it is found namely *shweta* (white), *rakta* (red), *pita* (yellow), and *krishna* (black). Therapeutically, the white kind is used for curing diseases, the red kind for rejuvenation, yellow kind for transmutation of metals and black colored mercury is useful for processes lead to liberation.

***Uparasas* (Secondary minerals)**

After *Rasa*, BPN describes the *uparasa* group. There are 20 *uparasas* viz. *Gandhaka*, *hingula*, *abhraka*, *talaka*, *manahshila*, *srotonjana*, *tankana*, *rajavarta*, *chumbaka*, *sphatika*, *shankha*, *khatika*, *gairika*, *kasisa*, *rasaka*, *kaparda*, *sikata*, *bola*, *kankusta* and *saurastri*[8]. When observed in the periodic table most of these are found to be compounds formed by IIIA (Boron-B, Aluminium-Al), IVA (Silicon-Si, Lead-Pb), VA (Antimony-Sb, Arsenic-As), VIA (Sulphur-S) elements. All the *uparasas* are represented with their types and therapeutic uses in the table below.

Table-3: *Uparasas* and their Therapeutic uses

Uparasa	**Types of *Uparasa***	**Therapeutic uses with their possible English equivalents: in order of first appearance in brackets**
Gandhaka (Sulphur-**S)**	-	*Pitta-kara* (increases pitta), *katu-vipaka (*post digestive action is spicy), *krimi-kandu-visarpa* (psoriasis)-*kustha-kshaya-pliha-kapha-vata-hara*
Hingula **(Ore of mercury – HgS)**	1. charmara (*shuklavarna*- White) 2. shukatundaka (*pita*-Yellow) 3.hamsapada (*japakusumavarna*-Red)	*Netraroga-kapha-pitta-hrllasa* (nausea)-*kustha-jvara-kamala* (hepatitis)-*pliha-amavata*(rheumatoid arthritis)-*gara* (poison) and *rogaghna*
Abhraka **(Mica)** ***Sita*-Muscovite** $H_2KAl_3(Sio4)_3$ ***Rakta*-Phlogopite** $[HK(MgF]_3Mg_3Al(SiO_4)_3$ ***Pita*-Lepidolite** $KLi[Al(OHF)_2]Al(SiO_4)_3$ ***Asita*-biotite** $KAl_3Si_3O_{10}(OH)_2$	1. sita (best suited to prepare silver) 2. rakta (it is used in Rasayana) 3. pita (it is used to prepare gold) 4. asita (cure diseases) Again asita type one is classified into four kinds as 1.pinaka, 2.dardara, 3.naga and 4.vajra	*ayushkara* (promotes longevity), *dhatu-vivardhana* (replication of tissues), *tridosha-vrana-meha-kustha-pliha-udara-granthi* (glands)-*visha-krimighna*
Talaka **(Orpiment-As_2S_3)**	1. patraka (gold in colour and having layers like that of mica 2.pindaka (has no layers)	*visha-kandu-kushtha-asyaroga* (acute diseases)*-rakta-doṣa* (blood disorders)-*kapha-pitta-vrana-hara*
Manahshila	-	*Visha-shvasa-kasa-kapha-raktavikara-hara*

(Realgar- AsS, α-As_4S_4		
Srotonjana **(Antimony Sulphide-Sb_2S_3**	1. krishna (srotonjanaṃ) 2.shveta (sauviranjanaṃ)	*Chardi* (vomiting)-*visha-sidhma* (skin disease)-*kshaya-raktavikara nashaka*
Ṭankana **(Borax-$Na_2B_4O_7 \cdot 10H_2O$**	-	*Kapharoga-hara*
Rajavarta **$(Na,Ca)_8Al_6Si_6O_{24}(S,SO)_4$**	-	*pitta-prameha-chardigadan nashaka*
Chumbaka **(Magnetic iron ore - Fe_3O_4**	-	*lekhana, medas-visha-gara-rogapanut*
Sphatika **(Alum-$KAl(SO_4)_2 \cdot 12H_2O$**	-	*vata-pitta-kapha-vrana-shvitra* (vitiligo)-*vishapragadahara* (toxicity related diseases)
Shankha **(Conch Shell**	-	*Netra-hitakara, pitta-kapha-raktadoṣa-gada-nashaka*
Khatika (Clay)	-	*Dahajit* (relieves thirst), *vishashodhajit* (clears toxicity)
Gairika **(Red Orchre Fe_2O_3)**	-	*Netrahita* (beneficial to eyes), *daha-raktapitta-kapha-hikka-viṣhapanut* (relieves thirst, haemorrhagic disorders, kapha, hiccoughs and poison)
Kasisa **(Ferrous sulphate- FeSO4**	Light yellow coloured one is called as *puṣpakasisa*	*Vata-shleshma-hara* (relieves wind and phlegm), *kesha-roga* (diseases of the scalp)-*netra-kandu* (itching in eyes)-*visha-vrananut, mutra-kṛcchra* (difficult micturition)-*ashmari-shvitragada-hara*
Rasaka **(Zinc Carbonate-$ZnCO_3$**	Tutthabhedaḥ – a variant of tuttha	*Netraroga-hara, kapha-pitta-hrit, visha-ashmari-kushtha-kandu-roga-hara*
Kaparda **(Cowri shell-$CaCO_3$)**	-	*Netra-roga, spota-kshaya, karna-srava* (discharge from ears)-*agni-mandya* (lack of appetite)-*pitta-kapha-gada-hara*
Baluka (Sand- **Si)**	-	*Vrana-urahkshata-nashani* (relieves wounds and pain in the thighs)
Bola **(Myrrh-natural gum or resin**)	-	*Rakta-hara* (relieves bleeding), *medhya, tridoshajit, jvara-apasmara* (convulsive disorders)-*kusthaghna, garbhashaya-vishuddhikrit* (cleanses uterus)
*Kankusta (*roots of	1. *raktakalaka* (*pīta* -	*Virechana* (purgative)*, krimi-shodha-udara-*

Rheum emodi wall.)	Yellow) 2. *andaka* (*krishna*-black)	*adhmana* (flatulence)-*gulma-anaha-kapha-rogaghna*
Saurashtri **(mud/clay)** Alum-$KAl(SO_4)_2 \cdot 12H_2O$	*krishnamrittika* (black), *kardama*	*Vata-pitta-kapha-vrana-shvitra-visharpagada-hara*

Abhraka is described in four kinds namely, s*ita (best in alchemical method), rakta* (rejuvenator) *pīta* (useful in preparing gold) and *asita* (cures diseases). *Sita abhraka* is further classified in four kinds viz. *pinaka, dardara, naga and vajra* respectively. *Talaka* is said to be available in two kinds namely, *patraka and pindaka*. *Kasisa* is a variety of *Tuttha*. Similarly, therapeutically, all the *uparasas* are used in various diseases. Based on the commonality of usage in some major diseases, *Abhraka* and *Rajavarta* are useful in urinary diseases and diabetes. *Uparasas* like *shankha, gairika, kasisa, rasaka* and *kaparda* are useful in eye diseases.

Ratnas (Precious stones)

Ratnas are precious stones. These are naturally occurring and some of these are compounds of IIA (Berillium-Be, Magnesium-Mg, Calcium-Ca) IIIA (Aluminium-Al) and IVA (Carbon-C, Silicon-Si) elements. They have a great influence on humans with regard to health and also have an astrological significance. *Bhavamishra* listed nine *Ratnas* such as *ratna, garutmat, pushyaraga, manikya, indranila, gomeda, vaidurya, mauktika* and *vidruma*[9]. Generally, gems stones are worn by the people for positive influence on health and well being. In *Ayurveda*, the usage of *Ratnas* is indicated in curing various diseases.

A complete list of *Ratnas* and their therapeutic uses from BPN are listed in the table below.

Table-4*: Ratnas* and their Therapeutic uses

Ratnas	**Types of *Ratnas***	**Therapuetic uses with their possible English equivalents: in order of first appearance in brackets**
Ratna **Diamond (Carbon -C)**	*1. shveta (used in rasayana)* *2. rakta (rogavidhvaṃsi, jaramṛityuhara)* *3. pita (dhanapradaḥ,*	*ayuspushṭa* (longevity), *bala* (strength), *virya* (potency), *varna* (complexion), *sarva-rogaghna* (relieves all diseases) *netrahita, vishahara,*

	dehadarḍhyakrit) *4. asita (nashayati vyadhin, vayastambham karoti)*	
Garutmat **(Emerald-** $Be_3Al_2Si_6O_{18}$**)**	-	*netrahita, vishahara*
Pushyaraga **(Topaz-** $Al_2SiO_4(F,OH)_2$	-	*netrahita, vishahara*
Manikya **(Ruby-** Al_2O_3	-	*netrahita, vishahara*
Indranila **(Sapphire-** Al_2O_3 **)**	-	*netrahita, vishahara*
Gomeda **(Hessonite-** $Ca_3Al_2(SiO_4)_3$	-	*netrahita, vishahara*
Vaidurya **(Cat's Eye** $BeAl_2O_4$	-	*netrahita, vishahara*
Mauktika **(Pearl-** $(CaCO_3)$	-	*netrahita, vishahara*
Vidruma (**Coral-** $CaCO_3$**) with Mg**	-	*netrahita, vishahara*

Among the *Ratnas*, the diamond has been said to be available in four varieties such as white (rejuvenator), red (cures diseases), yellow (bestows wealth) and black (destroys diseases) respectively. Therapeutically, All *Ratnas* are useful in eye diseases and destroy poisons.

***Uparatnas* (Semi-precious stones)**

Uparatnas are gem like stones or rather semiprecious gems. These semi precious stones are categorized based on the luster, hardness, and transparency. *Bhavamishra* has described *uparatnas* as *Kacha* (**Glass bead, Silica-**SiO_2**)**, *karpurashma(?), mukta* **(Pearl-Calcium Carbonate-** $CaCO_3$**)**, *shukti* (**Pearl Oyester**

shell- $CaCO_3$) and *shankha* **(Conch Shell- $CaCO_3$**)[10]. Most of the *upratnas* are calcium carbonate compounds. *Uparatnas* have therapeutic qualities similar to the *ratnas* but are less powerful.

***Dhatu* in RS and BPN**

Different RS texts over the ancient and medieval periods have categorised metal and mineral drugs into different categories *maharasa*, *uparasa*, *dhatu*, *upadhatu*, *ratna* and *uparatna* with a single thread of underscoring the importance of *rasa*. The subject revolves around *rasa*, hence it is called RS in all important treatises. However the centrality of *rasa* is not underlined in BPN and the subject is included under *dhatu-varga* as *dhatus* are given emphasis.

The categorization of metals and minerals in acclaimed RS texts is listed in the table below.

Table -5 Categorization of Metals/ Mineral in various *Rasashastra* texts

Text	Categories						
	Rasa (Mercury)	***Maharasa*** (Major minerals)	***Uparasa*** (Minor minerals)	***Loha/ Dhatu*** (Metals)	***Upadhatu*** (Ores and Alloys)	***Ratna*** (Precious Stones)	***Uparatna*** Semi-precious stones)
Rasahridaya Tantram (7th century C.E.)	+	+	+	+	-	-	-
Rasendramangalam (8th century C.E.)	+	+	+	+	-	-	-
Rasarnavam (12th century C.E.)	+	+	+	+	-	-	-
Anandakanda (13th century C.E.)	+	-	+	+	-	+	+
Rasaratnakara (13th century C.E.)	+	+	+	+	+	-	-
Rasaratna Samuchaya (14th century C.E.)	+	+	+	+	-	+	-
Bhava Prakasha Nighantu (16th century C.E.)	+	-	+	+	+	+	+

Discussion

While scrutinizing the mineral origin drugs in BPN, a few adaptations and establishments of *Rasa* concepts have been observed and these are drawn here for discussion, as follows:

1. The categorization of mineral origin is

similar to that of RS texts. But, the *maharasa* category is not mentioned in BPN.

2. The mineral origin drugs commence from *dhatu* category in BPN, whereas, the *Rasa* (mercury) is the initial one in *Rasa* texts.
3. In RS texts, *dhatu*/*loha* group comes after the *uparasas* and consist of eight or more metals. Whereas, the list of metals is seven in BPN.
4. The description of Rasa (mercury) is similar in both BPN and RS texts. *Rasa* has been clearly recognised as a metal or *dhatu*. Unlike other RS texts that start with *Rasa*, the author of BPN did not feel the need to start with *Rasa*.
5. All *uparasas* are expressed under *upadhatu* and *uparasa* groups in BP. The list of *uparasas* is visibly similar to that of *Ananadakanda* (*Rasa* text)[11].
6. The *upadhatu* category is similar in both BPN and *Rasaratnakara (*Rasa text*)*[12]. But, compared to *RS* texts, contents are more in BPN.
7. The metal '*Mandura*' (Iron Oxide) is described equally in both BPN and *Ananadakanda*.
8. The *ratna* and *uparatna* categories are similar in both RS texts and BPN.
9. *Bhavamishra* used *shodhana*, *marana*, and *jarana* methods to detoxify and increase the therapeutic potential of metals.
10. The *Bhasma* concept is similar to that of the RS texts.
11. No description on *yashada* is found in literature prior to 14th century. The *yashada* was included for the first time in '*Madanapala Nighantu* (14^{th} Century). Later, it was dealt independently in BPN[13].
12. *Shilajatu* a herbo-mineral preparation is an *upadhatu* in BPN.
13. *Vishas* and *upavishas* have been described in the *dhatu-varga* of BPN but these are of animal or plant origin.

These observations provide a unique opportunity to gauge the mineral origin drugs not from a regular RS treatise but from the point of view of a '*karmaushadhi pradhana nighantu'*. The historical evolvement of RS knowledge is hard to miss through the nomenclature it receives in BPN as *dhatu-varga*. This text coming as it does towards the end of the golden period of RS consolidates the gist of the preceding texts as a kind of ready reckoner, underlying the influence of *nighantu* writing. It therefore comes across as matter of fact and an easy to imbibe text for a student of RS. While a regular RS text begins with *rasa*, *maharasa* , *uparasa* and then moves forward to the *dhatus* and *upadhatus*, here is a text that categorically classifies *rasa* as *dhatu* and does not feel the need to mention it separately and dominantly. It might be due in some measure to the increasing therapeutic importance of the

dhatus as compared to the *maharasas* and *uparasas* during this period. Mercury has been called quick silver due to its appearance in the west in ancient times but the fact that it has been recognized as a metal in BPN, a couple of centuries before its placement among metals in the Mendeleev's periodic table is noteworthy. The *dhatus* are seven and as stated in the text, there are seven *upadhatus* for the seven *dhatus*. The *upadhatus* broadly seem to be having therapeutical properties similar to their corresponding *dhatus* such as *Svarnamakshika* and *Svarna, tara-makshika* and *raupya* and so on. Whether the *upadhatus* were meant to be used as substitutes for the *dhatus* is a matter for conjecture and research. It is also seen that in some cases the *upadhatu* has additional therapeutic action compared to the corresponding *dhatu* , for instance, *Bhagnasandhana* is associated with *sindhura* (Pb_3O_4) , the *upadhatu* but not with *sisa* (Pb) its *dhatu*. The alloys in RS are prepared by amalgamation of the naturally occurring metals in a specific ratio and therefore we think that it may not be appropriate to represent these alloys with the prevailing chemical formulae of the industrially prepared alloys where the proportion of the participating metals may be different. Interdisciplinary researches between RS experts and scientists of modern chemistry would however be helpful in assigning the correct chemical formulae for the alloys made according to RS texts and more work needs to be undertaken in this area.

It is a historical fact that Indians were pioneers in alchemy and used mercury to convert lower metals to higher metals. The placing of Copper (atomic number 29), Silver(47) and Gold(79) one below the other in increasing order of atomic number in group IB and mercury(80) next to gold in group IIB makes us ponder over their inescapable link through this proximity in their placing. The commonest lower metals that were transmutated to s*varna* were *raupya* and *tamra*. Mercury with atomic number 80 needs to lose just one proton for it to technically become gold with atomic number79. The placement of these elements in the periodic table and their significance in *lohavedha* cannot be coincidental.

The *maharasa* classification is surprisingly absent in BPN and it seems to take the path of the encyclopedic treatise *Anandakanda* (AK) here in taking into account only the *uparasa*. AK revolved around *Rasa* or *Parada* and with the other *dravyas* being secondary to *rasa* these were classified as *uparasa*. But unlike AK where the number of *uparasas* is forty nine that of BPN is only twenty. BPN places *dhatu* centrally encompassing *rasa*, hence *uparasa* classification is deemed fit. So the conventional *maharasas* from the RS texts find a place as *uparasa* in BPN. The *ratnas* without exception are expressed as *netrahita* and *vishahara* and in the absence of specific pointers merit research. *Uparatnas* of BPN consist of calcium carbonate compounds which are considered *sudha- varga dravya* in *Rasamritam* and also silica (Si) which is a *sikata-*

varga dravya. In the absence of references in other texts *karpurashma* an *uparatna* remains unidentified. It needs to be explored whether BPN's *karpurashma* is actually *dugdhapashana* (soft stone, steatite $Mg_3(Si_4O_{10})(OH)_2$) as it comes under *sikata-varga* in *Rasamritam*. If conclusively proved, the *uparatnas* of BPN allude to *sudha sikata-varga dravya* of the RS texts. It is also noteworthy that magnesium (Mg) and calcium (Ca) occupy the group IIA of the periodic table. *Dhatu-varga* of BPN through this analysis comes across as a concise and handy reference of RS knowledge.

Conclusion

Close scrutiny of the mineral origin drugs in BPN makes it clear that the development of minerals had held a significant place in *Ayurvedic* pharmacopoeia in the 16^{th} century. Similarly, it blended with RS with minor differences. Metals were well known during *Bhavamishra*'s time and it is interesting to note their proximity in placement in the same rows or groups in the Mendeleev's periodic table developed three centuries later. *Dhatus* and *upadhatus* are generally seen to be *rasayanas*, useful in *prameha*, and infections. *Ratnas* are useful for the eyes and are detoxifiers for the body in general. *Uparatnas* are mostly observed to be calcium carbonate compounds similar in action to *Ratnas* but less efficacious. Although mineral based, the *uparatnas* are mostly of animal origin. Based on this study, one can notice the increasing usage of minerals in Indian medicine through centuries and it will be a source for historical studies. For the present study, this work has been restricted to scrutinizing the categorization of metal and mineral in *Dathu-varga* of BPN. Further, it can be extended to analyse the differences in purification processes and therapeutic preparations of minerals between BPN and RS texts.

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