"A Text Book of Rasashastra"

Written by Dr. Vilas Dole and Dr. Prakash Paranjpe is a unique textbook in English on the subject. Incorporation of various tables, flow-charts, line-drawings and coloured photographs have enriched the book in its substance. Humble efforts of the authors to integrate Ayurvedic philosophy with modern postulates and parameters add to the value of this book. This book will be of a great help not only to the 2nd Year students of Ayurveda, but also to researchers, teachers, scientists and people interested in Ayurveda allover the world.

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• Dr. Vilas Dole • Dr. Prakash Paranjpe

A Text Book of Rasashastra

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Dr. Vilas Dole

Dr. Prakash Paranjpe

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A TEXT BOOK OF

RASASHASTRA

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Foreword

According to Indian philosophy, the ultimate aim of human life is to achieve salvation. In the developmental stream of civilization, hunger and sorrow are the important factors, which compelled mankind to search a solution. Man identified many things from his surroundings, which were found to be useful in eliminating hunger and sorrow. In this series, various nutritive food and drug materials have been explored. Chronologically, different kinds of knowledge were developed and society became civilized. Time, season, food habits and life-style influenced the human health. Due to change in food habits and life-style, various new diseases were produced. Simultaneously their remedy and management were also developed. Man has specific sense organs and wisdom, which differs him from other creatures. Hence, man is able to think about the future and recollect the past. In this connection, spiritual thoughts and findings were evolved. Spiritual achievement is possible with the specific mental status and concentration. Feeling and realization of truth or existence of God is possible with the super concentration. This type of super concentration is possible with good physical and mental status. After achieving amenities essential for the human life, spiritual thought appears, which compels the person to think about the future.

Diseases and senility are the important factors, which create hindrance in happiness and pleasure of life. For the prevention of disease and senility, various measures and ways were explored. In the ancient therapeutics, this measure is known as ***Rasayana*** therapy. It provides resistance

and vitality, prevents senility, produces a disease free strong body and also a feeling of sense of wellbeing. Many materials were identified to possess immuno-booster and rejuvenating properties. With the help of rejuvenating measures, mankind achieved long and healthy life span.

Ayurveda is a holistic and divine life science. It was developed by the divine people on realization through their deep sense and supper concentration. What so ever may be their thoughts and findings, they are very correct and time tested.

Earlier vegetable sources of materials were the main source of diet and drug. Later on animal products and mineral materials were also identified and incorporated in therapeutics. Particularly, mineral materials were found very potent for the elimination of diseases and rejuvenation purpose. However, during the Samhita period the use of minerals were very limited. Minerals are associated with various impurities and toxins. If administered as such, they may prove injurious and harmful for health. To make them therapeutically suitable, it is necessary to eliminate the toxic qualities in them.

For elimination of impurities and to make them suitable for internal administration, specialized procedures like ***Shodhan, Marana,*** and ***Samskara*** were developed in the mediaeval period (i.e. 8-10th cent. AD). After the development of these procedures, mineral originated material and their products like ***Bhasmas, Kupipakvas, Parpati, Pottali*** etc. became frequent in use in Ayurvedic therapeutics.

Rasashastra is a branch of learning of Ayurveda pharmaceutics, specially dealing with the minerals, metals, pre-

cious stones, certain poisonous herbs and their processing. These materials are very potent in eliminating dreadful diseases and also for rejuvenation purposes. Mineral based products are known as ***Rasaushadhi.*** Due to their small dose, quick effectiveness, tastelessness, effectiveness on dreadful diseases and long self life. *Rasaushadhis* occupied superior status among the Ayurvedic medicine.

It also believed that Rasashastra is an expansion of Ayurvedic ***Rasayana*** therapy. Most of the ***dravyas*** of Rasashastra possess ***Rasayana*** properties. Mercury is the chief material of Rasashastra. Rasashastra is developed on the nucleus of Mercury. Mercury is such a material, which consumes all the metals and materials of the universe. Hence, **Mercury is considered as essence of minerals.**

There is no material in the universe without having therapeutic property. Materials possess properties according to their physico-chemical constitution. Mercury is one of them having wide range of therapeutic property. Due to its amalgamating quality, it carries the properties of the amalgamated/consumed materials. No other material has this type of specific quality. After consumption of various materials, it develops high therapeutic values. Hence, it is successfully used as a potent medicine in Ayurvedic therapeutics.

Ayurveda is recognized through its medicine. Medicine is a tool by which diseases are eradicated. Genuine and standard medicine can only serve this purpose. Training in drug manufacturing is imparted to the Ayurvedic students during their study period to make them confident in drug manufacturing so that they may successfully treat their patients with genuine and standard drugs. Keeping this in view, Rasashastra and Bhaishajya Kalpana is included in

curriculum of Ayurveda. Earlier, subject was taught through the ancient classical texts like Rasaratnasamuchchaya, Rasendra Chudamani, Ayurveda Prakash etc. Now many compilation texts are written and available for the students according to the syllabus. Apart from Hindi, these books are also available in regional languages.

Nowadays Ayurveda is attaining global recognition and hence there is a need of making these books available in English. In Rasashastra subject, very few books are available in English. There is a need of a book on Rasashastra in English language with good commentary. In this direction Dr. Paranjpe and Dr. Dole have made an excellent attempt and contributed a nice book on Rasashastra. This book reflects the hard and sincere efforts made by the authors. They have covered the entire subject matter with proper scientific explanation. This book is a complete text of Rasashastra and will prove highly beneficial for the teachers, researchers and students of Rasashastra. It will also serve as a good reference text for foreign scholars. I extend my heartiest congratulations to the authors and wish they may contribute much more in the field of Rasashastra and Ayurveda in future.

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Preface

Authors' inspiration for this book grew out of a strong belief that Rasashastra should be shared not only with Indians but with the people all over the world. The wisdom of Ayurveda is recorded in Sanskrit, the ancient language of India. Hence, the authors have deliberately quoted the original Sanskrit verses throughout the book. At the same occasions it was difficult to explain certain concepts of Rasashastra when no adequate English translation may be made. On their first appearance in this text, these are clearly and simply elucidated.

Though history of Rasashastra dates back even before 300-400 B.C., when Koutilya's Arthashastra was documented, more and more valuable additons on the subject were recorded during 12th to 16th century. Almost all of them are in Sanskrit. Rasashastra is a vast treasure of knowledge on Mercury and various other metals regarding different methods of their purifications and their therapeutic uses. The medicines described in Rasashastra are fast-acting, effective and more potent. The scope of Rasashastra is very vast and it encompasses the study of ancient pyrometry, various appliances, many minerals, gems and animal sources as medicine. In this book, apart from a mere translation from the classics, a sincere effort for the conceptual understanding of the subject is attempted by us.

A conscious effort has also been made to bridge the gap between Ayurvedic philosophy and modern postulates and parameters and develop an integrated approach, based

on sciences like chemistry, metallurgy and gemmology etc. We are sure that it will be appreciated by students, scientists, researchers, teachers and even by a common man. However, this book has been written more in the interest of the students of 2nd year of Ayurvedacharya course as per the syllabus, which is common all over India. We hope it will serve the student fraternity all over India.

Authors

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This book would not have been completed without the colourful photographs of various specimens. We are thankful to the Department of Rasashastra, Tilak Ayurved Mahavidyalaya, Pune; Department of Geology and Zoology, University of Pune; Lagu Bandhu Motiwale, famous jewellers from Pune, for granting the permission to photograph various specimens from their collections.

We also are thankful to Mr. Kamaruddin Chikodi, Apex Colour Lab, Pune, for the cover photograph of Mercury and Mr. Vasant Sahasrabuddhe, artist, Pune, for his neat line-drawings.

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Authors

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Contents

(1) Introduction to Rasashastra

Definition of Rasashastra 2
Short History of Rasashastra 5
Etymology of the word 'Rasa' 10
Rasayana 11
Building of Pharmacy 11
Instruments and Machines 14

(2) Terminology

Lavana-panchaka 17
Lavana-shataka 17
Kshara-panchaka 17
Kshar-dvaya & Kshara-traya 18
Ksharashtaka 18
Madhura-traya 18
Amlavarga 19
Amla-panchaka 19
Aparam Amlapanchaka 19
Panchamrita 20
Panchagavya 20
Kshira-traya 20
Dravaka gana 20
Kajjali 21
Rasapanka 21
Rasapishti 21
- Navanita pishti 22
- Patana pishti 22
Bhavana 22
Dhalana 23
Awapa 23
Nirwapa 23
Nirwapana 23
Shodhana 23
Mritaloha 24
Panchamrittika 24

(3) Science of Appliances

Definition of an Apparatus: Yantra 28
Dola yantra 29
Damru yantra 31
Sthali yantra 31
Puta yantra 32
Palika yantra 33
Swedana yantra 33
Valuka yantra 34
Ghata yantra 36
Vidyadhar yantra 36
Patana yantra 37
- Urdhwapatana yantra 37
- Adhahpatana yantra 38
- Tiryakpatana yantra 39
Bhudhara yantra 40
Kachchhapa yantra 40
Khalva yantra 41
Patala yantra 43
Tula yantra 44
Scientific balance 45
Udukhala yantra 46

(4) The Crucibles

Etymology of the word Musha 47
Samanya musha (Ordinary crucible) 48
Vajra musha (Hard crucible) 48
Pakva musha (Roasted crucible) 49
Gostani musha (Under shaped crucible) 49
Adhunika musha (Modern crucible) 50
Sandhi-bandhana (Joint sealing) 50
Mritkarpata (Rags & mud) 51
Plaster of Paris 52
Mudra (A Seal) 52
- Madana mudra 53
- Hatha mudra 53

(5) Fireplace and Ancient Pyrometry

Koshthi (Fireplace) 55
Angarakoshti 55
Patalakoshthi 56
Garakoshthi 57
Chulhika 58
Puta 58
Mahaputa 60
Gajaputa 61
Varahaputa 62
Kukkutaputa 62
Kapotaputa 63
Gobaraputa 63
Bhandaputa or Kumbhaputa 64
Valukaputa 64
Bhudharaputa 64
Lavakaputa 64

(6) Mercury

General and Introductory Information 66
Synonyms of Mercury 66
- based on Dehavada 67
- based on Dhatuvada 68
- based on Indian Philosophy 69
- based on special properties 69
- describing external features of Mercury 69
- describing various motions 70
- based on mythological origin 70
Occurrunce of Mercury 70
Ores of Mercury 71
Unwanted and Harmful properties of Mercury 73
- Naisargika dosha 74
- Yougika dosha 74
- Oupadhika or kanchuka dosha 75
Acceptable and unacceptable forms of Mercury 77
Physical properties of Mercury 78
Simple tests of pure Mercury 78
Chemical properties 78

(7) Production of Mercury

Chemical purification of Mercury 82
Shodhana procedure 83

Purification of Mercury as per Rasashastra 86
General purification 87

(8) The Eight Staged Purification of Mercury

Names of the eight procedures 90
Swedana 92
Mardana 95
Murchchhana 97
Utthapana 98
Patana 99
- Urdhva patana 100
- Adhah patana 100
- Tiryak patana 102
Rodhana or Bodhana 102
Niyamana 104
Dipana 105
Anuvasana 107
Discussion and comments 107
Rasankusha (The science and procedure) 111

(9) Parada : Gati and Bandha

Parada gati
- Jala gati 114
- Hansa gati 114
- Mala gati 114
- Dhuma gati 115
- Jiva gati 115
Parada bandha 116
Hatha bandha 117
Arota bandha 117
Abhasa bandha 117
Kriyahina bandha 118
Pishtika bandha 118
Kshar bandha 118
Khota bandha 119
Pota bandha 119
Kalka bandha 119
Kajjali bandha 119
Sajiva bandha 110
Nirjiva bandha 120
Nirbija bandha 120
Sabija bandha 120
Shrinkhala bandha 120
Druti bandha 121
Balaka bandha 121
Kumara bandha 121
Taruna bandha 121
Vriddha bandha 121
Murti bandha 122
Jala bandha 122
Agni bandha 122
Susanskrit bandha 122
Maha bandha 123
Classification of bandha 126

(10) Few Mercurial Formulations

Kajjali (Black Murcury sulphide) 127
Parpati 130
- Mridu paka 132
- Madhyama paka 132
- Khara paka 132
Parpati devoid of Mercury and sulphur 133
Actions of parpati 133
Rasa parpati 134
Suvarna parpati 136
Loha parpati 136

Tamra parpati 137
Vijay parpati 138
Panchamrit parpati 139
Rasapushpa 140
Rasakarpura (corrosive sublimate) 141
Rasasindura (Red Mercury sulphide) 144
Makaradhwaja 146
Siddhamakaradhwaja 147
Hingulottha rasa 148
Mrityunjay rasa 149
Rajamriganka rasa 150
Hemagarbha pottali 151
Sarwajwarahara loha 152
Vatakulantaka rasa 153
Ramabana rasa 154
Kumarakalyana rasa 155
Garbhapala rasa 155
Pratapalankeshwar rasa 156
Lakshmivilas rasa (Kasa) 157
Lakshmivilas rasa (Rajayakshma) 158
Gandhaka vati 159
Chandrakant rasa 160
Abhra parpati 160

(11) Classification of Substances and Few General Procedures

Marana 169
Pulverization 170
Bhavana 171
Controlled heat 171
Amritikarana 172
Tests of bhasma 173
General tests 173
Special tests 175
Sattvapatana 177

(12) Maharasa

Abhraka (Mica) 179
Dhanyabhraka 184
Amritikarana of bhasma 185
Vaikrant (Fluorspar) 187
Makshika (Chalcopyrite) 190
Vimala (Cubic sulphide of iron) 194
Shailajatu (Black bitumen) 198
Karpura Shilajatu 203
Controvery in genesis of Shilajatu 203
Sasyaka (Blue vitriol) 205
Chapala 208
Controversies about Chapala 210
Rasaka 211
Few comments about Rasaka 215

(13) Uparasa

Gandhaka (Sulphur) 217
Ayurvedic classification of Sulphur 219
Modern-Chemical classification of Sulphur 219
Various uses of Sulphur 222
Gairika (Hematite) 225
Kasisa (Green vitriol) 228
Kankshi (Alum) 231
Haratala (Orpiment) 234

Manahshila (Realgar) 239
Anjana 242
- Srotonjana 243
- Sourviranjana 243
- Rasanjana 244
- Pushpanjana 244
- Nilanjana 245
Kankushtha 246

(14) Sadharana Rasa

Kampilla (Indian Kamala) 249
Gouripashana (Arsenious oxide) 251
Navasadara (Sal-Ammoniac) 254
Kaparda (Cowrie) 256
Vahnijara (Ambergrees) 259
Girisindura (Red mercuric oxide) 261
Hingula (Cinnabar) 262
Mriddarashringa (Litharge) 264

(15) Metals

Introduction 268
Classification 269
Historical background 269
General purification 273
Special purification 273
Prelude to extraction metallurgy 275
General properties of Metals 275
Metallurgy 276
Suvarana (Gold) 277
Rajata (Silver) 284
Tamra (Copper) 288
Amritikarana 294
Bhunaga sattva and Mayurapichchha sattva 296
Loha (Iron) 297
- Manda loha 300
- Tikshna loha 301
- Kanta loha 301
Mandura (Red iron oxide) 306
Vanga (Tin) 309
Naga (Lead) 313
Jasada (Zinc) 317
Kansya (Bronze) 321
Pittala (Brass) 323
Modern method of making Brass 324
Particulars of Metals 322
Particulars of bhasmas of Metals 328

(16) Gemstones and Semi-precious Stones

GEMSTONES

Definition of Gemstones 330
Salient properties of Gemstones 331
The five Gemstones 332
How Gemstone are formed 332
Classification of Gemstones 333
Crystal systems 333
Gemstones favourite to the planets 334
Opacity & Transparency 334
Beauty and scarcity of Gemstones 335

Physical properties of Gemstones 335
Optical properties of Gemstones 336
Natural inclusions (defaults or flaws) of Gemstones 338
Manikya (Ruby) 339
Mouktika (Pearl) 342
Pravala (Coral) 345
Tarkshya (Emerald) 348
Pushparaga (Yellow sapphire) 350
Vajra/Hiraka (Diamond) 351
Nilama (Blue sapphire) 354
Gomeda (Hessonite) 356
Vaidurya (Cat's eye) 358

SEMIPRECIOUS STONES

Vaikrant (Fluorite) 360
Suryakant (Spinel) 361
Chandrakant (Moonstone) 362
Rajavarta (Lapis lazuli) 364
Peroja (Turquoise) 366
Sphatika (Rock crystal) 367
Vyomashma (Jade) 368
Palanka (Onyx) 370
Rudhira (Carnelian) 370
Puttika (Peridot) 371
Sugandhika 372
Trinakant (Amber) 372
Properties of Gemstones (Table) 374
Properties of Semipre-cious stones (Table) 375

(17) Calcium Compounds

Formation of organic Calcium compounds 377
Natural sources of Calcium 378

I. Mineral Source of Calcium

Churnaka (Quick Lime) 379
Khatika (Chalk) 380
Dugdhapashana (Talc) 381
Godanti (Selenite) 382
Kousheyashma (Magnesium silicate) 383
Badarashma (Fossile norinite) 384

II. Animal Source of Calcium

Samudraphena (Cuttlebone) 385
Shukti (Oyster's shell) 387
Shankha (Conch) 390
Kapardika (Cowrie) 393
Mriga-shringa (Antlers) 393
Kukkutanda twak (Egg-shell) 395
Ajasthi (Goat's bone) 396
Pravala (Coral) 397
Mouktika (Pearl) 397

III. Plant Source of Calcium 397

(18) Poisons & Semipoisons

Etimology of the word 'Visha' 398

Synonyms of the word 'Visha' 399
Classification of Poisons 399
Occurrance of Poisons & Semipoisons 400
Collection of Poisonous plants 401
Effects of Poison on the body 402
Purification of Poisons 402
'Marana' of Poisons 403
The Dose of Poison 403
The General antidotes 404

POISONS
Vatsanabha 405

SEMIPOISONS
Vishatinduka 408
Ahiphena 410
Jayapal 411
Dhattura 413
Bhanga 415
Gunja 417
Bhallataka 418
Karavira 420
Langali 422
Arka 423
Snuhi 425

(18) The Drugs & Cosmetics Act, 1940
General Information 430
Misbranded Ayurvedic Drugs 433
Adulterated Drugs 433
Spurious Drugs 434

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Chapter 1

Introduction to Rasashastra

Treatment of various diseases or ailments with Ayurvedic drugs is becoming more and more popular day by day. Actually Ayurveda i.e. Science of life was conceived, developed and advanced in India and Indian subcontinent. But due to British rule in India and tremendous advances in the sciences, like Physics, Chemistry etc. Modern Medicine was established as main Health Care Science of this country. Presently again it seems that because of various reasons, the practice of Ayurveda is gaining popularity, not only in India but abroad too. The popularity of any medicinal discipline, ofcourse, depends upon curability, safety, affordability and availability of the drugs used in that discipline. Of these qualities, curability is most important. If one observes prescription of an Ayurvedic Physician, one notices that there are at least one or two drugs in it which belong to catagory of '*Rasaushadhi*' (drugs prepreared as per principles of Rasashatra). It can be said that Rasashastra has played a major role in popularizing Ayurveda in masses.

Rasashastra, though it was developed as a separate science in the beginning, in later period completely merged with Ayurveda. It is not considered as one of the eight main branches (*Ashtanga*) of Ayurveda, however it has gained so much importance that it has become indispensable part of Ayurvedic treatment. In this chapter an elementary and introductory information on Rasashastra is given.

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Definition of Rasashastra

The word 'Rasashastra' has two different constituents viz. *Rasa* and *Shastra*. The word *Shastra* means detailed and scientific study. The word *Rasa* has many meanings in Sanskrit language, however as far as this science is considered, it means Mercury. Thus the literal meaning of the word Rasashastra is detailed and scientific study of Mercury. Now here the question may arise why Mercury was singled out for detailed study ? The science of metallurgy was very well developed in ancient India. Noble metals like Gold, Silver and other metals like Copper, Iron, Zinc, Tin, Brass, Bell Metal etc. were known and were practically used. Still ancient scientists chose Mercury for detailed study to form an important science called Rasashastra. For proper understanding of the concept behind this science, it is necessary to focus our attention to few well known facts.

(1) The metal Mercury has some peculiar properties which attracted the attention of ancient scientists. The first of these properties is it is in liquid state at room temperature, and the second is its bright shining silver colour. These two properties are instrumental for its colloquial name "Quicksilver".

(2) It was very popular belief that by processing Mercury with other substances, if one can solidify it, it will be converted into Silver, a precious metal.

(3) Processed Mercury will be useful in converting nonprecious metals like Iron and Copper into precious metal like Gold.

(4) Mercury was considered, as per Hindu mythology, as semen of Lord Shiva, a deity responsible for destruction of wordly entities.

(5) Any human being has three ambitions basically and instinctively: (i) To live, and to live longer. (ii) To earn monery for living and (iii) To attain salvation after death. These are mentioned in Charaka Samhita, as *Pranaishana, Dhanaishana* and *Paralokaishana*, respectively.

Considering these facts it is no wonder that the ancient scientists from all over the world were attracted to Mercury and its scientific and detailed study began. The study was basically aimed at:

(1) To earn more money by converting nonprecious metals into precious ones with the help of Mercury and/or Mercurial products.

(2) To attain longevity, health and vigour by using drugs containing mercurial products.

The first aim i.e. to earn more money, is supposed to be advocated by occidental or Western School of thought. The second aim, i.e. to have longevity, health and vigour is supposed to be advocated by an Oriental School of thought. It states that this longevity to be attained is to be used for service of God so as to gain salvation after death.

न च रसशास्त्रं धातुवादार्थमेव इति मन्तव्यम् ।
देहवेधद्वारा मुक्तेरेव परमप्रयोजनत्वात् ।। (सर्वदर्शनसंग्रह)

When we consider the names of ancient Indian scientists and research workers of Rasashastra, it is revealed that they all were sages. For example Patanjali, Vyadi, Nagarjuna, Govindabhagwatpad and so on. These were the persons who did not indulged in many wordly routine activities and had spent their lives in service of God. Therefore it can be inferred that the science, Rasashastra was developed basically to prepare such medicine, which will increase longevity of life. Keep the healthy status of body constant so

that a person can serve the God for longer and attain salvation.

Does this mean that there were no any attempts to prepare noble metals from nonprecious metals in Indian subcontinent ? On the contrary there were many!! Infact there was a separate science for it. In Arthashastra, a famous treatise by Chanakya, (304 B.C.) there is classification of types of Gold. There a separate entity of *Rasavedhaj Suvarna* (Gold prepared using mercury) has been mentioned.

From the above discussions, it can be said that, whatever might be the intentions, may it be for preparing artificial Gold or for preparing potent medicine, Mercury was subject of interest to ancient scientists. It was subjected to extensive experimentation. The nature of experiments was subjecting Mercury to various processes like trituration, heating in closed or open vessels; mixing it with various minerals and plants as well as animal products, testing the products on trial and error basis, and further experimenting. This must be going on for pretty long period during which medicinal properties of mercurial byproducts and those of other substances which were used in the experiments, must have been revealed. And in this way, the science evolved in which Mercury and many other mineral substances along with many plant and animal products were studied for preparation of useful drugs. That science is known as Rasashastra. Thus it will be cleared that though Mercury is a substance of importance in this science, though it is main constituent of many drugs mentioned in this science, it is not an essential and imperative part of every drug. There are many drugs, especially drugs of '*Bhasma*' nature which may not have mercury as its constituent. Though the science evolved in the beginning as

study of Mercury, as it developed further and further, study of metals, minerals as well as animal and plant products was also included in it and this is how definition of Rasashastra having wider scope came into existence.

Short History of Rasashastra

When one tries to seek origin of any science one must depend on various materials like manuscripts, books etc. as well as references about that science in the contemporary and allied literature.

As is mentioned in the beginning of this chapter, Rasashastra started and was developed as a separate science and then slowly over a period of many hundred years, merged with Ayurveda. Therefore books or classical texts of Ayurveda are instrumental in tracing history of Rasashastra.

While defining the Rasashastra it has been said that it is a science in which art of manufacturing drugs from Mercury and other minerals and metals has been explained.

In the classical texts of Ayurveda like Charaka Samhita, Sushruta Samhita and others, many such minerals and metals are mentioned as theraputic agents, however in most of the cases their use was limited to external applications. e.g. substances like Sulphur (*Gandhaka*), Chalcopyrite (*Makshika*), Arsenic oxide (*Somal*), Arsenic trisulphide (*Haratal*), Ferric oxide (*Gairik*), Blue Vitriol ($CuSO_4$ $5H_2O$), Green Vitriol ($FeSO_4$ $7H_2O$), lead compounds etc. are mentioned for treatment of various ailments. Even Mercury itself was used, though for external application only. From these references it can be concluded that minerals, metals and Mercury which form the base of Rasashastra were practically used in 'Samhita' period.

The other major reference from which history of Rasashastra can be traced to a definite period is from Arthashastra, a major treatise written by Koutilya or more commonly known as Chanakya.

In the older text books of Rasashastra as well as in Arthashastra the process of preparing Gold from non-precious metals has been explained and Gold prepared with use of such process is called as *Rasavedhaja suvarna* as one of the types. This indicates that such art was very well known and practiced during that period. The period of Chanakya was 3rd Century B.C. It can therefore, safely be concluded that Rasashastra was very well developed and established even before that period.

The historical periods of authors of classical texts of Ayurveda are considered as (1) Charaka Samhita - 2200 B.C.; (2) Sushruta Samhita 1000 B.C. (3) Ashtanga Sangraha, and Ashtanga Hridaya, 3rd and 4th Century A.D. In these texts though many minerals and metals are mentioned for medical use, the forms in which they were used were very simple and uncomplicated. The process of *Ayaskriti* (using metals in fine colloidal form) though first written in Charaka Samhita, appears in more developed and detailed form in Sushruta Samhita. The progress during this period of about thousand years can easily be seen. However, we cannot find such progress as far as medicinal use of Mercury is concerned.

About the exact origin of Rasashastra, there are two Schools of thoughts amongst the scholars. According to one, study of Mercury began somewhere in Ancient Egypt first and then it was spread in the regime of Roman Emperors and Greeks. The original place of such studies was known as 'Chemia' and therefore the science developed

from that place is called as Chemistry. During the 'Mourya' Dynasty in Indian subcontinent in 3rd century B.C., cultural relations between these two regions were established and thus study and further development of Mercury began in India. Another fact to substantiate this theory is there is no occurance of Mercury or mercurial components in Indian subcontinent. The synonyms of Mercury and mercury compounds are *Mlechchha*, *Darada*. Originally these were the regions in the Hindukush and Gilgit valley from where Mercury and other mercurial products were supposed to be imported into India and hence the synonyms. It is therefore difficult to believe, that the 'Science of Mercury' was originated in India, where there are no mines or sources of Mercury.

On the contrary, there are scholars who firmly believe in exactly apposite, as classics like Charaka Samhita, Sushruta Samhita give references of Mercury (Thousands of yrs. B.C.). There are vivid mentions of Mercury in Ramayana (500 yrs. B.C.). And knowledge of Mercury must have reached Roman Empire and middle east through cultural exchange from India. As is usual in such cases, no definite conclusions can be drawn about the origin of Rasashastra.

Whatever might be the fact, one thing is sure that further development of Rasashastra took place in Indian subcontinent.

Before proceeding further in the history of Rasashastra, one must understand two terms which are often used viz. *Dhatuvada* and *Dehavada*. Development of Rasashastra so as to convert nonprecious metals into precious ones is called as *Dhatuvada* and development which took place to invent medicines to gain longevity of life, vigour and vitality, is called as *Dehavada*. In the beginning of the develop-

mental period these two terms were also called as 'Rasashastra' and 'Rasayan Shastra' respectively. By observing these and other references it can be said that the art and science of Rasashastra originated and developed in India during the period from 2000 yrs. B.C. to 2nd or 3rd Century A.D. and development of 'Rasayan Shastra', though originated many hundreds of years B.C., it actually began after 2nd-3rd Century A.D.

If various old manuscripts and edited editions of various books are taken into consideration, it can be seen that though Rasashastra was very well established and practiced during Chanakya's period, books from which its progress and development can be inferred are not available.

In the wide span of history of Rasashastra, the name "Nagarjuna" stands out as an important author. Actually the name Nagarjun is mentioned in the 1st, 2nd, 3rd, 4th and 8th Centuries. For convenience they are termed traditionally as Arya Nagarjun (1st Century); Nagarjun 2nd (2nd Century); Nagarjun of Gupta Dynasty (4th or 5th Century); and Siddha Nagarjuna (8th Century). There are many stories and acts of wonder allotted to every one of them, which cannot be substantiated with proper evidences. The books and manuscripts available today date back to 8th Century. Siddha Nagarjuna has many books to his credit viz. Rasaratnakar, Kakshaputatantra, Rasendramangal etc. These books give knowledge about both *Dhatuvada* as well as *Dehavada*.

The science of Rasashastra was developed and practiced basically by people of three cults - Bauddhas, Shaktas and Nathpanthis. For obvious reasons, secrecy was having top priority. Very potent medicines and art of making Gold from non-precious metals these were two very important

characteristics of these cults. These people used to stay and experiment in deep jungles. Naturally there was an aura of fear, secrecy around these sciences. In the early period the knowledge used to be spread by verbal teaching only and in later period when manuscripts were written, secret codes and undecipherable language was the order of the day!

From 8th Century onwards we find that the '*Dehavada*' part, or Rasayan Shastra developed rapidly though the name Rasashastra remained. Newer drug forms were invented. More and more metals and minerals were incorporated in study. Different methods of processing of Mercury and other metals were established.

It was thought that to achieve ultimate goal of *Dehavada*, i.e. to be successful in delaying the ageing, getting vigour and vitality with the help of Mercury, it should be processed by 18 different methods and after these 18 tedious processes, mercury becomes so potent that it can convert non-precious metals in to Gold. All these processes are well documented in books written in 9th Century onwards upto 13 to 14th Centuries.

During this period, people of different cults tried many things to keep laypersons away from the developments. Various rituals which were difficult to follow were established.

The books written in later period i.e. 13th to 14th Century onwards appear to be mear compilations from the older texts with little or no inclusion of new ideas.

At the advent of British colonial rule from 19th century onwards, knowledge and practice of Modern or Allopathic medicine spread in India very rapidly. The tremendous

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development in other allied sciences like Physics, Chemistry, Electronics etc. accilarated this spread. Fast action and easy availability, and mass scale production of the drugs helped popularizing this system of medicine.

This explosion of knowledge was bound to be reflected in the books written during this period. For classification of minerals, for production of the drug, knowledge of other allied sciences like Chemistry, Metallurgy etc. is used in books like Rasatarangini by Vd. Sadananda Sharma. (20th Century)

Thus it can be said in short that the science of Rasashastra as is practised presently has its origin in Samhita period or before i.e. about 4000 yrs back. However, actual development as far as medicinal use began in 2nd or 3rd Century, its peak period of development was from 8th Century onwards. After 14th Century the knowledge appears stagneted and presently after learning the sciences like Chemistry, again it is in the developmental stage. Knowledge of Chemistry and its allied branches like phytochemistry, analytical chemistry, various instruments and their knowledge in drug production, all these factors when applied to Rasashastra, will prove useful in understanding the 'secrets' of Rasashastra in future.

Etymology of the word 'Rasa'

In the Sanskrit language, there are many meanings of the word *Rasa*. These can be enumerated as — (1) Liquid; (2) Taste; (3) One of the Seven constituents of human body; As per Ayurvedic concepts; (4) It is used in classification of emotions produced in literature or speech. e.g. if a perticular article produces emotions of fear, or laugh or bravery, that article is of रौद्ररस, हास्यरस, वीररस etc. The word *Rasa* here

signifies the emotion; (5) In Vaidic literature the word *Rasa* is used to mean Cosmos (ब्रह्म).

However, as has been stated earlier, in this science, the word *Rasa* means 'Mercury'. It seems that there are two reasons for naming Mercury as *Rasa*. The first is it is the only metal which is in liquid form at room temperature and it has unique property to mix intimately with other metals and still maintaining the liquidity i.e. as if it liquifies other metals and mixes with them. In Sanskrit it is explained as 'रसनात् सर्वधातूनां रस इत्यभिधीयते'. Another exlplanation is again 'जरारुङ्मृत्युनाशाय रस्यते वा रसो मतः'. The verb रस्यते means 'is ingested or taken internally'. Because of very potent properties of the drugs prepared from Mercury, which are supposed to prevent death, old age and pain this name is given. In addition Mercury has many more synonyms, for which a separate chapter is devoted.

Rasayana

This very often used term explains one of the properties of Mercury. By definition it means whichever matter used for delaying aging and destroying diseases is called as रसायन. There are many types and various methods of using रसायन matters. But that is not main subject of this chapter. A student or reader should not be confused with this term due to similarity in the words and that is why the term is explained in short over here.

Building of Pharmacy

(Rasashala-nirmanam)

In almost every classical text of Rasashastra, usually a separate chapter is devoted in describing building of a production unit. One finds detail and meticulous description of the production unit in such texts. In such descriptions,

right from selection of the place, water facilities, light facility and availability of raw materials, ventilation of the air, etc. are ideally given. Not only this but accurate and well thought off directions regarding various departments, selection of staff, financial requirements and security are also meticulously given. It must be remembered that all these texts date back to a period between 10th and 16th Centuries. It is therefore need not be stated that the descriptions are as per need of the period, however, if we can separate the basic thought-process or principles, it can be very well seen that they adhere to modern period also. Such principles are:

(1) Selection of Place: It is clearly mentioned that while selecting the place for production unit, availability of raw materials, availability of water, ample and adequate space should be considered.

(2) The Infrastructure of the Productuion Unit: It should have four big doors and many windows. Obviously, cross ventilation and natural light must have been considered here.

(3) Internal Arrangement: The floor should be flat and smooth, there should be separate compartments for processes in which fire is used and where ample amount of water is used for washing and cleaning purposes. A separate section for safekeeping of various instruments and machines is also advised.

(4) Selection of workers and other staff: Such people should be honest, who like cleanlyness and who are aware of their duties. In present era, the Pharmaceutical Industry has developed tremendously. Manpower, Machinery and Energy have become areas of preferences and thus actual

terms of references have changed. However, the basic thought-process and principles in building a Pharmaceutical Production unit are unchanged.

Let us now see in little detail about the internal arrangements of the production unit which are common in all ancient text books of Rasashastra with little difference if any. Such details are as under:

(1) The God Rasabhairav should be on east side.

(2) All the processes of giving heat should be performed at a place situated at South-east direction (*agneya*).

(3) All processes for breaking, powdering etc. are to be performed at a place situated at South.

(4) All the 'metal work' should be performed in South-west direction.

(5) West is reserved for washing procedures while North-west is for drying purpose.

(6) A place situated in North direction should be used for '*Vedhan*' process.

(7) Store room should be situated at North-east.

One need not wonder about why such peculier arrangement is advocated. Because all the Ancient sciences from Indian subcontinent have religion and God as their base. Rasashastra is no exception to it. e.g. South east direction belongs to goddess of fire (*agni*), therefore all processes for which *agni* is required are performed in that direction. Every statement made can thus be explained in such a way. One must therefore conclude that the objective of such arrangement must be to arrange separate section for each processes. Presently ofcourse, the places for each process are fixed as per availability of light, water and space.

Instruments & Machines

Very detailed and elaborate description is given in the ancient texts of Rasashastra about various instruments and machines which are to be used in production of drugs. It will be wrong if it is stated that these are still used. Because the development occurred in this field, along with development in sciences like Physics and Electronics is so tremendous that every day new machines are coming up in the field making the previous ones obsolete! However, if we just go through the list, we can conclude that presently modern forms of these very instruments and machines are used.

The list is as stated under:

1. Various Mortars and Pestles of both metals and stones and of different sizes.
2. Vessels of glass, wood and mud of various sizes.
3. Pairs of tongs and sissors of various sizes.
4. Sifters of different sizes and different meshes.
5. Metal furnaces of different sizes.
6. Various routinely used machines e.g. *Dola yantra* etc.
7. Containers with lids of various sizes.
8. Different types of scales to measure the matter.
9. Stock of different types of fodder e.g. cowdung cakes, wood, coals etc.
10. Cleaning instruments etc.

If one observes carefully then it will be clear that even today the machines, instruments etc. which are actually used in modern pharmaceutical units are modern versions of the instruments used in those days. e.g. instead of mortars and pestles, today mechanised grinders and mixers are

used. Separators are used for straing, sifting etc. Drying machines, tabletting machines, coating machines etc. now perform work of skilled hands. Such changes if they are based basically on Principles of Ayurveda are definitely acceptable and are always welcome.

Chapter 2

Terminology

In scientific literature, many a times, the words used have specific meaning pertaining to that science only. The technical use of words avoid the unwanted description. Though these words may possess different literal meaning, their scientific meanings related to that science are specific. For example, the Sanskrit word '*Rasa*' has various meanings like taste, juice, essence, sap, aesthetic appreciation, liquid, artistic delight, potion, nectar, melodious sound, the element mercury etc. In Dravyaguna i.e. Materia Medica of Ayurvedic drugs, it represents as the taste, whereas in Rasashastra it denotes the Mercury. Hence it is important to understand the technical terms of that particular science. These technical words are known as the 'terminology' (*paribhasha*). The treatise Paribhasha Pradipa' quotes the definition of the word '*Paribhasha*' as follows:

अव्यक्तानुक्तलेषोक्तसन्दिग्धार्थप्रकाशिकाः ।
परिभाषाः प्रकथ्यन्ते दीपीभूताः सुनिश्चिताः ।। (1:6)

The technical words which explain the meaning of unexpressed, unspoken and ambiguous words are known as '*Paribhasha*'. As the light enlightens the things in the dark and helps to know them, similarly the terminology enables to know the meaning of coded and difficult words. There are many technical terms commonly used in Rasashastra. Let us see the meaning of few coded words i.e. terminology, in this chapter.

(1) Lavana-panchaka

सैन्धवञ्चाथ सामुद्रं बिडं सौवर्चलं तथा ।
रोमकञ्चेति विज्ञेयं बुधैर्लवणपञ्चकम् ।। (रसतरंगिणी 2:3)

The group of five salts viz. *saindhava* (rock-salt), *samudra* (common salt), *bida* (a type of black salt), *souvarchala* (potassium nitrate) and *romaka* (earthen salt), together, are known as *lavana-panchaka.* (Rasatarangini 2:3)

सौवर्चलं सैन्धवं च बिडमौद्भिदमेव च ।
सामुद्रेण समायुक्तं ज्ञेयं लवणपञ्चकम् ।। (योगरत्नाकर)

The group of five salts viz. *souvarchala* (potassium nitrate), *saindhava* (rock salt), *bida-lavana* (a type of black salt), *oudbhida* (fossil salt) and *samudra* (common salt), together, are termed as *lavana-panchaka.* (Yogaratnakar)

(2) Lavana-shataka

लवणानि षडुच्यन्ते सामुद्रं सैन्धवं बिडम् ।
सौवर्चलं रोमकं च चुल्लिकालवणं तथा ।। (र.र.स.10:67)

The group of six salts viz. *samudra* (sea salt), *saindhava* (rock salt), *bida lavana* (a type of black salt), *souvarchala* (potassium nitrate), *romaka* (earthen salt) and *chullika lavana* (ammonium chloride), together, are called as *lavana-shataka* or *shad-lavanas.* (Rasaratnasamuchchaya 10:67)

Moreover, other authors have mentioned few changes in salts under the term *lavanashataka.* Rasatarangini and Rasaratnasamucchaya terminology is granted today also.

(3) Kshara-panchaka

पलाशमुष्ककक्षारौ यवक्षारः सुवर्चिका ।
तिलनालोद्भवः क्षारः संयुक्तं क्षारपञ्चकम् ।। (र.र.स.10:69)

The group of five alkalis (*kshara*) viz. *palasha kshara, mushkak-kshara, yava-kshara, sajji-kshara* and *tila-kshara* makes *kshara-panchaka.* (Rasaratnasamuchchaya 10:69)

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स्वर्जिका टङ्कणं चैव यवक्षार उदाहृतः ।
पलाशतिलनालोत्थं क्षाराभ्यां क्षारपञ्चकम् ।।

(रसेन्द्रसारसंग्रह/रसधातुप्रकाश)

The group of five alkalies (*kshara*) viz. *sajji kshara, tankana, yava kshara, palasha kshara* and *tila kshara* is known as *Kshara-panchaka.* (Rasendrasarasangraha/Rasadhatuprakash)

(4) Kshara-dvaya and Kshara-traya

स्वर्जिक्षारो यवक्षारः क्षारद्वयमुदाहृतम् ।
सौभाग्येन समायुक्तं क्षारत्रिकमुदाहृतम् ।। (रसतरंगिणी 2:6)

The two alkalis (*kshara)* viz. *sajji kshara* and *yava kshara,* together, are known as *kshara-dvaya,* whereas the addition of *tankana* (borax) makes it *kshara-traya* i.e. three alkalis.

(Rasatarangini 2:6)

(5) Ksharashtaka

सुधापलाशशिखरीचिञ्चार्कतिलनालजाः ।
स्वर्जिका यावशूकश्च क्षाराष्टकमुदाहृतम् ।। (रसतरंगिणी 2:8)

The eight alkalis (*kshara*) prepared from *snuhi* (Euphorbia neriifolia), *palash* (Butea frondosa), *apamarga* (Achyranthes aspera), *chincha* (Tamarindus indica), *arka* (Calatropis procera) and *tila* (Seasamum indicum) alongwith *sajji-kshara* and *yavakshara* make *ksharashtaka.*

(Rasatarangini 2:8)

अपामार्गपलाशार्कतिलमुष्कयवाग्रजम् ।
स्वर्जिटङ्कणसंयुक्तं क्षाराष्टकमुदाहृतम् ।। (योगरत्नाकर)

The group of the alkalis (*kshara*) of *apamarga, palasha, arka, tila* and *murva* (Marsdenia tenacissima) alongwith *sajji-kshara* and *tankana (*borax*)* is called as *Ksharashtaka.*

(Yogaratnakar)

(6) Madhura-traya

घृतं गुडो माक्षिकञ्च विज्ञेयं मधुरत्रयम् । (र.र.स.10:70)

The group of *ghrita* (ghee), *guda* (jaggery) and *madhu* (honey) together is called as *madhura-traya.*

(Rasaratnasamuchchaya 10:70)

(7) Amlavarga

अम्लवेतसजम्बीरनिम्बुकं बीजपूरकम् ।
चाङ्गेरी चणकाम्लं च अम्लीकं कोलदाडिमम् ।।
अम्बष्ठा तिन्तिडीकं च नारङ्गं रसपत्रिका ।
करवन्दं तथा चान्यदम्लवर्गः प्रकीर्तितः ।। (र.र.स.10:77-78)

The herbs possessing sour taste (*amla rasa*) predominently are grouped together as *amlavarga.* They are *amlavetasa* (Garcinia pedunculata), *jambira* (Citrus limonum), *nimbuka* (Citrus acida), *bijapuraka* (Citrus medica), *changeri* (Oxalis corniculata), *amlika* (Tamarindus indica), *kola* (Zizyphus jujuba), *dadima* (Punica granatum) raw, *ambashtha* (Cyclea peltata), *vrikshamla* (Garcinia indica), *chukra* (Rumex vesicarius), *karwanda* (Carissa congesta), *Naringa* (Citrus aurantinum).

(Rasaratnasamuchchaya 10:77-78)

(8) Amlapanchaka

अम्लवेतसजम्बीरलुङ्गनारङ्गनिम्बुकैः ।
फलपञ्चाम्लकं ख्यातं कीर्तितञ्चाम्लपञ्चकम् ।। (रसतरंगिणी 2:15)

The five sour fruits viz. *amlavetasa* (Garcinia pedunculata), *jambira* (Citrus limonum), *matulunga* i.e. *bijapuraka* (Citrus medica), *naringa* (Citrus aurantinum) and *Nimbuka* (Citrus acida), together are called as *amlapanchaka.*

(Rasatarangini 2:15)

(9) Aparam amlapanchaka

कोलदाडिमवृक्षाम्लचाङ्गेरीचिञ्चिकारसैः ।
पञ्चाम्लकं समाख्यातं त्वम्लपञ्चकमेव च ।।
सर्वेषामम्लजातीनां निम्बूकं गुणवत्तमम् ।
अम्लवेतसकं वापि त्वम्लिका वा गुणाधिका ।।(रसतरंगिणी 2:16-17)

The sour fruits like *kola, dadima, vrikshamla, changeri* and *amlika* and their sour juice, together, are called as *amla-panchaka*. Amongst all sour fruits, the lemon (*nimbuka*) is highly esteemed for its sour taste. *Amlavetasa* and *amlika* (tamarind) are ranked to be more sour amongst all sour fruits, next to lemon. (Rasatarangini 2:16-17)

(10) Panchamrita

गव्यक्षीरं दधि घृतं माक्षिकं चाथ शर्करा ।
पञ्चामृतं समाख्यातं रसकर्मप्रसाधकम् ।। (रसतरंगिणी 2:21)

Cow's milk, curds, ghee, honey, and sugar, together, are known as *panchamrita*. It is used in *rasakarma*.

(Rasatarangini 2:21)

(11) Panchagavya

गव्यक्षीरं दधि घृतं गोमूत्रं गोमयं तथा ।
एकत्रं योजितं तुल्यं पञ्चगव्यमिहोच्यते ।। (रसतरंगिणी 2:22)
क्षीरं दधि घृतं मूत्रं गोमयं पञ्चगवयकम् । (रसमित्र, प्रथमरश्मि पृ.9)

The cow's milk, curds, ghee, cow's urine and cow dung, together, is termed as *panchagavya*.

(Rasatarangini 2:22; Rasamrita p. 9)

(12) Kshira-traya

रविक्षीरं वटक्षीरं स्नूहीक्षीरं तथैव च ।
क्षीरत्रयमिति ख्यातं मारणादौ प्रशस्यते । (रसतंगिणी 2:23)

The latex of three herbs viz. *arka* (Calotropis procera), *vata* (Ficus bengalensis) and *snuhi* (Euphorbia nerrifolia), together, is known as *kshira-traya*. It is useful in *marana* i.e. *bhasma* i.e incineration process of metals.

(Rasatarangini 2:23)

(13) Dravaka gana

गुञ्जा मधु गुडः सर्पिः सौभाग्यं गुग्गुलुस्तथा ।
पूर्वाचार्यैः कीर्तितोऽयं धातूनां द्रावको गणः ।। (रसतरंगिणी 2:35)

The group of substances like *gunja* (Abrus precatorius), *madhu* (honey), *guda* (jaggery), *sarpih* i.e. *ghrita* (ghee), *tankana* (borax) and *guggulu* (Commiphora mukul), which helps to liquify the metals is called as *dravaka gana*.

(Rasatarangini 2:35)

(14) Kajjali

निर्द्रवैर्धातुभिश्चाथ गन्धादिभिः पेषितः पारदः श्लक्ष्णतां प्रापितः ।
कज्जलाभो यदा जायतेऽसौ तदा नामतः कोविदैः कज्जलीत्युच्यते ।।
(रसतरंगिणी 2:27)

The mercury is triturated with *gandhaka* (sulphur) till it becomes a fine powder. The jet black substance like collyrium thus formed, is known as *kajjali*. (Rasatarangini 2:27)

धातुभिर्गन्धकाद्यैश्च निर्द्रवैर्मर्दितो रसः ।
सुश्लक्ष्णः कज्जलाभोऽसौ कज्जलीत्यभिधीयते ।। (र.र.स.8:5)

When Mercury is triturated with sulphur alongwith metals without adding any liquids, the fine jet black powder obtained is called as *kajjali*. (Rasaratnasamuchchaya 8:5)

(15) Rasapanka

सद्रवा मर्दिता सैव रसपङ्क इति स्मृताः ।। (र.र.स.8:6)

When the *kajjali* is triturated with any liquid substance, it is known as *rasapanka*. (Rasaratnasamuchchaya 8:6)

(16) Rasapishti

खल्ले विमर्द्य गन्धेन सह पारदम् ।
पेषणात्पिष्टतां याति सा पिष्टीति मता परैः ।। (र.र.स.8:8)

The Mercury and sulphur are triturated alongwith milk, attains the fine powder form. It is called as *rasapishti, pishti* or *pishtika*. When *rasapanka* prepared using milk is further triturated, it gets a form of a grey powder which is known as *rasapishti*. (Rasaratnasamuchchaya 8:8)

In Rasaratnasamuchchaya, a mention has been made of two types of *pishtis* e.g. *navanita pishti* and *patana pishti.*

• Navanita Pishti

अर्कांशतुल्याद्रसतोऽथ गन्धान्निष्कार्धतुल्यात्कुटितोऽभिखल्ले ।
अर्कातपे तीव्रतरे विमर्द्यात् पिष्टी भवेत्सा नवनीतरूपा ।

(र.र.स.8:7)

One part sulphur and twelve parts Mercury, when are triturated together in the hot sun, it attains a form like a butter *(navanita)*, hence is known as *navanita pishti.*

(Rasaratnasamuchchaya, 8:7)

• Patana Pishti

चतुर्थांशसुवर्णेन रसेन कृतपिष्टिका ।
भवेत्पातनपिष्टी सा रसस्योत्तमसिद्धिदा ।। (र.र.स.8:9)

One part Mercury is triturated with one fourth part of Gold and then adding equal amount of sulphur, the whole mixture is triturated further. Many scholars do not add sulphur and still called the mixture as *pishti.* It forms a fine powder, called as *patana pishti.* From this *patana pishti,* the Mercury can be regained by distillation, which is rich in properties. (Rasaratnasamuchchaya, 8:9)

(17) Bhavana (impregnation)

यच्चूर्णितस्य धात्वादेर्द्रवैः सम्पेष्य शोषणम् ।
भावनं तन्मतं विज्ञैर्भावना च निगद्यते ।। (रसतरंगिणी 2:49)

A liquid is added to the powder and is triturated till the all liquid portion is absorbed. This procedure is known as *bhavana vidhi* or to give *bhavana.* It augments the potency of medicine. The amount of liquid to be explained as:

द्रवेण यावता द्रव्यं चूर्णितं त्वार्द्रतां व्रजेत् ।
तावानेव द्रवो देयो भिषग्भिर्भावनाविधौ ।। (रसतरंगिणी 2:50)

Add the liquid to the powder in optimum proportion, that it gets sufficient moisture and forms a pulp.

(Rasatarangini 2:49-50)

(18) Dhalana (pouring)

द्रुतद्रव्यस्य निक्षेपो द्रवे तद् ढालनं मतम् । (र.र.स.8:43)

The action of pouring the smolten matter into another liquid is known as *dhalana.* (Rasaratnasamuchchaya 8:43)

(19) Awapa (addition)

द्रुते द्रवयान्तरक्षेपो लोहाद्ये क्रियते हि यः ।
स आवापः प्रतीवापस्तदेवाऽऽच्छादनं मतम् ।। (र.र.स.8:52)

When other substances are added in liquid metals, the process is called as *avapa.* It is also called as *prativapa* or *achchhadana.* (Rasaratnasamuchchaya 8:52)

(20) Nirwapa (immersion)

तप्तस्याप्सु विनिक्षेपो निर्वापः स्नपनं च तत् । (र.र.स.8:54)

When the heated metals are immersed in some liquid in order to remove their heat, it is known as *nirwapa* or *snapana* (Rasaratnasamucchaya 8:54)

(21) Nirwapana

साध्यलोहेऽन्यलोहं चेत्प्रक्षिप्तं वङ्कनालतः ।
निर्वापणं तु तत्प्रोक्तं वैद्यैर्निर्वाहणं तथा ।। (र.र.स. 8:24)

When (in a liquid metal, which is to be converted) the other metal is mixed (by liquifying it) with the help of blow pipe, the procedure is known as *nirvapana* or *nirvahana.* (Rasaratnasamuchchaya 8:24)

(22) Shodhana (purification)

उद्दिष्टैरौषधैः सार्द्धं क्रियते पेषणादिकम् ।
मलविच्छित्तये यत्तु शोधनं तदिहोच्यते ।। (रसतरंगिणी 2:52)

When (a substance) is subjected to trituration etc. with required plant or animal products, so as to remove unwanted properties it is known as *shodhana.*

(Rasatarangini 2:52)

निर्दिष्टैरौषधैः सार्द्धं पेषणं स्वेदनादिकम् ।
दुष्टं दोषविनाशाय शोधनं परिकीर्तितम् ।।(रसमित्र, प्रथम रश्मि पृ.11)

The act of treating a substance with advised matter by rubbing, steaming etc. so as to remove bad properties, it is known as *shodhana.* (Rasamitra, Chapter 1)

(23) Mritaloha

The Sanskrit word '*loha*' denotes a metal. The word *mritaloha* means a metal which is dead (*mrita*). The procedure of heating thin sheets or a powder of a metal along with another substance is known as *marana kriya,* i.e. killing. At the end of this procedure, finally, a very fine powder is obtained which is known as *mritaloha.* The basic idea behind calling the metal 'dead' is, as a result of this procedure, it cannot be converted into original form.

There is a reference of *mritaloha* in Rasamitra and Rasatarangini, mentioning the definition, which elaborates about the fineness of *mritaloha.* It does not specify about heating and procedure of preparing the calx.

तर्जन्यङ्गुष्ठसंघृष्टं विशेद्रेखान्तरं तु यत् ।
निविष्टञ्च बहिर्नैति मृतलोहं तदुच्यते ।।
मृतं लोहं पुटे ध्मातं ताराज्यमधुसंयुतम् ।
न त्यजेत्तारमानं वा मृतलोहं तदुच्यते ।। (रसतरंगिणी 2:54-55)

When the *bhasma* (literally, 'ash'; an incinerated metal or mineral) is rubbed between an index finger and the thumb, it should fill the lines on the fingertips, which demonstrates its particle size. This fine *bhasma* is known as *mritaloha.* (Commonly *'loha'* means an iron).

Bhasma, when reprocessed with honey, ghee and silver does not show any difference in the weight of the silver, is called as *mritaloha.*

The Sanskrit word '*Mrita*' literally means the one which is dead or vanished. The word '*Loha*' denotes a metal, here. Thus *'mritaloha'* indicates the dead metal i.e. its *bhasma.* It was thought in the past that the *bhasma* of a metal does not contain any traces of the basic metal. The definition of *mritaloha* indicates the fineness of the particle size. The procedure of killing *(marana)* or preparing the *bhasma* from a metal requires intense heating. With the view of modern chemistry, these metals are converted into oxides or some compounds because of heating. When these *bhasmas* are again treated by intense heating, the original metal can be regained. Hence, *mritaloha* can be defined as:

"The procedure of *marana kriya* or preparing a *bhasma* is the one, which enables the metals with the help of heating and some manupulations, to get them assimilable to the human body. The final product prepared, is called as *'mritaloha'.*

(24) Panchamrittika

इष्टिका गैरिका लोणं भस्म वल्मीकमृत्तिका ।
रसप्रयोगकुशलैः कीर्तिताः पञ्चमृत्तिकाः ।।

(र.र.स. 10:81; पारदसंहिता 7:1)

The brick-powder, red ochre, salt, ash and soil of ant-hill, together, is known as *panchamrittika.* The efficient *vaidya* should use these five types of soils (at proper time).

(Rasaratnasamuchchaya; Parada Samhita, 7:1)

वल्मीकमृत्तिका धूमगैरिकं चेष्टिका खटी ।
इत्येता मृत्तिकाः पञ्च प्रोक्तस्थाने प्रयोगिका ।।

(टोडरानन्द, पारदसंस्कार 7:2)

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The soil of an ant-hill, home-soil, red ochre, brick powder and chalk are the five types of soils, together called as *panchamrittika.* (Todarananda; Parada-sanskar 7:2)

Reviewing the meanings of the technical terminologies, it is seen that they have different meanings, as they were documented in different texts, written at different time. It is, especially, noted in the terminology of a group of substances. Fortunately these terminologies are seldom used in day to day practice. For example, though mentioned, the terms like *rasapanka, rasapishti, mritaloha* are hardly used in the texts also. The group of substances like *amla varga, lavana varga* are the mentions of the substances available in those days. It is possible to incorporate substances like sugar, glucose and lactose like honey, jaggery and ghee under the term *madhura-traya* . Many organic and inorganic sour substances, researched in recent years, could also be incorporated in the *amla varga.*

It is obvious that one should follow the terminology while preparing the medicines, from a particular reference, which denotes the specific substances. For example, if one wants to use *amlapanchaka* refering Rasatarangini, he should use the five sour substances mentioned in that text. Then only it will be possible to revalidate the texts and update them.

Chapter 3

Science of Appliances

While preparing medicines from Mercury or mineral substances, often it is necessary to process them by different methods *(sanskara)*. Mainly it includes to grind the substance into a fine powder, to roast it, to heat it alongwith some liquid (*swedana*) i.e. to boil or cook it in the liquid, to incinerate with the help of intense heating (*bhasmikarana*) etc. For these processes some specific appliances are required. During the special treatment by specific method, it should fulfil the critical criteria, like maintaining temperature during heating process, so as to procure a standard quality medicine. For this few special appliances are required, specifically designed to achieve the best medicine. Ancient scholars of Ayurveda were well versed with the metals like gold, silver, copper and iron. Later on the additions of tin (*vanga*), zinc (*jasada*), lead (*naga*) and alloys like bronze (*kansya*) and brass (*pittala*) were also there, since those days. But these metals or alloys were seldom used in the form of appliances. Since those days, Ayurvedic scholars were aware of the effects of sour substances on the metals as well as the effects of various plant material and animal resources used for medicinal purpose. Hence, the apparatus designed was of earthen origin mainly. Various appliances used for processing the drug material during production of the standard medicine are called as *Yantra* or appliances.

During the production of various medicinal formulations, different types of appliances are required, to process the Mercury, metals or minerals by different methods. These appliances are specially designed for specific processes

(*samskara*), which vary in their design as per the needs. Majority of the appliances are prepared from the clay. The apparatus prepared from the clay is first dried in the shadow and then subjected to undergo intense heating. Before using any apparatus, it is minutely seen for any hole, crack or leakage and then used to avoid the wastage of any material, time and efforts.

Since ancient time, the appliances used are made up of clay. The earthen appliances are quite economical. Moreover, the main obstacle for using the appliances prepared from the metals is their interaction with the drug material. It will affect the quality of final product as well as few untoward effects on the health of the patient.

With time, these appliances might have undergone few changes or modifications. In future, they are likely to be replaced with better appliances. But before that it is important to understand the basic principles of appliances, described in the old days. It is interesting to study the design of few important appliances used for specific processes.

Definition of an Apparatus : Yantra

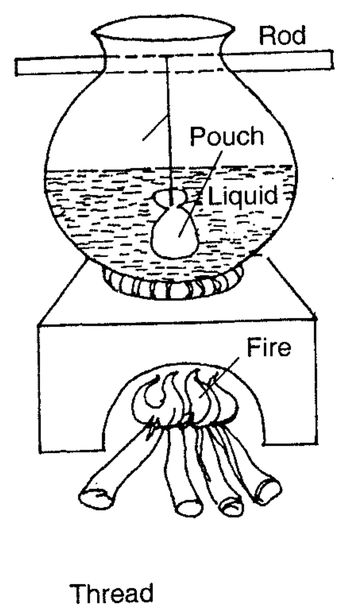
स्वेदादिकर्म निर्मातुं वार्तिकेन्द्रैः प्रयत्नतः ।
यन्त्र्यते पारदो यस्मात्तस्माद्यन्त्रमिति स्मृतम् ।। (र.र.स. 9:2)

The appliances designed and used by the ancient scholars of Ayurveda, to process the Mercury by different methods, are called as the apparatuses (*yantra*). (R.R.S. 9:2)

We have seen in the last chapter that various methods innovated to process the Mercury were the cause of the development of Rasashastra. Hence, the mention of Mercury is quoted in the definition of appliances itself. It should be noted that all these appliances were not used alone to process the Mercury. For example, the appliances like *khalva yantra, dola yantra, damaru yantra* are also used for different purposes than to process the Mercury. Thus, any apparatus or the group of appliances used to process any substance should be called as *yantra.* The earthenwares like saucers (*sharava*), big pots (*handi*) and small pots, used since those days, are also catagorised as *yantras.* Today we can replace the previously used earthen appliances by glasswares, stainless steel etc. For that we should first know the basic principle of each apparatus and then replace or integrate it with modern times. Let us study few important appliances and ponder on the principles behind them.

(1) Dola Yantra (Swing Apparatus)

द्रवद्रव्येण भाण्डस्य पूरितार्धेदकस्य च ।
मुखस्योभयतो द्वारद्वयं कृत्वा प्रयत्नतः ।।
तयोस्तु निक्षिपेद्दण्डं तन्मध्ये रसपोटलीम् ।
बद्ध्वा तु स्वेदयेदेतद्दोलायन्त्रमिति स्मृतम् ।। (र.र.स. 9:3-4)



An earthen vessel is taken and two holes are made on both sides of the neck of vessel in which a rod is put. The vessel is filled half with the required liquid. The substance (to be processed) kept in cloth pouch is bound with strings to the rod so that the pouch may stay swinging in the liquid. Then the vessel is subjected for slow heating. This apparatus is known as *Dola yantra* i.e. swing apparatus. (Rasaratnasamuchchaya 9:3-4)

An earthern vessel well roasted in the fire, should be selected. The holes on both sides of its neck should be done

delicately, so that it will not crack the vessel. The wooden rod used, should be sturdy. The pouch used should be either cotton or silk, but not of synthetic material which may get melt with the heat. The pouch should be tied fit and should have four layers of cloth. The thread used to suspend the pouch, should be made up of the silk. The pouch should be suspended in such a way, that it will not touch the bottom, but should be completely emmersed in the liquid.

The procedure of heating should be low and slow. When the liquid in an earthern vessel starts boiling, the heat should be still curtailed if required. The liquid is to supposed to be boiling steadily. The liquid in the apparatus is replenished as and when necessary.

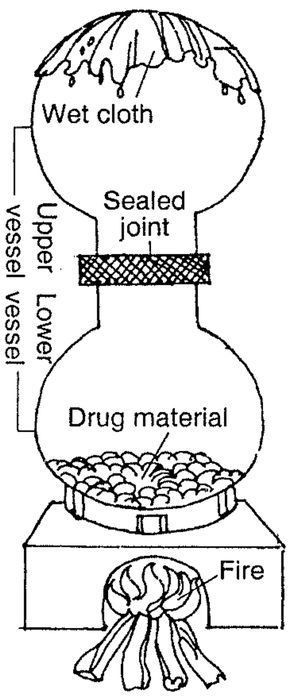
The boiling liquid in the vessel comes in contact with the drug material in the pouch during this *swedana* procedure. The interaction takes place between the boiling liquid and the drug material in the pouch. Whenever more liquid is poured in the vessel, it should have the same temperature of the boiling liquid, so that maintenance of temperature can be achieved. It is not feasible to change the temperature of drug material in the pouch.

The liquid used for processing is often a gruel. Sometimes the sour liquid, alkali, plant juice or decotion is also used. The mention has been made in few texts about the proportion of the drug material in the pouch and the liquid in the vessel. The liquid part is sixteen times to that of drug material in the pouch. Accordingly, the size of an earthern vessel is selected. If the drug material in the pouch is heavy, then the pouch itself should be tied with the thread on all sides. *Dola yantra* is used for *swedana* of Mercury. It is also

used in *shodhana* process of *dhattura bija*, *jaypala bija*, *vatsanabha* purification and *haratal* (As_2S_3) *shodhana*.

(2) Damaru Yantra (Hour-glass Apparatus)

यन्त्रस्थाल्युपरि स्थालीं न्युब्जां दत्त्वा निरुन्धयेत् ।
यन्त्रं डमरुकाख्यं तद्रसभस्मकृते हितम् ।। (र.र.स. 9:58)



Substance to be treated is kept in an earthen vessel. Another vessel is kept over the mouth of the first vessel, so as to fit perfectly, and the joint at their mouth is closed tightly with the mud cloth-plaster. It looks like a tabor shaped, hence called as *Damaru yantra*. It is used to prepare *bhasma* of Mercury. (R.R.S. 9:58)

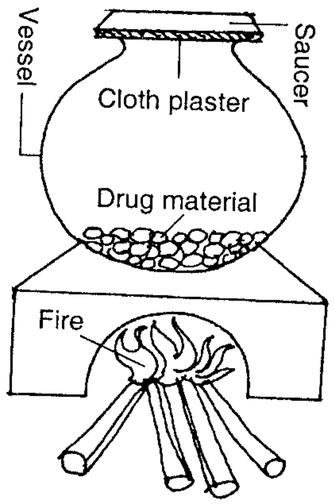
Out of the two vessels, the lower one contains the drug material and is subjected for heating. On the upper surface of upper vessel, a wet cloth is placed. The mouth of the upper vessel should be slightly bigger than the lower one, so that both the vessels shall fit snugly and the joint should be sealed with a plaster of mud on cloth.

Damaru yantra is used in preparing the *bhasma* of Mercury, in purification of ammonium chloride (*navasagar*) and to procure Mercury from cinnabar (*hingula*).

The shape of this appratus resembles to that of tabor, hence it is known as *damaru yantra*. It is similar in the structure to that of distillation apparatus used in modern times.

(3) Sthali Yantra

स्थाल्यां ताम्रादि निक्षिप्य मल्लेनाऽऽस्यं निरुध्य च ।
पच्यते स्थालिकाधस्तात्स्थालीयन्त्रमिदं स्मृतम् ।। (र.र.स. 9:67)

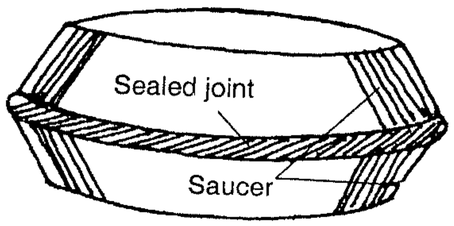


An earthen vessel containing the drug material like copper etc. is used by placing the saucer (*sharava*) on the mouth and is sealed with the cloth plaster. Then it is subjected for heating. This apparatus is known as *Sthali yantra*. It is used to procure the extracts of *upadhatus* like orpiment (*haratal*), realgar (*manahshila*) etc.

(Rasaratnasamuchchaya, 9:67)

(4) Puta Yantra

शरावसम्पुटान्तःस्थं करीषेष्वग्निमानवित् ।
पचेच्चुल्ल्यां द्वियामं वा रसं तत्पुटयन्त्रकम् ।। (र.र.स. 9:45)



The Mercury (rubbed with the drug material or some other substance) is kept in between two saucers, which are sealed with the mud cloth plaster. It is then subjected for heating on the fire of sheep dung for about six hours. This apparatus is known as *Puta yantra*.

(Rasaratnasamuchchaya 9:45)

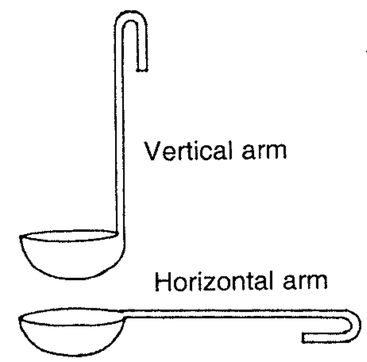
After keeping the drug material in one saucer, the other saucer (*sharava*) is placed upside down on its top and is sealed with a plaster of mud on cloth. After getting this sealing dried, an expert who decides the duration of heating required, is known as '*agnimanavid*'.

The size of the sacuers depends upon the drug material and its quantity. After accomodating the drug material in the sacuers, one-third of the total space should be vacant. Accordingly, the size of the saucers is determined. The saucers being earthern, are porous. A thin coating of lime is

given on the inner sides of the saucers, to avoid the sticking of drug material in the pores. In the preparations of *bhasmas* of the substances, *puta yantras* are often used. e.g. *abhraka bhasma*, *shankha bhasma*, *naga bhasma* etc.

(5) Palika Yantra

चषकं वर्तुलं लौहं विनताग्रोर्ध्वदण्डकम् ।
एतद्धि पालिकायन्त्रं बलिजारणहेतवे ।। (र.र.स. 9:50)



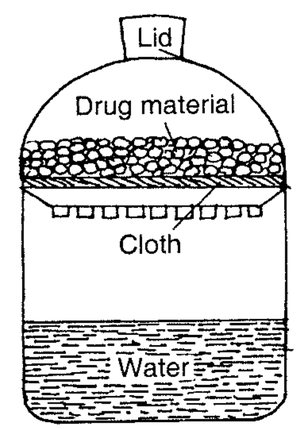
A round shaped iron vessel, with a bend vertical arm or handle to hold it, is known as *Palika yantra*. Sometimes it has a horizontal arm or handle also.

(Rasaratnasamuchchaya 9:50)

This apparatus is used for heating *kajjali*, to liquify it and also in *gandhaka jarana* i.e. sulphur is added to Mercury and processed according to prescribed method.

(6) Swedana Yantra (Steaming Apparatus)

साम्बुस्थालीमुखाबद्धे वस्त्रे पाक्यं निवेशयेत् ।
पिधाय पच्यते यत्र स्वेदनीयन्त्रमुच्यते ।। (र.र.स. 9:5)



An earthen vessel filled with water and a cloth is tied on the mouth of the vessel. The drug material is placed on that cloth and the vessel is closed with a lid on the top. The vessel containing water is then subjected for heating and steaming of the drug material is achieved. This apparatus is known as *Swedana yantra*.

(Rasaratnasamuchchaya 9:5)

The selection of an earthen vessel should be done so as to see that it should sustain the heating. The cloth tied should be thick. The heating should be slow and the heat

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should not reach upto the cloth. The water in the vessel when starts boiling, the vapour passed through the cloth, where it will steam the drug material. Some part of drug material will get dissolved in the steam and get mixed with the water in the vessel. When the drug material contains more than two substances, possibility of their interaction, after steaming, is there. Moreover, instead of water when the vessel is filled with some decoction or juice, its vapour can act on the drug material.

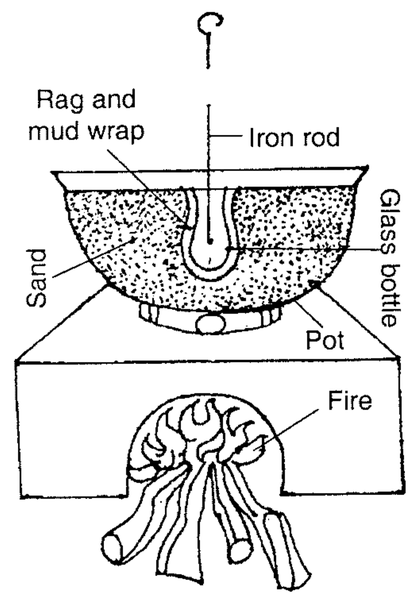
Swedana yantra is commonly used to soften the hard substances by steaming. For example, before taking out the juice of *Vasa* (Adhatoda vasica) leaves, they are first subjected for steaming, to make them soft.

(7) Valuka Yantra (Sand Apparatus)

सरसां गूढवक्त्रां मृद्वस्त्राङ्गुलघनावृताम् ।
शोषितां काचकलशीं त्रिषु भागेषु पूरयेत् ।।
भाण्डे वितस्तिगम्भीरे वालुकासु प्रतिष्ठिता ।
तद्भाण्डं पूरयेत्त्रिभिरन्याभिरवगुण्ठयेत् ।।
भण्डवक्त्रं मणिकया सन्धिं लिम्पेन्मृदा पचेत् ।
चुल्ल्यां तृणस्य चादाहान्मणिकापृष्ठवर्तिनः ।
एतद्धि वालुकायन्त्रं तद्यन्त्रं लवणाश्रयम् ।
पञ्चाढवालुकापूर्णभाण्डे निक्षिपय यत्नतः ।
पच्यते रसगोलार्धं वालुकायन्त्रमीरितम् ।। (र.र.स. 9:36-39)

A bottle of glass and the vessel filled with sand are two important parts of this apparatus. The mercurial is put into a bottle which is wrapped with rag and mud and dried. This is kept in a vessel which is filled with sand upto the neck of the bottle. Then it is heated. The bottle of glass should sustain prolonged heating and should be a narrow mouth. Three-fourth part of the bottle is filled with the mercurial. The thickness of rag and mud sealing is quoted to be of 0.75 inch.

An earthen vessel is filled with the sand at the bottom upto 8"- 9" thickness. Then the bottle filled with mercurial is placed on it and surrounded by the sand on all sides. On the top of the vessel a saucer is placed and sealed with rag and mud. After drying, the whole apparatus is put on the fire and subjected for slow heating. To moniter the amount of heat, a grass stick is kept on the top of the saucer, which is not supposed to get burnt. When insted of sand the apparatus is filled with the salt, it is known as a '*Lavana yantra*'. (Rasaratasamuchchaya 9:36-39)



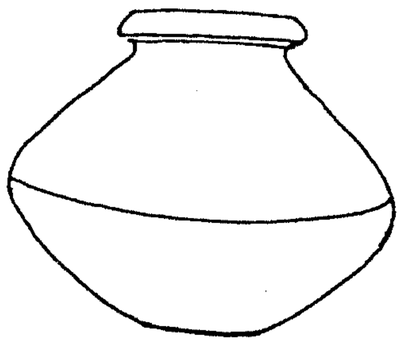
From the description mentioned above, it is noted that there is no specific mention of the size of the either the glass bottle or that of sandy vessel. Though it is quoted that the earthen vessel containing sand and a bottle filled with mercurial in its centre, is sealed at the top with a saucer. It is not possible to see with a probe, whether the drug material is finally prepared or not, in the bottle. Such type of monitoring is frequently required in *kupipakva* preparations. Hence, it is seen that the apparatus is not closed or sealed with saucer or lid at the top.

The basic principle of heating the drug material is to heat it slowly for prolonged period. The heat reaches the mercurial from the earthen vessel to sand, then rag and mud, and then finally to the glass bottle. All these substances are the bad conductors of heat. Hence, it is concluded that the heating desired is low and slow. Today, it is possible to standardise the amount of heat with the help of thermometer.

Mention has been made about the amount of sand to be filled in the apparatus. An earthern vessel filled with 5 *adhaka* (approximately 12.8 kg) of sand, which contains a glass bottle filled with mercurial product which is subjected for slow heating is known as *Valuka yantra*. It is used in preparing *Rasasindura, Suvarnaraj vangeshwar, Makaradhwaja* like *kupipakva rasayanas.*

(8) Ghata Yantra

चतुष्प्रस्थजलाधारश्चतुरङ्गुलिकाऽऽननः ।
घटयन्त्रमिदं प्रोक्तं तदाप्यायनकं स्मृतम् ।। (र.र.स.9:51)



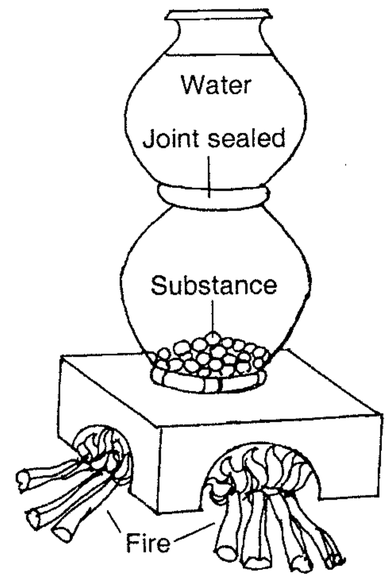
An earthen vessel which can accomodate 4 *prastha* (approximately 2.5 litres) quantity of water and whose neck is 3 inches in diameter, is known as *Ghata yantra*. The vessel should be well roasted in fire and should not have any crack. It is used for storing the juices, water and decoction etc. As the neck of the vessel is too narrow, it is difficult to cleanse it from inside. Probably, in old days, *ghata yantra* made up of the earth might be used as a disposible apparatus. (R.R.S. 9:51)

(9) Vidyadhar Yantra

यन्त्रं विद्याधरं ज्ञेयं स्थालीद्वितयसम्पुटात् ।
चुल्लीं चतुर्मुखी कृत्वा यन्त्रभाण्डं निवेशयेत् ।।
तत्रौषधं विनिक्षिप्य निरुन्ध्याद्भाण्डकाननम् ।
यन्त्रं विद्याधरं नाम तन्त्रज्ञैः परिकीर्तितम् ।। (र.र.स. 9:37-38)

Two earthen vessels are joined on each other and sealed with rag and mud. The lower vessel contains the drug material or substance like *hingula* (cinnabar) and the upper vessel is filled with water. It is then kept on the fire, which

has four inlets for fodder. Between both the vessels, first the sealing with rag and mud is done and after drying it is subjected for heating. The fire in this apparatus is unique, on four sides at the base, with the intention of uniform heating. It is called as *Vidyadhar yantra* and also as *Koshti yantra.* (R.R.S. 9:37-38)



Amongst the two earthen vessels, the neck of the lower one should be broad and the base of the upper vessel should be broad. So that, after heating the vapours of the drug material will come in the contact with the base of upper vessel. Whenever intense heating is desired, this apparatus is used. It is used in procuring Mercury from cinnabar.

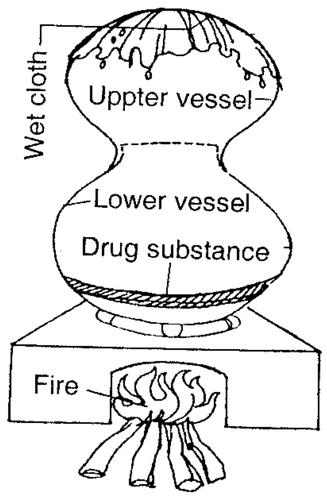
(10) Patana Yantra (Distillation Apparatus)

There are three types of Distillation processes viz. *urdhwapatana, adhahpatana* and *tiryakpatana.* The functions and hence the construction of apparatus is different. Let us see the structure and function of each type of apparatus.

- **Urdhwapatana Yantra**

अष्टाङ्गुलपरीणाहमानाहेन दशाङ्गुलम् ।
चतुरङ्गुलकोत्सेधं तोयाधारं गलादधः ।
अधोभाण्डे मुखं तस्य भाण्डस्योपरि वर्त्तिनः ।
षोडशाङ्गुलविस्तीर्णपृष्ठस्यास्ये प्रवेशयेत् ।।
पार्श्वयोर्महिषीक्षीरचूर्णमण्डूरफाणितैः ।
लिप्त्वा विशोषयेत्सन्धिं जलाधारे जलं क्षिपेत् ।।
चुल्ल्यामारोपयेद्यत्नात्पातनायन्त्रमुच्यते ।। (र.र.स. 9:6-8)

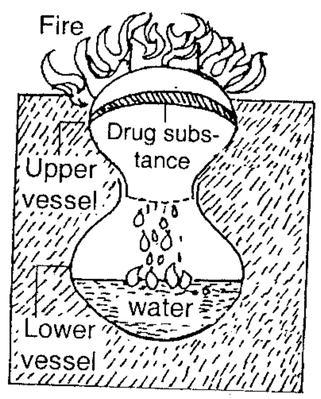
Two earthen vessels are snugly joint with their mouths into



each other and the joint is sealed with rag and mud. The upper vessel should have the bottom area of about 12", as on inside of it, the sublimated drug material's vapour is going to solidify and stick there. On the outer surface of the bottom of upper vessel one slot is designed, which measures 6" in breadth, 7.5" in length and 3" in thickness. It is known as *toyadhar*, on which the wet cloth is kept, during the procedure. Before sealing, the lower vessel is filled with the drug material, to be processed, at the bottom. The joint of earthen vessels is plastered with the combination of ash, *mandura,* lime and buffalo's milk. After drying it, the *toyadhar* is filled with the water. This arrangement of flowing cold water enables the vapour to get condensed and solidify. (R.R.S. 9:6-8)

After proper sealing of both the vessels, when the plaster is dried then the apparatus is subjected to slow heating. The fire flames should not reach upto the upper vessel. The bottom of the lower vessel should get uniform heating. Few texts of Ayurveda have mentioned this apparatus as *Vidyadhar yantra.*

- **Adhahpatana Yantra**



अथोर्ध्वभाजने लिप्तस्थापितस्य जले सुधीः ।
दीप्तैर्वनोपलैः कुर्यादधःपातं प्रयत्नतः ।। (र.र.स. 9:9)

In this apparatus the drug substance, which is to be distilled, is coated on the inner surface of the bottom of the upper vessel. After heating, the vapours of drug substance get into the

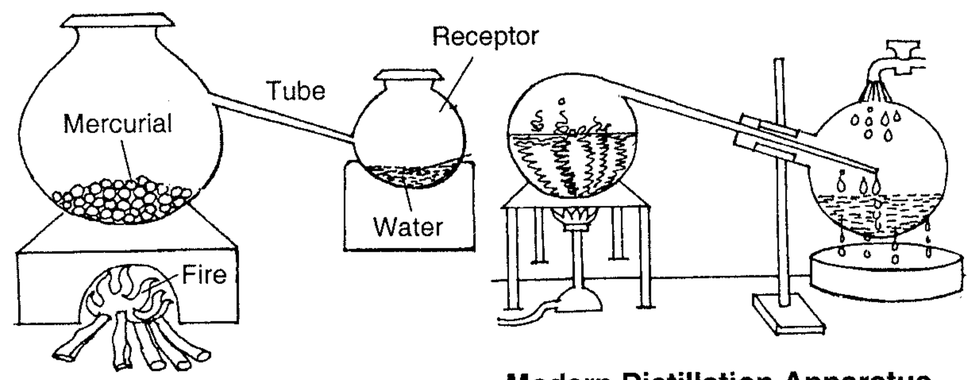
water at the bottom of the lower vessel. This apparatus is used for distillation of the Mercury.

- **Tiryakpatana Yantra (Distilling Apparatus)**

क्षिपेद्रसं घटे दीर्घे नताधोनालसंयुते ।
तन्नालं निक्षिपेदन्यघटकुक्ष्यन्तरे खलु ।।
तत्र रुद्ध्वा मृदा सम्यग्वदने घटयोरधः ।
अधस्ताद्रसकुम्भस्य ज्वालयेत्तीव्रपावकम् ।।
इतरस्मिन् घटे तोयं प्रक्षिपेत्स्वादुशीतलम् ।
तिर्यक्पातनमेतद्धि वार्तिकैरभिधीयते ।। (र.र.स. 9:10-12)

One big-sized earthen vessel is connected with a tube fitted at its neck, with another small-sized vessel just above its bottom. The big-sized or larger vessel contains Mercury at the bottom and the smaller vessel contains water at the bottom. The mouths of both the vessels are sealed with the lids, which are plastered with rag and mud. The larger vessel containing Mercury is then subjected to heating. This apparatus is used for distillation of Mercury.

(Rasaratnasamuchchaya 9:10-12)

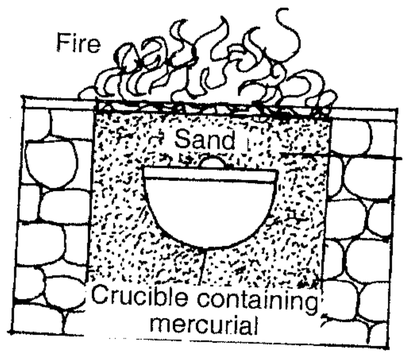


Modern Distillation Apparatus

This apparatus can also be used to yield the extracts of aromatic herbs. New modified versions of distillating apparatus like fractional distillators for separation are also available in the market.

(11) Bhudhara Yantra

बालुकागूढसर्वाङ्गां गर्ते मूषां रसान्विताम् ।
दीप्तोत्पलैः संवृणुयाद् यन्त्रं तद् भूधराह्वयम् ।। (र.र.स. 9:44)

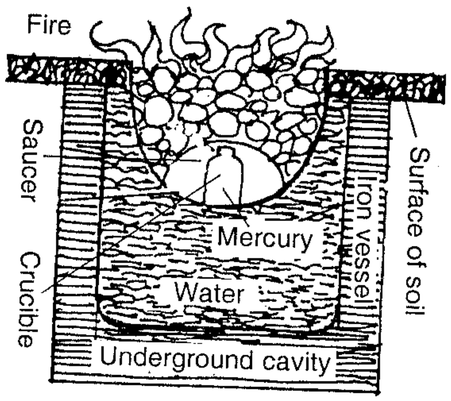


A crucible is filled with mercurial products upto three-fourth of its capacity and closed on the top with a lid and sealed. This crucible is put beneath the soil in a ditch and sand is filled on all sides of the crucible. On the top of the sand surface fire is placed. This apparatus is known as *Bhudhara yantra.* (Rasaratnasamuchchaya 9:44)

The amount of fire required, the dimensions of the ditch and the sand required depend upon the size of the crucible and mercurial products taken for processing. There is no mention of which type of processing is done on the mercurial products, with this apparatus.

(12) Kachchhapa Yantra

जलपूर्णपात्रमध्ये दत्त्वा घटखर्परं सुविस्तीर्णम् ।
तदुपरि बिडमध्यगतः स्थाप्यः सूतः कृतः कोष्ठ्याम् ।।
लघुलोहकटोरिकया कृतपटमृत्सन्धिलेपयाऽऽच्छाद्य ।
पूर्वोक्तघटखर्परमध्येऽङ्गारैः खदिरकोलभवैः ।
स्वेदनतो मर्दनतः कच्छपयन्त्रस्थितो रसो जरति ।
अग्निबलेनैव ततो गर्भे द्रवन्ति सर्वसत्त्वानि ।। (र.र.स. 9:13-15)



An iron vessel is first placed in the underground cavity and is filled with water. Another earthen vessel is placed into this water. Inside the earthen vessel, a small crucible containing Mercury with *bida* is

kept for *jarana*. The crucible is covered with an iron vessel and sealed with rag and mud. On drying the sealing, it is heated from above. *Khadira* wood is recommended as a fuel to procure fire. The water in an iron vessel controls the temperature of the crucible.

(Rasaratnasamuchchaya 9:13:15)

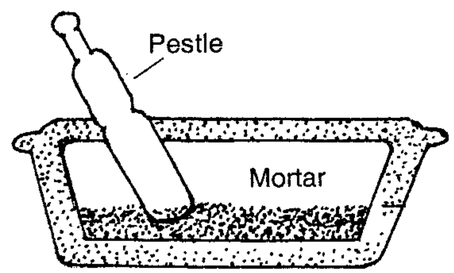
(13) Khalva Yantra (Pestle and Mortar)

खल्लयोग्या शिला नीला श्यामा स्निग्धा दृढा गुरुः ।
षोडशाङ्गुलकोत्सेधा नवाङ्गुलकविस्तरा ।।
चतुर्विंशाङ्गुला दीर्घा र्घषणी द्वादशाङ्गुला ।
विंशत्यङ्गुलदीर्घो वा स्यादुत्सेधे दशाङ्गुला ।।
खल्लप्रमाणं तज्ज्ञेयं श्रेष्ठं स्याद् रसकर्मणि ।।

(र.र.स.9:78-80)

The mortars are commonly prepared from the stone. The stone should be black or bluish in colour, heavy, hard and lustrous. The dimensions of mortar mentioned should be 18" x 6.5" x 12" in length, breadth and height respectively (i.e. 24 x 9 x 16 *angulas*). The pestle should be 9" (12 *angulas*) in length. The length of the mortar 15" (20 *angulas*) and height 7.5" (10 *angulas*) is also mentioned to be optimum. (Rasaratnasamuchchaya 9:78-80)

Pestle and mortar is commonly used for rubbing and pounding the substance to prepare a powder. Hence the size of pestle and mortar, infact, will depend upon the amount of substance to be rubbed or ground. During the procedure, the only requirement is that the pestle should be freely moved and the drug material should not get spilt out.



The stone selected for preparing pestle and mortar should be black and mortar should be

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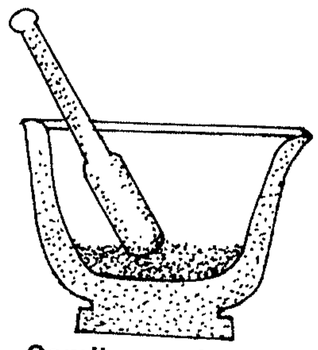
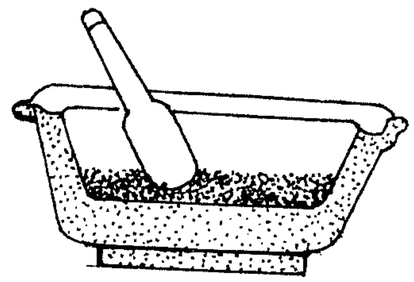
black or bluish, as it is the hardest variety of stone, which facilitates the rubbing easily. Also, the stone being inert does not affect the drug substances.

There is a mention of two varieties of mortars viz. semilunar shaped and circular. The dimensions of semilunar shaped mortar mentioned are 12" x 7.5" x 5" in length, breadth and height, respectively. The base of the bottom should be 1.5" in thickness. The dimensions of circular mortar are 9" in diameter and 3" in the height. The pestle should be 9" in length and the circumference of its rubbing end should be also 9". It should be round in shape.

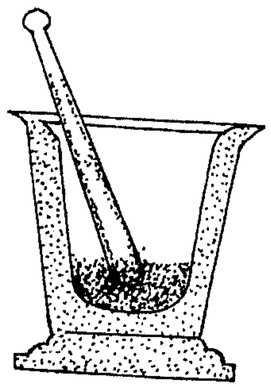


Semilunar shaped

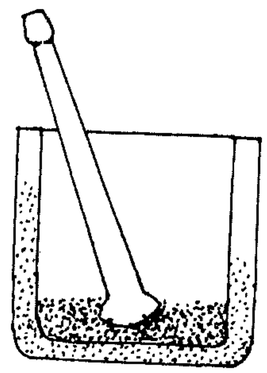


Circular shaped

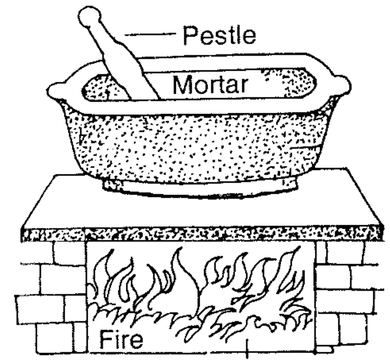
There are two varieties in the shapes of mortars e.g. with circular base and flat surfaced base. These are made up of an iron. They are moreover used for grinding than rubbing. Now a days, the pestle and mortars are operated electrically.



Circular-based Iron Mortar



Flat-based Iron Mortar



Tapta Khalwa

During rubbing and grinding processes, sometimes heating is also required. For that purpose, mortars prepared of iron are kept on the fire and rubbing process is carried out. This type of apparatus is known as *Tapta khalva*. Sometimes the mortar is placed in the boiling water, instead of fire.

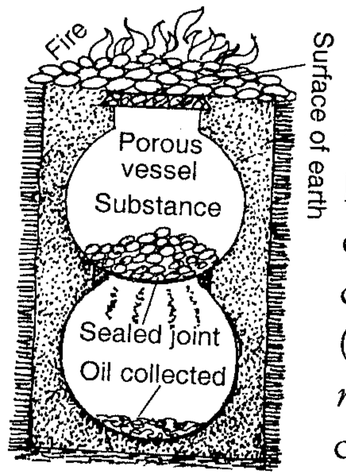
Tapta khalva is commonly produced from *kanta loha*.

(14) Patal Yantra (Underground Apparatus)

निम्नं हस्तप्रमाणं च गर्तं कृत्वा प्रयत्नतः ।
तस्मिन् भाण्डं च संस्थाप्य तथाऽन्यत् पात्रमाहरेत् ।।
तस्मिन्नौषधिवर्गं च दत्त्वाऽन्यं च शरावकम् ।
मुखे संस्थाप्य छिद्राणि कृत्वा चैव शरावके ।।
शरावसहितं पात्रं गर्तस्थे भाजने न्यसेत् ।
सन्धिलेपं ततः कृत्वा गर्तमापूर्य मृत्स्नया ।।
पश्चादग्निं च प्रज्वाल्य स्वाङ्गशीतं समुद्धरेत् ।
पश्चात् तत्पात्रमध्यस्थं पात्रं युक्त्या समाहरेत् ।।
तदन्तस्थं च तत् तैलं गृह्णीयाद्विधिपूर्वकम् ।
पातालाख्यमिदं यन्त्रं शम्भुना भाषितं स्वयम् ।।
(रसचण्डाशु, पूर्वखण्ड 610-614; रसप्रकाशसुधाकर, अध्याय 10)

In the underground cavity measuring about one cubic foot a vesel is kept. Substance to be processed is kept in another vessel. It is covered with a fitting lid which has a hole in the centre. It is put upside down on the first vessel and the joint of their mouth is sealed tightly. The cavity is filled up with earth. The apparatus is heated from above. The apparatus is known as *Patal yantra*.

(Rasachandanshu, Purva khanda 610-614
and Rasaprakash Sudhakar, A-10)

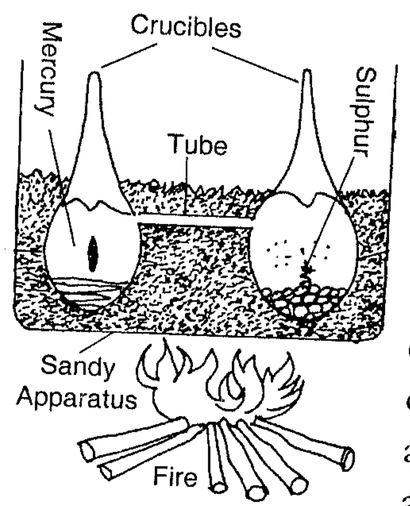


Due to heat, the oily substance in the porous earthen vessel gets melted and the oily part gets trickled down in the lower vessel. This apparatus is used to extract the oil from the herbs which contain oils. The oils like *Bhallataka* (Semecarpus anacardium) *taila*, *Karanja* (Pongamia glabra) *taila* are procured with this apparatus.

(15) Tula Yantra

वृन्ताकाकारमूषे द्वे तयोः कण्ठादधः खलु ।
प्रादेशमात्रनलिका मृदालिप्तसुसन्धिका ।।
तत्रैकस्यां क्षिपेत्सूतमन्यस्यां गन्धचूर्णकम् ।
निरुद्ध्य मूषयोर्वक्त्रं बालुकायन्त्रके क्षिपेत् ।
अधोऽग्निं ज्वालयेदेतत् तुलायन्त्रमुदाहृतम् ।।
शिलातालकगन्धाश्म जारणाय प्रकीर्तितम् ।।

(रसेन्द्रचूडामणि 5:57-59)



Two brinjal-shaped crucibles (*vrintaka musha*) are joined with a long, narrow tube at their neck. The joint is properly sealed with rag and mud. One crucible is filled with mercury, whereas the other with sulphur. Both the crucibles are closed at mouth. Then all this is kept in sandy apparatus, apparatus looks like a balance, hence known as *Tula yantra*.

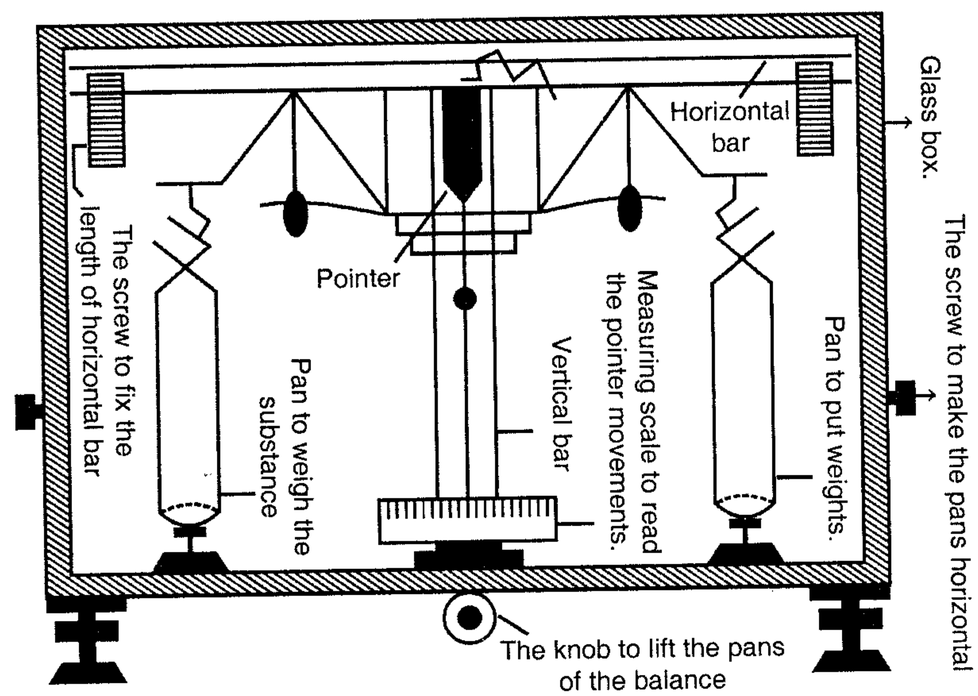
(Rasendrachudamani 5:57-59)

This apparatus is used for the *Jarana* of Mercury with sulphur and also with realgar (*manahshila*), orpiment (*haratala*) amalgamation with mercury.

After receiving heat, the fumes of sulphur enter through the tube into the crucible which contains Mercury and the amalgamation takes place. Because of sandy apparatus is surrounding the tube, the vapours or fumes of sulphur do not get solidified. Hence, the whole apparatus is aptly designed to be surrounded by sandy apparatus. Though there is no mention whether the crucibles are to be kept above the sand or completely placed inside the sand, it is rational to place both the crucibles surrounded by the sandy apparatus.

(16) Scientific Balance

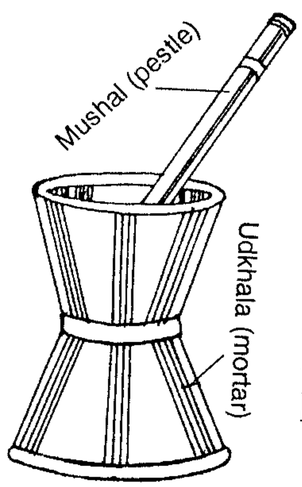
Tula yantra or *Shastriya taraju* is modified into a very finer apparatus during last century. With the help of this one can measure or weigh the substance even upto one miligram. It is known as Scientific (or Chemical) Balance. It is essential to know about this apparatus, as we often need accuracy about the proportions of the drug substances in manufacturing the medicines of Ayurveda.



This apparatus is often used to weigh the solid substances. In the centre the vertical bar with a metal rod is fixed. On both sides the weighing pans of equal size and weight are suspended. In the centre of the metal rod a pointer is attached which moves on the scale. The length of horizontal bar can be monitored with a screw. Both pans rest on the platform and are lifted during the process of weighing. The pointer moves on the lighter side. It stays in the centre when both sides weigh equal. This apparatus is encased in the glass box to eliminate the effect of wind on the pans. One can weigh the substance even upto one miligram.

(17) Udukhala Yantra (Wooden Mortar)

It is made up of thick and tough wood. It is oblong in shape with pointed area at the base of inner surface. But the base at outer surface is broadened for the stability. The wooden pestle is about five feet in length. The tip of pestle is flat and surrounded with an iron ring to avoid damage to the wood. This apparatus is commonly used to pound the dry plant parts or mineral substances. Domestic use of this apparatus is done for husking the rice etc.



Chapter 4

The Crucibles

During various processings (*samskara*) or while undergoing experiments, many a times the metals or minerals are proposed for heating. Especially, the metals when melted, require intense heating. The utensils otherwise used cannot withstand or sustain a high degree of temperature and they get broken or cracked. Hence the ancient scholars had designed special crucibles of particular shapes, which can sustain intense heating. During *sattvapatana* (separation of an active principle) of minerals or melting the metals, these crucibles not only sustain the heat but also help to eliminate the defeccts or impurities. Such crucibles are known as '*Musha*'.

मुष्णाति दोषान् मूषेयान् सा मूषेति निगद्यते । (र.र.स. 10:1)

Etymology of the word *musha* (crucible) is, one that eliminates the defects or impurities, is known as '*Musha*'.

(Rasaratnasamuchchaya 10:1)

मूषा हि क्रौञ्चिका प्रोक्ता कुमुदी करहाटिका ।
पाचनी वह्निमित्रा च रसवादिभिरीर्यते ।। (र.र.स.10:1)

There are various synonyms to *musha* like *krounchika*, *kaumudi*, *karahatika*, *pachani*, and *vanhimitra* etc.

In ancient times, iron and earth-mud were used for preparing the crucibles (*musha*). Moreover, the substances like horse dung, charcoal powder, husks of the grains and ash were also used. All these substances mixed together were kneded and different shapes were given and the crucibles were prepared after roasting them in the fire. Thus they could resist the heat, were hard and durable. In mod-

ern times, the crucibles are made up of porcelain and graphite like substances. Ancient texts have specified the specific substances, shapes and particular uses of crucibles. Let us see few of them in this chatper.

(1) Samanya Musha (Ordinary Crucible)

या मृत्तिका दग्धतुषैः शणेन शिखित्रकैर्वा हयलद्दिना च ।
लौहेन दण्डेन च कुट्टिता सा साधारणा स्यात्खलु मूषिकार्थे ।।
(र.र.स.10:7)

For preparing the curcibles, the pulp of following substances is first prepared :

1. Ash of husks of grains (*dagdha tusha*)
2. Fibres of *wakha**
3. Ash powder
4. Horse dung
5. *Lohakitta* (a type of iron-rust)
6. Black soil

All these ingredients are mixed together and the pulp is given the desired shape of crucible and then roasted in fire. The well roasted crucible is called as '*Samanya musha*' i.e. an ordinary crucible. There is no mention of the proportion of of above ingredients. It is used for *sattvapatana* of *shilajit* (black bitumen) and *vimala* (iron pyrite) wherein low heating is sufficient.

(2) Vajra Musha (Hard Crucible)

मृदस्त्रिभागाः शणलद्दिभागौ भागश्च निर्दग्धतुषोपलादेः ।
किट्टार्धभागं परिखण्ड्य वज्रमूषां विदध्यात्खलु सत्त्वपाते ।।
(र.र.स.10:9)

Wakha is prepared from the filamentous integuments of certain plants like *Ambadi, Ghayal* and *Taga*. The skins of these plants are used to prepare fine thread, which is then made into cordage.

Though the mention of proportion of the ingredients to prepare a *Samanya musha* (ordinary crucible) has not been made, to prepare *Vajra musha* (hard crucible) the proportion of specific ingredients is quoted in the texts. To prepare *Vajra musha*, following ingredients are taken:

Black soil	-	3 parts
Wakha pieces	-	2 parts
Horse dung	-	2 parts
Wood ash	-	1 parts
Lohakitta (iron-rust)	-	0.5 parts

All the ingredients are first pounded together and then the crucible is prepared by roasting it in fire. *Vajra musha* can sustain high amount of heating while processing. It is commonly used for *sattvapatana* procedures of minerals.

(3) Pakva Musha (Roasted Crucible)

कुलालभाण्डरूपा या दृढा च परिपाचिता ।
पक्वमूषेति सा प्रोक्ता पोटल्यादिविपाचने ।। (र.र.स.10:26)

The ingredients of ordinary crucible and roasted crucible are the same. The only difference is that these crucibles are more roasted in the fire and are large in shape like a pot. *Pakva musha* is used to prepare the *pottali rasayanas.* During the preparation of *pottali rasayanas,* the drug substance is cooked in liquid sulphur at boiling temperature for prolonged period and the temperature reaches upto 444.5^{0}C. The crucible has to withstand it for 3 to 12 hours. Thus the crucible should be hard and should sustain high temperature. *Pakva musha* fulfils these requirements.

(4) Gostani Musha (Udder-shaped Crucible)

मूषा या गोस्तनाकारा शिखायुक्तपिधानका ।
सत्त्वानां द्रावणे शुद्धौ मूषा सा गोस्तनी भवेत् ।। (र.र.स.10:24)

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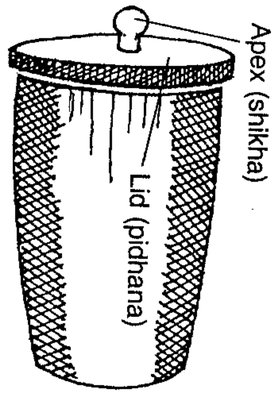

The crucible which is oblong, resembling the shape of an udder of a cow, having a lid (*pidhana*) on the top, with an apex (*shikha*) is known as '*Gostani musha*'. It is commonly used when a closed heating is required.

Moreover, there is a mention of other types of crucibles in the ancient texts like *vrintaka musha, gara musha, bid musha, andha musha* etc. which are used for specific procedures.

(5) Adhunika Musha (Modern Crucible)

The crucibles used now a days, are prepared of silica or China clay (Kaolin). The China clay (*chini mati* - in Marathi language) is a combination of the clays of *shadoo* (modelling clay) and *chikkana* clay. It contains aluminium silicate, sodium silicate, potassium silicate and calcium silicate. This clay after exposure to atmosphere undergoes natural process of oxidation and China clay (kaolin) is formed. The complex formation of all these is the Kaolin. Then it is subjected to heating, after giving the specific shapes and finally are treated with borax powder, which gives a fine coating on the surface. China clay is also called kaolin as it is found near the mount Kaolin in China. The high quality Chinaware is called porcelain. The crucibles made from silica contain a pure silicate - SiO_2 (silicon dioxide), which is made into silica glass and the vessels or crucibles are prepared from it. Heating causes very little expansion of articles made from this glass. Also, it is not affected chemically by either acids or alkalis. Hence items of laboratory apparatus are made of silica glass. It is however, very costly.

Sandhi Bandhana (Joint Sealings)

During various procedures the vessels, crucibles and appliances often undergo the heating process. Many a times a closed heating is desired to avoid getting the substance spilt out from the container or to avoid any chemical change due to exposure to atmosphere. In these circumstances, there is an acute need to cover the apparatus with a lid or join the two vessels with airtight joint. These joints are sealed before undergoing the closed heating, which are known as '*Sandhi-bandhana*' i.e. joint sealings. Commonly, the joints are sealed by two procedures.

(1) Mritkarpata (Rags and Mud)

A thin cloth and ordinary clay or *gopichandana* clay is used for preparing the sealing material. First of all, the clay and water are mixed together and semisolid mixture is obtained. It is then spread on the thin cloth and with this cloth the joint of the vessels or lids are wrapped for three times. During wrapping, the clay is properly pasted and the joint cover is done smooth on its surface. The end portion of the cloth is pressed with the fingers and again a thin layer of clay is given on the surface. The apparatus is then properly dried in the sunlight and then processed with heat. When the clay is smooth, sticky and uniform the sealing done beomes even and of good quality. It requires one to three days, depending upon the season, for sealing to get completely dried. In few cases, the sealing is wrapped into seven layers. e.g. the glass bottle kept in *Valuka yantra*. सरसां गूढवक्त्रां मृद्वस्त्राङ्गुलघनावृताम् । (र.र.स. 9:36). It is advised in such cases, to first give the three layers wrapping, dry it completely and then further layers are given. It is quite a time consuming procedure.

Ancient scholars had recommended another procedure to curtail the time. In that, the ingredients used for sealing are soil, ash, *lohakitta* - a type of an iron rust, jaggery and lime. The paste prepared is applied to the joint and sealing is performed.

This type of sealing is harder and also dries off quickly. But when the sealing is to be removed after completion of the procedures, the sealing of rags and mud is easy to remove. The sealing done by other method is difficult to remove and often the appliances are broken.

Plaster of Paris

In recent days, the Plaster of Paris is used in laboratories for sealing gaps where air tight arrangement is required.

Plaster of Paris is a white powder that, when mixed with water to form a paste, turns hard in a few minutes. This substance is prepared by heating gypsum, a stone composed of calcium sulphate and water. When the water is partly driven off, the gypsum softens and is easily crushed to form a powder. When water is added again, the mass hardens to a stonelike substance similar to the original gypsum. This property is known as efflorescence. It is represented as:

$$\underset{\text{Gypsum}}{2\,(CaSO_4)\,2H_2O} \rightarrow \underset{\text{Calcium Sulphate}}{(CaSO_4)_2,\,H_2O} + \underset{\text{Water}}{3H_2O}$$

The chemical name of Plaster of Paris is Calcium sulphate anhydride $(CaSO_4)_2$, H_2O. It is also used in case of bone fractures to maintain the bone in a fixed position and in preparing casts for statues.

(2) Mudra (A Seal)

In later chapters we are going to study the procedures of

preparing *Kupipakva rasayanas*, i.e. medicines prepared by heating in bottles, from Mercury. In preparing these medicines, the drug substance is kept in the bottle and is heated in *Valuka yantra* (sand apparatus). After heating the fumes come out and get ceased. At this moment, before giving further heat the bottles are closed and this procedure of closing the bottles is known as '*mudra*' or to seal. For that purpose a sticky substance which gets hardened with further heating, is required. Different varieties of *mudra* are described, made up of different ingredients.

(A) Madana Mudra

For this type of *mudra* (sealing), the ingredients used are the latex of plants like *udumbara* (Ficus racemosa) and *vata* (Ficus bengalensis), *laksha* (lac) which is secretion of an insect called *Coccus lacca*, *kanta loha* (magnetic iron) and *gorochana* i.e. a bright yellow pigment prepared from the urine or bile of a cow. All these ingredients are taken in equal quantity and mixed with *atasi taila*,. i.e. linseed oil and rubbed together. The pulp formed is sticky and slightly hard, which is used for sealing.

औदुम्बराख्यवटदुग्धपलं पलञ्च लाक्षापलमृषिपलं त्वथ चुम्बकस्य ।
सङ्कुट्यमानमतसीफलतैलमिश्रं सूतस्य जारणविधौ मदनाख्यमुद्रा ।।
(आनन्दकन्द, रसराजसुन्दर)

(B) Hatha Mudra

Ingredients like the glass powder, brick powder, *tankana* (borax) and *mandura* (red iron oxide) are finely powdered and rubbed together and then rubbed with latex of *vata* (Ficus bengalensis), *udumbara* (Ficus racemosa) and *arka* (Calotropis procera) for one day and finally used for sealing. There are other versions which include different ingredients, but the name is same e.g.

चुम्बकं लौहचूर्णं च क्रोडरक्तेन संयुतम् ।
तत्र सर्वं प्रदातव्यं घनघातेन ताडयेत् ।।
सन्ध्यारम्भोदयो यावत् सूर्यबिम्बं न दृश्यते ।
हठमुद्रेति विख्यातं सर्वसिद्धैर्नमस्कृता ।। (आनन्दकन्द)

Now-a-days, a cork is plugged into the mouth of the bottle which is wrapped with a cloth dipped in Plaster of Paris.

Chapter 5

Fireplace and Ancient Pyrometry

In previous chapters we have learnt about various appliances used to prepare medicines and varieties of crucibles used for the process of *sattvapatana* i.e. separation of an active principle. During various procedures in preparing medicines, fire is required for heating. We are going to get the information about the various types of *Koshthis* (fireplaces) along with the science of standardized and controlled heating i.e. pyrometry (*puta-vijnaniya*), which was used to prepare medicines during ancient time. It is interesting to see that, in those days, the scholars of Ayurveda had devised manoeuvres for uniform heating with the help of specifically built fireplaces, selected fuel obtained from the wood of particular plants or cow-dung cakes etc.

• **Koshthi (Fireplace)**

सत्त्वानां पातनार्थाय पातितानां विशुद्धये ।
कोष्ठिका विविधाकाराः..... ।। (र.र.स. 10:32)

For the purpose of separation of an active principle (*sattva-patana*) and its purification, the fireplaces of different shapes and sizes are used. Let us see few commonly used types of fireplaces. (Rasaratnasamuchchaya 10:32)

(1) Angarakoshthi

राजहस्तसमुत्सेधा तदर्धायामविस्तरा ।
चतुरस्रा च कुड्येन वेष्टिता मृण्मयेन च ।।
एकभित्तौ चरेद्द्वारं वितस्त्याभोगसंयुतम् ।
द्वारं सार्धवितस्त्या च सम्मितं सुदृढं शुभम् ।।
देहल्यधो विधातव्यं धमनाय यथोचितम् ।
प्रादेशप्रमिता भित्तिरुत्तरङ्गस्य चोर्ध्वतः ।।

द्वारं चोपरि कर्त्तव्यं प्रादेशप्रमितं खलु ।
ततश्चेष्टिकया रुद्ध्वा द्वारसन्धिं विलिप्य च ।।
शिखित्रैस्तां समापूर्य्य धमेद्भस्त्राद्वयेन च ।
शिखित्रान् धमनद्रव्यमूर्ध्वद्वारेण निक्षिपेत् ।।
सत्त्वपातनगोलाँश्च पञ्च पञ्च पुनः पुनः ।
भवेदङ्गारकोष्ठीयं खराणां सत्त्वपातिनी ।। (र.र.स.10:33-38)

This type of fireplace is built up with bricks and measures 2' x 1' x 1' in height, length and breadth, respectively. A thin layer of soft clay is pasted on its inner as well as outer surface. On the surface of its one wall, near bottom a hole of about 3" in diameter is created and it is connected to a tube attached to a bellow. The charcoal is filled at the base of fireplace, from the top. Then the crucible containing the drug substance, properly sealed is kept on the surface of charcoal and more charcoals are placed on its top. Finally the charcoals are ignited and the air current is continuously monitered with the bellow, so as the livecoals or embers create the intense amount of heat. Thus, the drug substance is subjected to *sattvapatana*. The charcoal used as a fuel is obtained from the tough and hard wood of plants like *khadira* (Acacia catechu) or *babbula* (Acacia arabica) or coal. *Angarakoshthi* is commonly used for separation of an active principle (*sattvapatana*) from the hard substances or to smelt the metals.

(2) Patalakoshthi

दृढभूमौ चरेद्गर्तं वितस्त्या सम्मितं शुभम् ।
वर्तुलं चाथ तन्मध्ये गर्तमन्यं प्रकल्पयेत् ।।
चतुरङ्गुलविस्तारनिम्नत्वेन समन्वितम् ।
गर्ताद्धरणिपर्यन्तं तिर्यङ्नालसमन्वितम् ।।
किञ्चित्समुन्नतं बाह्यं गर्ताभिमुखनिम्नगम् ।
मृच्चक्रीं पञ्चरन्ध्राढ्यां गर्भगर्तोदरे क्षिपेत् ।।
आपूर्य कोकिलैः कोष्ठीं प्रधमेदेकभस्त्रया ।

पातालकोष्ठिका ह्येषा मृदूनां सत्त्वपातिनी ।
ध्मानसाध्यपदार्थानां नन्दिना परिकीर्त्तिता ।। (र.र.स.10:39-42)

An underground cylindrical cavity measuring 10" in height and diameter is prepared. At the bottom of this cavity, another small cylindrical cavity measuring 3" in diameter and height is prepared. At the bottom of this small cavity, a tube is fixed, of which the other end is joined to bellow on the surface of the soil. On the surface of small cavity, a lattice or sieve is fixed. The bigger cavity is filled with charcoal and the drug substance covered in crucible, is kept on the surface. The charcoal fuel is ignited and air is blown with the help of bellow, so that the livecoals produce good amount of heat. The ash formed, settles down through the lattice or sieve; and does not block the tube. In the procedure of *sattvapatana*, where small amount of heat is sufficient, is performed with the help of *Patalakoshthi*. For example, *sattvapatana* of *Rasaka* (lead-zinc ore) and *Shilajatu* (black bitumen) is prepared with the help of this fireplace.

(3) Garakoshthi

द्वादशाङ्गुलनिम्ना या प्रादेशप्रमिता तथा ।
चतुरङ्गुलतश्चोर्ध्वं वलयेन समन्विता ।।
भूरिच्छिद्रवतीं चक्रीं वलयोपरि निक्षिपेत् ।
शिखित्रांस्तत्र निक्षिप्य प्रधमेद्वङ्कनालतः ।।
गारकोष्ठीयमाख्याता सृष्टलोहविनाशिनी ।। (र.र.स.10:43-44)

'*Gar*' means the clay of a pond. As this fireplace is made up of the clay from the pond, hence the name '*Garakoshthi*'. It measures 7.5" x 7.5" x 9" in the length, breadth and height, respectively. From its base, at about 3" height, a lattice or sieve is fit and the livecoals or embers are placed on it. The drug substance is kept on these livecoals, in properly sealed crucible. A tube below the surface of the

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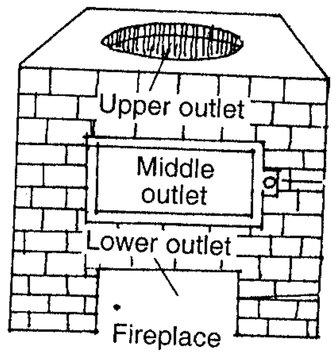
sieve serves to ventilate the fire, which is connected to a bellow. *Garakoshthi* is commonly used to get rid of impurities in the metals like gold and silver etc.

(4) Chulhika

Chulhika means a fireplace. Commonly it is used to heat the substance or any drug with the help of fire. The size of fireplace depends upon the quantity of substance to be heated. It is built up of bricks or the soft clay, if it is of a small size. Now a days it is made up of cement.



At the bottom,in the lower outlet, the wood-sticks used as fuel are burnt and the fire is produced. On the upper outlet, the drug substance which is to be heated is kept in a container. At the level of middle outlet, a sieve is fixed horizontally, on which then livecoals can be placed for heating the drug substance.

• Puta (Unit of Heat)

रसादिद्रव्यपाकानां प्रमाणज्ञापनं पुटम् ।
नेष्टो न्यूनाधिकः पाकः सुपक्वं हितमौषधम् ।। (र.र.स. 10:47)

When the *rasas*, *maharasas*, and *uparasas* undergo any heating procedure, the proper stage of end-product obtained is known as *paka*. This *paka* obtained should be optimum. It should not be more or less, and the formation of such *paka* is the most senstitive index of optimum heating or cooking. Thus, the unit of heat required to obtain the optimum *paka* (known as *supaka*) is called as *puta*.

(Rasaratnasamuchchaya 10:47)

Before the concept of *puta*, we have seen commonly used heating appliances used in preparing Ayurvedic medicines and their principles. Ayurveda pharmacy, now a days, has

become a large scale industry. Today, there are various heating appliances of modified types like oil furnaces, gas heating appliances etc. available in the market. With the advancements in metallurgy and metallurgical science, the wide variety of furnaces are used, which utilise heating by coal, oil or gas, electric resistance and even by currents induced in the metal and include baths of molten salts in which the work has immersed. For example, blast furnace is used in production of zinc, an electric forced air-circulation furnace for heating aluminium alloys, Billet preheating furnace for copper alloys for extrusion and blast or arc-furnaces for iron-smelting etc. All these appliances are highly sophisticated and can be used in Ayurvedic pharmaceutical industries.

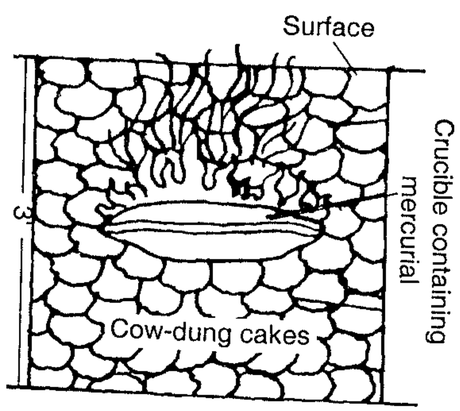
As we know now, that *puta* is the unit of heat required to obtain the optimum *paka*. Before going to see the different varieties of *puta*, it should be noted that these types of *puta* indicate the qualitative as well as quantitative measures of heating, mentioned in ancient time. The foundations of present-day pyrometry were laid towards the end of last century. Prior to this, there was little metallurgical science, and in process work dependence was placed on the operator's experience and judgement. There is no clearly defined distinction between "thermometry" and "pyrometry", although the latter in general implies high temperature measurements. The important instruments used to measure temperature in metallurgy for laboratory or industrial purpose are of three types, namely, electrical resistance - 240 - 600°C, thermo-electric - 200-1200°C and radiation pyrometers above 700°C. All these are arranged to make continuous recordings automatically, and also to control furnace temperatures to within certain limits. In future these appliances can be adopted in Ayurvedic industry after un-

derstanding the principles and optimum requirements of standardized heating, demanded for specific processing.

Ancient scholars of Ayurveda, in those days, had designed different types of varieties of *puta*. In each type, the specification of the fireplace, the fuel used, amount of fuel material e.g. cow-dung cakes or charcoal obtained from particular plant wood, dimensions of fireplace etc. is precisely described. It indicates that they had laid the foundation of particular amount of heat required to prepare a specific medicine or processing. Let us study the commonly used types of *putas*.

(1) Mahaputa

निम्ने विस्तरतः कुण्डे द्विहस्ते चतुरस्रके ।
वनोत्पलसहस्रेण पूरिते पुटनौषधम् ।।
क्रौञ्च्यां रुद्धं प्रयत्नेन पिष्टिकोपरि निक्षिपेत् ।
वनोत्पलसहस्रार्धं क्रौञ्चिकोपरि विन्यसेत् ।।
वह्निं प्रज्वालयेत्तत्र महापुटमिदं स्मृतम् ।। (र.र.स.10:51-52)



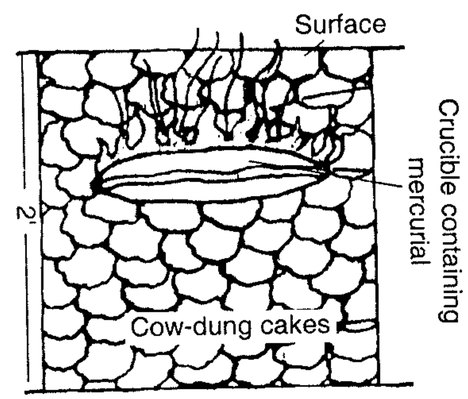
Structure: An underground cavity measuring 3'x3'x3' in length, breadth and depth is prepared. About 1000 cow-dung cakes are arranged at the base of cavity. The crucible, properly sealed, is placed and again 500 cow-dung cakes are placed over it, covering the crucible from all sides. Then the cow-dung cakes are ignited and the heat is given to the crucible, containing the drug substance, till all cow-dung cakes are burnt into ash and gets cooled on itself (*swanga shita*). At the beginning, the intensity of heat is not intense but as all the cow-dung cakes begin to burn, it reaches the temperature about

1000°C and remains steady for a long time. It should be noted, the crucible selected should withstand this high temperature and its sealing should be absolutely air tight. The heating recommended is underground, so that it renders a prolonged heating; which enables to obtain the proper '*paka*' i.e. the end product.

Usage: *Mahaputa* is used to prepare *bhasmas* like *Abhraka bhasma* (incineration of mica) and *Vaikrant bhasma* (incineration of fluorspar) etc.

(2) Gajaputa

राजहस्तप्रमाणेन चतुरस्रञ्च निम्नकम् ।
पूर्णञ्चोपलसाठीभिः कण्ठावध्यथ विन्यसेत् ।।
विन्यसेत् कुमुदीं तत्र पुटनद्रव्यपूरिताम् ।
पूर्वाच्छगणतोऽर्धानि गिरिण्डानि विनिक्षिपेत् ।।
एतद्गजपुटं प्रोक्तं महागुणविधायकम् ।। (र.र.स.10:53-54)

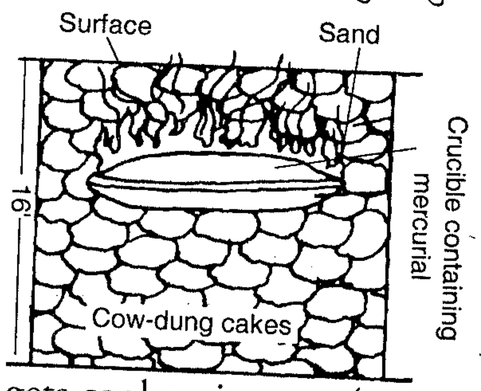


Structure: The structure of *Gajaputa* is similar to that of *Mahaputa*. The only difference is in its dimensions and the number of cow-dung cakes used. *Gajaputa* is an underground cavity measuring 2'x2'x2' in length, breadth and depth. About 250 cow-dung cakes are placed at the base on which the crucible is kept for heating. Moreover, 125 cow-dung cakes are placed on the upper surface of the crucible, covering it on all sides. The cow-dung cakes are ignited and the crucible receives heat from all sides. On cooling on its own (*swanga shita*), the crucible is taken out and the drug substance gets ready in a form of optimum *paka*. The temperature in *Gajaputa* ranges between 800°C to 1000°C.

Usage: *Gajaputa* is used to prepare *bhasma* like *Vajra bhasma* (incineration of diamond), *Abhraka bhasma* (incineration of mica) and *Shankha bhasma* (inceneration of conch) etc.

(3) Varahaputa

इत्थं चारत्निके कुण्डे पुटं वाराहमुच्यते ।। (र.र.स.10:55)

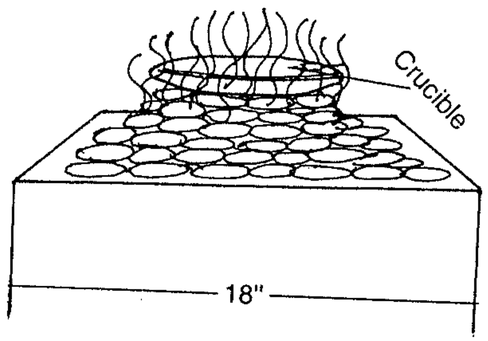


Strucrure: It is similar in structure to those described above, the underground cavity measures 16"x16"x16" in length, breadth and depth. It offers less intense heat than varieties described above. It gets cool on its own (*swanga shita*) earlier.

Usage: *Varahaputa* is used to prepare *Shouktika bhasma* (incineration of Oyster shell), *Kapardika bhasma* (incineration of Cowrie), *agniputi Praval bhasma* (incineration of Coral) etc.

(4) Kukkutaputa

पुटं भूमितले यत्तद्वितस्तिद्वितयोच्छ्रयम् ।
तावच्च तलविस्तीर्णं तत्स्यात्कुक्कुटकं पुटम् ।। (र.र.स.10:56)



Structure: The cow-dung cakes are placed on a circular area of about 18" in diameter. The crucible containing a drug substance is properly sealed and kept on the surface of cow-dung cakes and they are ignited. It requires only 50-60 cow-dung cakes and reaches the temperature between 200^0 to 250^{0}C.

Usage: *Kukkutaputa* is used to prepare the *paka* of soft drug substances and for their killing (*marana*).

(5) Kapotaputa

यत्पुटं दीयते भूमावष्टसङ्ख्यैर्वनोत्पलैः ।
बद्ध्वा सूतकभस्मार्थं कपोतपुटमुच्यते ।। (र.र.स.10:57)

Structure: The fuel used for this type is only 8 cow-dung cakes. They are placed either underground or on the surface of earth. It creates heat of relatively very low intensity. It is used for the drug substances which are very soft.

All these *putas* described above are designed according to their measurement and generating the amount of heat and are named according to the shapes resembling to those of animals and birds such as *Varahaputa, Kukkutaputa, Kapotaputa* etc.

Usage: It is mentioned in the texts as used to prepare the *bhasma* of mercury.

(6) Gobaraputa

गोष्ठान्तर्गोक्षुरक्षुण्णं शुष्कं चूर्णितगोमयम् ।
गोबरं तत्समादिष्टं वरिष्ठं रससाधने ।।
गोबरैर्वा तुषैर्वापि पुटं यत्र प्रदीयते ।
तद्गोबरपुटं प्रोक्तं सिद्धये रसभस्मन ।। (र.र.स.10:58-59)

Structure: Whenever the fuel used is of the bits and fragments of cow-dung collected from a cow-pen, the *puta* is known as *Gobaraputa*. Sometimes, the husks of the grains are also used for the fuel purpose.

The crucible containing a drug substance is kept in the middle of an iron pot and the bits and fragments of cow-dung are placed surrounding it and pressed around the crucible. The fuel ignited burns slowly and creates less intense heat.

(7) Bhandaputa or Kumbhaputa

स्थूलभाण्डे तुषापूर्णे मध्ये मूषासमन्विते ।
वह्निना विहिते पाके तद्भाण्डपुटमुच्यते ।। (र.र.स.10:60)

Structure: It is similar to that of *Gobaraputa*, the only difference is instead of an iron pot, the pitcher like pot first is filled with husks of grains or fragments of cow-dung upto half and the crucible is kept on it. The whole vessel is filled with fragments of cow-dung above the surface of crucible and the fuel is ignited. Bhavaprakash has mentioned that the pot is to be sealed and put on the fireplace. But it is not practised as the cow-dung fuel is a bad conductor of heat.

(8) Valukaputa

अधस्तादुपरिष्टाच्च क्रौञ्चिकाऽऽच्छाद्यते खलु ।
बालुकाभिः प्रतप्ताभिर्यत्र तद्वालुकापुटम् ।। (र.र.स.10:61)

Structure: An earthen pot is half filled with the sand and the crucible containing a drug substance is kept on it. Then the whole pot is filled with sand above the surface of crucible. The sand is first made hot and then filled, which serves to heat the crucible. It renders a slow heating. There is no mention about the particle size of the sand or how much it is heated.

(9) Bhudharaputa

वह्निमित्रां क्षितौ सम्यङ् निखन्याद्द्व्यङ्गुलादधः ।
उपरिष्टात्पुटं यत्र पुटं तद्भूधराह्वयम् ।। (र.र.स.10:62)

Structure: The crucible is kept in the underground cavity 1.5" beneath the surface of soil. The cavity is then filled with the soil covering the crucible and cow-dung cakes are burnt on its top, which serve the heating. There is no mention of the number of cow-dung cakes to be used. It depends on the hardness or softness of the drug substance to be processed.

(10) Lavakaputa

ऊर्ध्वं षोडशिकामात्रैस्तुषैर्वा गोबरैः पुटम् ।
यत्र तल्लावकाख्यं स्यात्सुमृदुद्रव्यसाधने ।। (र.र.स.10:63)

Structure: The heat is generated by igniting the husk of grains or fragments and bits of cow-dung, weighing approximately 40 gm. It is used to process the soft drug substance, as the heat generated is very less.

Puta, as mentioned earlier, is the unit of heat given to achieve the optimum quality end product (*supaka*) from the substance. Though there is mention of above varieties of *putas* in the ancient texts, there are more varieties of *putas* practiced by Ayurvedic scholars, which have no specific names as such. *Laghuputa*, commonly practiced type of *puta* is not mentioned in any text. *Laghu* means small, thus it is a type of *puta* which renders less heat than that of *Mahaputa* or *Gajaputa*. It is accepted that *Laghuputa* renders half the amount of heat than that of *Gajaputa* or *Mahaputa*. There is another thought that *Laghuputa* means half the heat rendered by *Kapotaputa*. Ayurvedic texts have quoted that there are few more varieties of *putas* which have no nomenclature, which are known as '*Anuktaputa*'.

अनुक्तपुटमाने तु साध्यद्रव्यबलाबलात् ।
पुटं विज्ञाय दातव्यमूहापोहविचक्षणैः ।। (र.र.स. 10:64)

The processings wherein no specific *puta* has been mentioned, one has to think the hardness or softness of the drug substance and accordingly, should decide the *puta* or amount of heat to be given, with consulting the experts. Experience plays the great role of teacher, here.

(Rasaratnasamuchchaya 10:64)

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Chapter 6

Mercury

Introduction

We already had some information in this regards while studying definition of Rasashastra and its history. One can easily imagine the importance of Mercury from the introductory chapter. In the development of Rasashastra, the importance which Mercury commands is self explanatory. The drugs manufactured as per texts of Rasashastra may contain plant and animal products, however, mercury appears to be main constituent and hence such drugs become more potent and effective. We will study mercury as per the following points:

1. Synonyms of Mercury
2. Occurence
3. Nature of various Mercurial ores and compounds
4. Naturally present unwanted properties of Mercury and their nature
5. Acceptability of Mercury.

These points will be considered in detail as per Ayurvedic and modern scientific principles as far as possible and an attempt will be made to corelate them with each other.

(1) Synonyms of Mercury

Ancient literature of Rasashastra is written and compiled in Sanskrit language. As per traditions and customs of those periods such literature is in the particular literary forms. viz. *Shloka* or *Sutra*. Such *Shloka* of a particular construction/structure contains definite number of words.

While constructing such verses, the author many a times requires different words of the same meaning and different number of letters. Suppose the author while composing a verse has to fit the word *Parada* in it, however he has only two letterspace at his disposal, then he will use word *Rasa* instead of *Parada*. This is one of the reasons why synonyms are used. Another important reason for using synonyms is secrecy. When the author wishes that the exact meaning of what has been written need not be revealed to public at large, he uses synonyms and tries to mask the original meaning. Many a times synonyms explain the properties, functions, actions, occurences etc.

Hence it is necessary to know various synonyms of the substances mentioned in texts of Rasashastra, especially so for *Parada* or Mercury. It gives exact context in which it is used in a given verse and conveys exact meaning. Many of the often used synonyms of *Parada* are explained here. As mentioned previously these synonyms are normally based on the various medicinal properties of Mercury. For convenience the synonyms can be classified as under.

• Synonyms based on Dehavada

Mercury is supposed to achieve longevity of life, and to avoid oldage and death, when used in a proper way. The philosophy proclaiming this property is called *Dehavada*. Various synonyms explaining such properties are:

(1) *Amrita*: Literal meaning - which never dies, (immortal). The implied meaning is "with the use of which one achieves longevity".

(2) *Jaitra*: Actual meaning is victorious. Implid meaning is "which has achieved victory over death and diseases".

(3) *Dehada*: Which gives (healthy) body.

(4) *Paramamrita*: Amrita (see above) of ultimate quality.

(5) *Parata*: One which helps in completing successful and long life.

(6) *Parada*: Same as above (v).

(7) *Mrityunashana*: Which destroys death.

(8) *Rasayana*: By definition it means one which destroys old age, death and pain.

• Synonyms based on Dhatuvada

It has been already mentioned previously that Mercury has typical and unique properties such as (i) Liquid metal; and (ii) Property of mixing with other metals. It is supposed to be instrumental in converting nonprecious metals in to precious ones. Philosophy explaining these properties is called *Dhatuvada*. Use of these properties is made in devising synonyms like:

(1) *Divya rasa*: Liquid of Devine nature.

(2) *Maharasa*: The great liquid.

(3) *Rasa*: The liquid.

(4) *Rasendra, Rasesha, Rasottama*: Best liquid.

(5) *Rasanath, Rasaraja*: Master of the liquids.

(6) *Mishraka*: One which mixes with and assimilates others. It is also a notion that it has properties of all metals, in mixed form and hence *mishraka*.

(7) *Suta, Sutaka, Sutarat*: In Sanskrit the verbal form *'Su'* means to produce, to form.

देहलोहमयीं सिद्धिं सूते सूतस्ततः स्मृतः । (रसरत्नसमुच्चय)

It means it is instrumental in forming both *Dehasiddhi* and *Lohasiddhi* and hence called as *Suta*.

• Synonyms based on Indian Philosophy

Few properties of Mercury and specially its power to cure diseases are so great that it is almost impossible to establish relations between its known properties and actual action manifested in the patients. In such cases one turns Philosophical and seek explanations. Keeping this in mind one has to think of synonyms. These are:

(1) *Jiva, Jaiva*: Concerning life.

(2) *Divya*: Means Divine.

(3) *Achintya*: Beyond thinking.

• Synonyms based on Special Properties

When drugs made from Mercury first came into use, it created drastic change in mode of treatment and almost every good property of drug was atributed to it. Some exageration in these attributions was rule rather than exception. Here are few examples:

(1) *Ananta*: Actual meaning - one without end. Implied meaning - one who has unending good virtues.

(2) *Amara*: Actual meaning is one who never dies, the word is usually used to mean God. Here the implied meaning is "which has devine, God-like properties".

(3) *Yashade*: Which gives success, or here it implies which is instrumental in successful treatment of diseases.

(4) *Soubhagya*: Actual meaning is goodluck. Implied meaning - with which good luck can be achieved in treatment.

• Synonyms Describing External Features of Mercury

(1) *Galadrupyanibham*: It means like liquified silver. The English synonym Quick Silver implies the same meaning.

(2) *Mahavahni*: Literary meaning a big fire. Implied meaning - as bright as big fire.

(3) *Suvarna*: '*Su*' - means good one; '*varna*' - means colour. Actual meaning Gold. Implied meaning - one which is having required colour.

(4) *Mahatejas*: It means having great brightness.

• Synonyms Describing Various Motions

While performing various experiments on Mercury it was observed that loss of Mercury is the rule and it was rightly concluded that the loss was mostly due to four types of motions. These were called as '*Gati*'. These are to be studied in detail in forthcoming chapters. Presently these '*Gati*' and Quickness of Mercury are basis of various synonyms.

(1) *Chapala, Chala*: One which is quick in nature.

(2) *Khechara*: '*Kha*' means sky. '*Khe*' means in the sky and '*chara*' means movements. The literal meaning of the word - one which moves in the sky.

• Synonyms of Mercury based on Mythological Origin

It is already explained previously that Mercury is supposed to be originated from Lord Shankara mythologically. Therefore all the names with which Lord Shankara is known, automatically become synonyms of Mercury. Such names are literally innumerable and hence need not be elaborated here.

(2) Occurrence of Mercury

Almost all the classical texts of Rasashastra mention that Mercury occurs in the 'Himalayas'. Its exact location, mode of extraction and transport etc. are hardly mentioned. To add more confusion to the knowledge, various mythological stories regarding how Mercury was formed

in the beginning were believed into. Many scholars try to interprete various acts of the story as literary forms (simily, exagarations etc.) for actual facts. e.g. The prolonged intercourse of Lord Shiva and Goddess Parvati as an earthquake etc. But by the knowledge of Geology and other allied sciences, it has been established that Himalayan range do not have any Mercurial ore in the geological belt.

Here an anology can be sited for comparison. The metal Tin is called as '*Vanga*' in Ayurvedic literature. The literary meaning of *Vanga* is Bengal region of Indian Subcontinent. Are there tin mines in Bengal ? The answer is no ! Then why this name indicating a perticular region ? Becuase since historical period it used to be imported from Southeast Asian countries in the Ports of Vanga, i.e. Bengal and hence the name.

Mercury and other Mercurial compounds like *Hingula* used to be imported since long from China, Tibet and Afganistan by Road transport. This could be one of the possible reasons why occurrence of Mercury as stated in old texts is mentioned as Himalaya. In addition to this reason the mythology around production of Mercury, had a story and deeply rooted hold on the minds of Indian people. In the mythological literature the residence of Lord Shiva is supposed to be Himalaya and hence the mentioned about Himalaya.

In actuallity, today Mercury mines are present in Spain, South American nations, U.S.A., China, South Africa, Australia, New Zeland, Germary, Hungary and these are the countries which are fair exporter of Mercury.

(3) Ores of Mercury

Mercury occurs in nature in various forms. As it is a very

active substance chemically, it occurs in combined state and not in free state, however few compounds of Mercury have loose bondage in their chemical structures and hence it can occur in free stage in a very small percentage. But, from the point of view of Industrial Production it is of no significance. In the classical texts of Rasashastra, two substances viz. *Hingula* and *Girisindura* are mercurial compounds.

The following are the ores of Mercury from which Mercury can be produced.

Calomel — This ore of Mercury is in the form of Mercurious chloride. It occurs in Spain.

Cinnabar — This mercurial ore is chemically Mercuric Sulphide. Depending upon the impurities present in different quantities, it occurs in different colours and hence for discription purposes, they are named differently. But the main constituent of such ores is Cinnabar, a form of Mercuric sulphide.

(1) Cinnabar Native: This is one of the most important ores of the Mercury. As mentioned previously chemically it is Mercury sulphide. It is bright and dark red in colour. Quartzs, silica, carbon etc. are present in Cinnabar native as impurities.

(2) Hepatic Cinnabar: When percentage of carbon impurities is higher in Cinnabar, its colour becomes darker. Such an ore is called as hepatic Cinnabar.

(3) Meta Cinnabar: Mercury ore of this type contains muddy dust in more percent and that makes its colour still darker, almost to a black shade.

(4) Coral Ore: Ores of Mercury, especially occuring in Germany and in Italy are in the form of Rose coloured

earthen material. When mercury sulphide in coral ore is separated, it is Rosy in colour. It contains about 2% Mercury by weight.

(5) Montroydite: This ore contains Mercuric Oxide as its main constituent.

(6) Brick Ore: This also contains Mercuric Oxide upto 8%.

(7) Steel Ore: This is another ore of Mercury which has significant percentage of mercury. It contains about 75% of Mercury.

(8) Brick Ore: There are many ores which are rich in Mercuric Oxide. i.e. HgO. It is called as Brick ore. Percentage of obtainable Mercury is about 68%.

(9) Montraydite: This is another ore of Mercury which occurs mainly in Oxide form.

In addition to these, Clinite, Mosesite etc. are Mercurial ores which are mixture of Chloride and Oxide forms of Mercury.

(4) Unwanted and Harmful Properties of Mercury (Parada dosha)

In present era, our knowledge of Chemistry, Physiology, Pharmacy etc. is quite advanced and we know for certain that Mercury and other mercurial products are considered as poisonous substances. However, the scientists of this science must have learned it by hard way of trial and error. By observing the results of various mercurial products, they must have attributed the bad properties to Mercury.

It must have been an extensive research work spanning over many hundreds of years. The final conclusions are given here. Such unwanted properties i.e. *Parada Dosha*

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can be classified as (1) *Naisargika* (i.e. Natural); (2) *Yougika*; (3) *Oupadhika*.

(1) Natural : Naisargika

There are some unwanted properties of Mercury which are 'Natural' in origin i.e. these properties are present even though Mercury is 100% pure. These bad effects are explained in the following verse:

विषं वह्निर्मलश्चेति दोषाः नैसर्गिकास्त्रयः ।
रसे मरणसन्तापमूर्च्छानां हेतवः क्रमात् ।। (र.र.स. 11:20)

Names given to these bad effects are *Visha*, *Vahni* and *Mala*. The symptoms manifested due to these are Death, Burning sensation (of body) and Fainting, respectively. It goes without saying that the severity of manifestations will be directly proportional to the amount of Mercury ingested primarily. As has been said previously these are the Natural properties of Mercury and are called as *dosha* only because they are unwanted in human body due to their adverse effects. 'Small' dose will produce fainting, slightly more amount will produce burning sensation and if ingested in larger amount death is inevitable. As these are the inherent properties of Mercury, they are called as Natural. Few experts give different opinion. They consider that these unwanted effects are due to some amount of Lead, Arsenic, Tin etc. which are mixed in the mercury 'naturally' and hence called as Natural. But the authors do not agree with this as a separate entity for such properties has been described further.

(2) Compounded bad effects : Yougika Dosha

It is a known fact that metals such as Tin and Lead, when heated, are melted easily and their external appearance in this stage resembles that of Mercury. In addition when

such metals in molten stage are mixed in Mercury, they get assimilated completely. This knowledge is often used for adulteration of Mercury. When such metals are mixed in mercury for the sole purpose of adulteration, the drugs prepared from such Mercury definitely produce bad and unwanted effects. Such symptom complex includes distention of abdomen, and increased skin thickness (*Jadya, adhmana*). These bad effects are named as *Naga dosha* and *Vanga dosha*. (यौगिकौ नागवङ्गौ द्वौ ।)

(3) Oupadhika or Kanchuka dosha

औपाधिकाः पुनश्चान्ये कीर्तिताः सप्त कञ्चुकाः ।
भूमिजा गिरिजा वार्जा द्वे च द्वे नागवङ्गजे ।।
द्वादशैते रसे दोषाः प्रोक्ता रसविशारदैः ।।
पर्पटी पाटिनी भेदी द्रावी मलकरी तथा ।
अन्धकारी तथा ध्वाङ्क्षी विज्ञेयाः सप्त कञ्चुकाः ।। (र.र.स.11:19-21)

Mercury, if observed carefully and minutely, appears to have a thin film coating over its surface. In Sanskrit such detachable coating is called as *Kanchuka*. Various other bad effects and symptom complexes were attributed to this thin film and hence collectively called as *Kanchuka dosha*. It has been stated in the classical texts that this thin film consists of seven different layers. Each layer is named after the bad effect it is supposed to produce over human body. Their names are : (1) *Parpati*, (2) *Patani*, (3) *Bhedi*, (4) *Dravi*, (5) *Malakari*, (6) *Andhakari*, (7) *Dhwankshi*.

The then scientists of Rasashastra further attribute various causes to produce these layers. It is stated that *Parpati* is due which causes present inside the earth i.e. *Bhumija*. *Patani* is likewise due to *Girija* causes. *Bhedi* is formed due to water i.e. *Varija*. *Dravi* and *Malakari* are due to Lead and hence called *Nagaja*. Whereas *Andhakari* and *Dhwankshi* are due to Tin and called as *Vangaja*.

These effects as stated above are mentioned in Rasaratnasamuchchaya which is a most standard and accepted treatise on Rasashastra, however, the names and numbers of *Parada dosha* vary from five to nineteen if other texts of Rasashastra like Rasendramangal, Rasasanketakalika, Rasendrachudamani, Rasaprakash-Sudhakar, Anandakanda etc. are taken into consideration. List of names of *dosha* and the manifesting effect is quite exhaustive and need not be given in full here.

After reading about this brief description of *Parada dosha*, one is definitely likely to be confused, due to various reasons. One finds that there is often repeatation of names and effects. e.g. bad effects of *Naga. Vanga* are mentioned in all the classes of *dosha* i.e. *Naisargika*, *Yougika* and *Oupadhika*. Are they one and same or different ? How effect of a *dosha* was attributed to a particular symptom ? or was it that the bad effects were observed first and the *dosha* were named later ? How it was possible to observe seven layers of a thin film called *Kanchuka* ? How it was decided that a particular film gives rise to particular bad effect ? Are the names of the layers mentioned from outside to inner core ore vice-versa ? What happens to these layers when a drop of Mercury breaks in to thousand of minute droplets? These and many more similar questions do appear in the minds of sincere reader, and most of them remain unanswered, as their authentic explanation is not found any where in the classical texts.

But let us not get sidetracked due to such confusion. From the knowledge of History of Rasashastra, we know that Merury was and is being experimented from thousands of years. The centres for such experiments were scattered all over Indian subcontinent. After making many experiments including clinical trials, the observations were put-forth for the benefit of next generations. And as per the availability of such clinical materials, with the help of logical imagination, different conclusions were formed and entered into books. This is the logical explanation of why there are such differences in opinions in different books, conceived in different times.

After going through these observations and conclusions carefully, few 'facts' imerge which can be tested and confirmed today also. These are :

(1) In freshly mined Mercury we do find Lead, Tin, Arsenic as impurities.

(2) These impurities do form a thin film over the external surface of Mercury. Oxide of Mercury, formed due to oxygen present in the atmosphere, is also a part of this thin film.

(3) Many different unwanted and bad effects can be observed if drugs prepared from such 'Impure' Mercury are consumed by the patient.

(4) If such 'Impure' Mercury is subjected to 'Purification' treatment, described in next chapter, such bad effects are either curtailed to major extent or not observed at all.

(5) Acceptable and Unacceptable forms of Mercury

There is a beautiful verse in Ayurveda Prakash which gives exact and apt description of Mercury which is to be used in medicinal preparations. It reads as:

अन्तस्सुनीलो बहिरुज्वलो यो मध्याह्नसूर्यप्रतिमप्रकाशः ।
योज्योऽथ धूम्रः परिपाण्डुरश्च चित्रो न योज्यो रसकर्मसिद्ध्यैः ।।
(आयुर्वेद-प्रकाश, पृष्ठ 8)

The expert in preparing medicines from Mercury,

(*Rasakarmasiddhi*) should use Mercury which is as bright as midday Sun, externally and which has a bluish tinge comming from within and Mercury which is moky dull, or yellowish white (*Paripandura*) or with different colours must not be used. Another exact term used to describe Mercury is *Galadroupyanibham*, means just like liquified Silver. This description holds good for pure Mercury even today.

Physical Properties of Mercury

(1) It is silverwhite in colour and eventhough it is metal, it is in liquid state at room temperature.

(2) Its Atomic number is 80 and Atomic weight is 200.

(3) Freezing point of Mercury is -39^0 C and boiling point is 357.25^0C.

(4) Mercury evaporates even at room temperature.

(5) Specific gravity of Mercury is 13.59. This is heaviest liquid substance at room temperature.

Simple Tests of Pure Mercury

(1) Boiling point of Mercury is 357.25^0C. When impurities, especially metalic impurities are mixed in the Mercury, its boiling point changes to a lower temperature.

(2) Pure Mercury does not stick to a clean glass, on the contrary impure mercury leaves behind its track on the clean glass.

(3) Impure Mercury when shaken for some time in open air, forms a thin film of blackish powder over its surface. This is due to oxidation of the metalic impurities. If mercury is pure, this does not occur.

Chemical Properties

(1) Effect of Air: At ordinary room temperature, with low

or high humidity, Mercury is not at all affected chemically. If it is heated in open air gradually upto its boiling point, it reacts with oxygen present in the atmosphere to form oxide of Mercury.

(2) Effects of Water on Mercury: Water, at any temperature, has not any chemical effect on Mercury.

(3) Effects of Acids: Hydrochloric acid, dilute or concentrated does not cause any change in Mercury chemically. Concentrated Sulphuric acid also does not bring about any change in Mercury, however it produces Sulphur dioxide gas when used in hot and concentrated form.

The chemical reaction is as under :

$$Hg + 2H_2SO_4 \rightarrow HgSO_4 + 2H_2O + SO_2 \uparrow$$

In the similar way hot and concentrated Nitric Acid reacts with Mercury to produce Mercury Nitrate and Nitrogen Oxide.

$$2Hg + 6HNO_3 \rightarrow 2\ Hg(NO_3)_2 + NO + 3H_2O + NO_2$$

Mild and dilute nitirc acid also reacts with Mercury in the following way:

$$6Hg + 8HNO_3 \rightarrow 3\ Hg_2(NO_3)_2 + 2NO + 4H_2O$$

(4) Effects of Alkalies: Alkalies may it be concentrated or dilute, hot or cold do not have any effect on Mercury. (Perhaps this was known to ancient researchers also as it has been advocated that in purification method, 'slakedlime' $Ca(OH)_2$ a mild alkali produced from Calcium Oxide has been used.)

(5) Other Chemicals which act on Mercury: Halogen and halogen compounds i.e. Iodine, Bromine, Fluorine, Chlorine and their compounds do have effects on Mercury to forms - Iodides, bromides, fluorides and chlorides.

(6) Amalgam Formation: When two or more metals are mixed with each other in definite proportion the resultant metal is called as an Alloy. But when one of the metals is Mercury, the resultant metal is called as an amalgam. Mercury has an amazing property to produce Amalgam. Except for Iron and Platinum it readily mixes with all other metals to form alloys which are called as Amalgam. Metalic properties of such amalgams are very useful in different industries.

Chapter 7

Production of Mercury

Mercury production from the ores of Mercury is a rather complicated process. Because, as is already stated in the last chapter, Mercury occurs in the mines in which large quantities of ores of other metals like Lead, Tin also are present. It, therefore , becomes important procedural part to separate ores of Mercury from those of other metals. Previously such ores were separated by expert labours who could identify and separate Mercury ores from ores of other metals. Presently however the ores are placed on moving and rocking tables. Mercury ores, being heavier than the other ores, fell off the table upto a short distance while other metals they fell off upto a longer distance. Mercury ores fell off the tables last. Ofcourse, hundred percent correct separation is not possible but for all practical purposes this method suits the industry. Once such separation is achieved then by various methods, Mercury is produced from the ore. Cinnabar or Cinnabar native is the main and important ore of Mercury. Chemically it is in the form of Mercuric sulphide. Big chunks of Cinnabar are mixed with coal in definite proportion. This mixture is fed to a furnace called as shaft-furnace. The structure of the furnace is such that it is quite high, there are inclined shelves over the internal walls so that ores when poured from above reach the bottom gradually. There is facility to start blast of hot air from the bottom of furance. The outlet of the furnace is madeup of a typical and specific type of eastern material.

When piece of Cinnabar come in contact with hot air

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blast, they decompose to give Mercury & Sulphur. The Sulphur reacts with Oxygen from the air to form Sulphur-dioxide gas. Vapours of Mercury collected from the outlets of the furnace are condenced and cooled and thus mercury is produced from the ores.

This ofcourse is a very very rough sketch of the actual procedure. Presently the methods used are very sofisticated and technically quite advanced so as to get more yield of Mercury, more easily, however the basic principle i.e. decomposition of Mercury Sulphide and collection of prepared Mercury is one and the same.

Chemical Purification of Mercury

Mercury thus collected naturally has many impurities. It contains elements like Lead, Tin, Bismuth and Zinc in variable amounts. In addition to these, there are some insoluble impurities. To get pure mercury, the impure form is first strained through Chamoi's leather to separate insoluble impurities. Then a thin stream of mercury is passed through dilute Nitric acid. Due to action of dilute nitirc acid, Lead, Tin, etc. metalic impurities react with nitric acid and can be separated. Mercury thus obtained is subjected to vaccum distiallation so as to get almost 100% pure Mercury.

The characteristic fact about Rasashastra comes in to play a very important role here. Eventhough 100% pure Mercury is obtained by this or similar such methods, such mercury cannot be and should not be used to prepare medicine as per Rasashastra. In fact not only Mercury but any metal or mineral substance to be used to prepare drugs, must be subjected to a procedure called as '*Shodhana*'. What exactly is meant by this *Shodhana* procedure ?

Before we study *Shodhana* procedure of Mercury let us first have a comprehensive knowledge of the term *Shodhana* as used in Rasashastra.

The Shodhana Procedure as Explained/ Expressed in Rasashastra

The word '*Shodhana*' is developed from the verb '*shuddha*' which means to purify. The matter which is to be ingredient of DRUG, must be 'pure' in nature, meaning thereby that there should not be any impurities. It should not be adulterated with other less effective substances. Ancient Scientists and Metallurgists had developed and devised many such procedures to obtain metals in 'pure' form. The question now arises is, when any metal or metallic compound described in the texts of Rasashastra is presently available in 100% pure form due to well developed modern chemical techniques, is it really necessary to follow the *Shodhana* procedures as mentioned in the old texts ? Before embarking upon the answers to this question it will be better if we study the *Shodhana* procedures in general as mentioned in the standard texts of Rasashastra. Because after studying few examples of so called '*Shodhana*' procedure one is bound to get confused. Let us see various *Shodhana* procedures for different substances. For metals like Gold, Silver, Copper and Iron, a common *Shodhan* procedure is - sheets of these metals are heated till they become redhot and then they are dipped into oil of Sesame. This procedure is then repeated for six more times. Then it is repeated by changing the liquid for immersion to butter milk, cow's urine, '*Aranal*' and decoction of *Kulattha*. Similar procedures i.e. heating and immersing in organic liquid are also prescribed for Mica, Chalcopyrite, Tourmaline, etc.

Another method which is often prescribed is to roast the substance. The substances like Red lumbar (*gairika*) or Allum (*kankshi*) Borax (*tankana*) are examples of this method. Many times marine products like corals, conches, oyster shells, pearls, etc. are dipped into or boiled with acidic substances like lemon juice or *Aranala* for 'purification'. Metals like Lead, Tin or Zinc which have comparatively low melting point are heated to melt them and the liquified metals are poured in to liquids of animal orgine like milk, urine or various plant juices or decoctions. Very often the non-metallic substance like Sulphur is also purified in similar way. Some substances like Arsenic oxide, Arsenic di-dulphide, Arsenic trisulphide are boiled for specified time in various plant juices or decoctions.

All these and many more alike, are the procedures which are performed for 'purification' of various substances.

As is mentioned earlier, any student who has studied basics of Chemistry is bound to get confused. Overall chemical effect of any of these purification method will be to make the substance 'impure' in its truest sense ! And still these procedures are called as Purification Methods. How come? Metals and metallic compounds when they are heated and dipped in various organic liquids, most of them of acidic nature, are bound to get converted in to some other substance due to chemical reaction. Similar are the cases where substances are roasted or liquified and dipped into various liquids. It means almost every purification method makes the substance impure and still the procedure is called as Purification.

Now to clear this confusion it must be understood that the word 'Purification' or 'Pure' is used in Rasashastra in a rather broad perspective. It is a known fact that when a

substance of Inorganic nature enters in to human body, mostly it is not accepted in it. It is either rejected totally in the form of severe vomitting or loose motions or it is absorbed and detoxified in liver or other tissues. All our body organs are madeup of organic chemical compounds. It is, therefore, natural that drugs, if they are in the organic form will be more easier to digest and will be more acceptable to the body. Most of the metals and mineral compounds which are used to prepare various drugs, are first converted in to '*bhasma*' form before actual use and purification procedure is the first step of preparing *bhasma*. What are the changes which are brought about in the substance which has undergone purification process ? These can be enumerated as:

(1) The substance becomes brittle by loosing its hardness due to repeated heating and cooling.

(2) Due to repeated contact with heat and some organic liquid, which most of the times is acidic in nature, the substance is converted into some herbomineral compound.

(3) Toxic substances like arsenical compounds are boiled in various liquids so as to reduce its toxicity.

(4) Few substances like *Hingula* are trituarated with liquids having similar properties for purification so as to enhance and augment its original properties. Similarly few substances are triturated with liquids having opposite properties e.g. *Jaipal* (Croton seeds) do possess property of producing spasms in intestine. For 'Purification' the seeds are triturated with lemon juice which possess antispasmodic property. In short *Shodhana* can be effective in enhancing required proportion and curbing unwanted properties.

(5) When substances having '*Prithivi*' factor predominantly in their constitution are heated they become '*laghu*' from '*guru*'.

All these and some, are the effects of *Shodhana* procedures on various substances. In other words, it can be said that various purifiction methods are devised for different substances so as to bring about one or more of the effects mentioned above. The basic aim of purification methods is NOT just purify the substance but to convert it into such a form so that (i) it will be a herbomineral compound and/or (ii) it becomes first step in *bhasma* process and/or (iii) its useful and required properties are enhanced and unwanted properties are curbed or removed and/or (iv) it becomes *laghu* in nature, and/or (v) it becomes clean and extranious substances if any in the matter are removed.

Here the question raised in the beginning can be answered. Once the objectives of purification procedures are known, then those cannot be achieved if 100% chemically pure substances are used in drug production. The meaning of words Pure (*Shuddha*) and Purification (*Shodhana*) have different and broader meaning in Rasashastra and therefore to achieve good results of the drugs, the substances used should undergo Purification Procedures.

Purification of Mercury as per Rasashastra

After seeing the broad meaning of the word 'purification' let us see how it is applied to Mercury. The purifications methods of Mercury can primarily be devided into two groups - 1. Common or *Samanya* and 2. Group of Eighteen Procedures or special procedures. When Mercury is to be used to prepare drugs to combat diseases, the common procedcure alone is useful. However, if it is to be used to

prepare drugs which are to be used as '*Rasayana*', then the special procedures are to be followed, as just common procedures will not be sufficient. Mercury subjected to common purification procedures will not have '*Rasayana*' properties on the contrary Mercury purified with special procedures will have both properties, *Rasayana* as well as *Vyadhinashana*.

व्याधौ रसायने चैव द्विविधा सा परिकीर्तिता ।
या शुद्धिः कथिता व्याधो सा नेष्टा हि रसायने ।
रसायने तु या शुद्धिः सा व्याधावपि कीर्तिता ।। (रसराजसुन्दर 2:25)

The eighteen special procedures of purification of Mercury can further be classified into a sub-group called as *Ashtasamskara* or group of eight procedures. Mercury purified with these eight procedures will have both properties mentioned above but when remaining 10 procedures are completed, then that Mercury can be used in *Dhatuvada*. i.e. techniques of converting nonprecious metals into precious metals.

Mercury has great affinity for metals to form amalgams, except for iron. It is therefore necessary that all apparatus, containers, tubes etc. to be used in the purification procedures must be of glass, enamel, stone, earthenware, or iron.

In short description of these processes is as under:

General Purification

This usually is a very simple, uncomplicated procedure. Various scientists of bygone era have developed these procedures. It consists of triturating the Mercury in a stone mortar with pestle along with various plant and mineral substances and then washing and/or straining the mixture so as to obtain Mercury in original but purified form. The

substances vary from period to period and as per experience of scientists. Few often used procedures are :

रसेश्वरं समसुधारजसा मर्दयेत् त्र्यहम् ।
ततो द्विगुणवस्त्रान्तर्गालितं खल्वके न्यसेत् ।।
रसोनं निस्तुषं तुल्यं तदर्धं लवणं हरेत् ।
तत्कल्के मर्दयेत्सूतं यावदायाति कृष्णताम् ।।
कृष्णं कल्कं परित्यज्य तथा प्रक्षाल्य युक्तितः ।
एवमेकेन वारेण रसेन्द्रः शुद्धिमाप्नुयात् ।। (र.त. 5:27-29)

(1) Equal amount of slaked lime is mixed in Mercury and the mixture is triturated for 3 days. It is then strained through twofold cloth and again taken in to the mortar. This time it is mixed with deskined garlic cloves 1/2 parts and 1/4th part Rocksalt (*Saindhava*). It is triturated for such a time, till the mixtures becomes black in colour. The mixture is then washed with hot water to get Mercury back. This procedure performed once only enables the Mercury to be pure. (Rasatarangini 5:27-29)

कुमारिकाचित्रकरक्तसर्षपैः कृतैः कषायैर्बृहतीविमिश्रितैः ।
फलत्रिकेणापि विमर्दितो रसो दिनत्रयं सप्तमलैर्विमुच्यते ।। (र.त. 5:31)

(2) Mercury is triturated and intimately mixed with Pulp of Aloe, Plumbago rosae (*Chitraka*) and *Bhrihati* with decoction of *Triphala* for 3 days. (Rasatarangini 5:31)

नागवल्लीदलरसैस्तथा चार्द्रकजै रसैः ।
क्षारत्रययुतैश्चापि रसराजं विमर्दयेत् ।।
ततस्तेभ्यः पृथक्कृत्वा सप्तदोषविवर्जितम् ।
मुक्ताफलसमाकारं रसराजं प्रयोजयेत् ।। (र.त. 5:34-35)

(3) Mercury is subjected to similar treatement using (i) Beatle leaf juice, (ii) Juice of ginger and *Kshara-traya* for 3 days and then washed. It is said that Mercury becomes as bright as pearls due to this procedure.

(Rasatarangini 5:34-35)

विमर्द्य सुधया सप्तदिनं धूमनिशेष्टकैः ।
त्रिदिनं मर्दयेत्सूतं काञ्जिकैः क्षालयेत्ततः ।।
वस्त्रं चतुर्गुणं कृत्वा सूतं निःसारयेत्ततः ।
सप्तकञ्चुकनिर्मुक्तो जायते निर्मलो रसः ।। (र.त. 5:36-37)

(4) Another method states that Mercury is triturated with slaked lime for 7 days and strained through 4 fold cloth. Then it is again triturated with Carbonsoot, turmeric powder and powder of bricks and strained through cloth again. (Rasatarangini 5:36-37)

एकेन लशुनेनापि शुद्धो भवति पारदः ।
पिष्टो लवणसंयुक्तो सप्ताहं तप्तखल्वके ।। (आयुर्वेदप्रकाश 1:165)

(5) Mercury is similarly treated in hot mortar with garlic cloves and Rocksalt (*Saindhava*) for seven days and then is washed to get back.

There are many more, each advocated by different scientist from different period and claiming different results. However, basically the procedure of triturating Mercury with either plant or animal product remains the same. It must be remembered from practical point of view that the time mentioned to complete the procedure is 3 days, 7 days, etc. Here a 'day' is practically considered as continuous work of 7 to 8 hours.

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Chapter 8

The Eight Staged Purification of Mercury (Parada Ashtasamskara)

It is already stated that 'special' purification procedures are nothing but a group of 18 procedures. Out of these first eight are grouped as *Ashta samskara*. We are to see and study those in details.

Names of the Eight Procedures

स्वेदनं मर्दनं चैव मूर्च्छनोत्थापनं तथा ।
पातनं बोधनं चैव नियामनमतः परम् ।
दीपनं चेति संस्काराः सूतस्याष्टौ प्रकीर्तिता ।। (रसेन्द्रसारसंग्रह 1:54)

Swedana, Mardana, Murchchhana, Utthapana, Patana, Bodhana, Niyamana, Dipana are the eight names given to these procedures. Few important factors must be considered before study of actual procedures.

(1) Few texts like Anadakanda, Rasarnava, Rasaratnakar, mention yet another procedure called as *Anuvasana* in this group of procedures making the number of procedures in the group nine. But Rasaratnasamuchchaya which is supposed to be standard book on Rasashastra mentions eight procedures only.

(2) When such eight procedures are to be performed the minimum amount of Mercury is specified. Atleast that much amount must be taken in the beginning.

The options given for such quantity are (i) 2000 *pala* or (ii) 1000 *pala* or (iii) 100 *pala* or (iv) 28 *pala* or (v) 10 *pala* or (vi) 5 *pala* or (vii) 1 *pala* or (viii) 1/2 *pala*. Here one *pala* is equal to four *tola*. One *tola* is almost equal to 10 grams. (Actually it is slightly more than that).

If these weights are to be converted into metric system, the above-mentioned quantities will be 80 kg, 40 kg, 4 kg, 1.12 kg , 400 gm, 200 gm, 40 gm,or 20 gm respectively.

The original verse given in Rasaratnasamuchchaya reads like this:

द्वे सहस्रे पलानां तु सहस्रं शतमेव वा ।
अष्टाविंशत् पलान्येव दश पञ्चैकमेव वा ।।
पलार्धेनैव कर्तव्यः संस्कारः सूतकस्य च । (र.र.स.11:24-25)

The range of 'mimimum' quantity required for purification process appears to be too vast as it ranges from 80 kgs to 20 gms. The apparatus to handle these extreme quantities of Mercury will be totally different from eachother. To handle 80 kgs of Mercury will be quite difficult, will be difficult even for established production companies, where as 20 gms of Mercury which is minimum allowed quantity will be too small to undergo all the tedious procedures. The details of the procedures will be explained in the next chapter, however most of the procedures of purification consist of either intimately mixing, boilling, distillating and reobtaining the converted Mercury back. If methods of boilling, mixing, distillating in those days are considered, then in light of vapourizing property of Mercury, it is obvious that the amount of Mercury lost in this way must have been great. This must be the reason why the upper range of minimal required quantity is so high. But it could not be understood why the lower range is as low as 20 gms, because it will be too difficult to perform the procedures on such a small quantity of Mercury, the amount of processed Mercury at the end will be too small as the expenditure and manpower to be used is considered. The ancient scientist were aware of the fact that Mercury do get lost in the procedures to be completed. Infact, it was their experi-

ence that when all the eight procedures are completed following all the instructions meticulously, then the final yield of Mercury is 1/8th of the original quantity. And hence getting yield of 1/8th quantity of the Mercury became a criterion for purified Mercury.

स्वेदनादिनवकर्मसंस्कृतः सप्तकञ्चुकविवर्जितो भवेत् ।
अष्टमांशमवशिष्यते तदा शुद्धसूत इति कथ्यते तदा ।। (रसराजसुन्दर)

The group of these procedures is collectively called as *Ashtasamskar*. As has been explained before, all these purification processes have been devised over a period of hundreds of years by many scientists of that period. This is the reason why there is difference of opinion regarding final procedures and amount of matter required. Rasaprakashsudhakar, Bhavaprakash, Rasaratnasamuchchaya, Sharngadhara Samhita, and many other compendia, written in different periods of time give slightly different information about each procedure from each other, though nomenclature used is similar in all of them. In this chapter the main references are from Rasaratnasamuchchaya with passing remarks about references from other authors.

(1) The First Procedure : Swedana

The actual meaning of the word *'sweda'* is sweat. *Swedana* is mode of applying heat to body by which profuse sweating is induced. But here the meaning is applying heat to Mercury in a special way. The definition given in the text reads as under :

क्षाराम्लैरौषधैर्वाऽपि दोलायन्त्रे स्थितस्य हि ।
पचनं स्वेदनाख्यं स्यात् मलशैथिल्यकारकम् ।। (र.र.स. 8:59)

Heat given in *Dola yantra* with various acidic and alkaline matter and/or with plant material for *Pachana* of mercury is called as *swedana*. It loosens the cover of *mala*. The

actual procedure by which this is achieved is described as under:

त्र्यूषणं लवणासुर्यौ चित्रकार्द्रकमूलकम् ।
क्षिप्त्वा सूतो मुहुः स्वेद्यः काञ्जिकेन दिनत्रयम् ।। (र.र.स. 11:26)

The literary meaning of this verse is Mercury is to be steam heated again and again in sour gruel (*kanji*) in which the plant materials mentioned in the first line are added, for three days.

But there are many practical difficulties.

(1) Exact quantity or percentage of the plant material is not mentioned here.
(2) The form in which the plant material is used, e.g. whether their juice, paste, decoction etc. are to be used or any other form, is not clearly stated.
(3) There are different opinions about the exact nature of *Dola yantra*.

However, tradition plays an important part in ancient sciences like Rasashastra. Therefore, we have to go by tradition in actual experiment to achieve optimum results. The question why and how are not uasually answerable in such cases because by tradition they must have been set by trial and error.

The drugs mentioned in the first line are as under:

	Sanskrit	*English Name*	*Botanical/Chemical name*
1.	Shunthi	Dry Ginger	Zingiber officinale
2.	Maricha	Black Pepper	Piper nigrum
3.	Pippali	Long Pepper	Piper longum
4.	Saindhava	Rock salt	KCl + NaCl
5.	Asuri	Mustard seeds	Brassica juncea
6.	Chitraka	Leadwort	Plumbago zeylanica
7.	Ardraka	Ginger	Zingiber officinale
8.	Mulaka	Radish	Raphanus sativus

The author of Bhavaprakasha advises that every one of the above, should be 1/16th of Mercury; where others opt for equal amount and its total quantity is taken as 1/4th or 1/8th of Mercury.

Presently opinion of Bhavaprakasha is followed and hence every substance is taken in 1/16th part of the Mercury to be purified.

All these substances are taken together to form paste (*kalka*). To make such a paste, *kanji* is to be used as wetting agent and not water. The main procedure is, Mercury to be purified is kept in this paste and then cooked in *Dola yantra* for 3 days.

Now to devise such an experiment, one has to improvise the apparatus in many ways which are not mentioned in the verse itself.

The pulp or paste of the ingredients is made to such a consistancy that it can easily be moulded in to a shape of bowl or glass. This is then covered from all sides with thick leaves of either *Vata* (Ficus religiosa) or Bananna (*Musa sapientum*). The Mercury to be purified is kept in this mold and the mold is kept in a sling made up of cloth. This sling is hanged from the horizontal bar of the *Dola yantra* so that it remains immersed in the *kanji* which is the liquid to be used in *Dola yantra*. The whole unit is then subjected to low heat and it is continued for 3 days. The liquid from the *Dola yantra* i.e. *kanji* is replenished as and when required.

After continuous heat of three days, the sling along with the mould inside is emptied in an enamel bowl. The liquid from the *Dola yantra* is collected carefully and washed with hot water which is also poured in to the tray. It is well

stirred and allowed to settle for 3 hours. The supernant liquid is then decanted or siphoned off. Mercury settled at the bottom is carefully washed again and dried and collected for next procedure.

This, ofcourse, is a very short description of the actual process. One may face many more difficulties depending on mode of giving heat, apparatus used and quality of supervision.

There are differences of opinion regarding almost every step of the procedure. The main pot of *Dola yantra* is supposed to be of either Iron or Copper or earthenware. Some texts advocate to prepare new pulp and mould every day. The period for which heat is applied also varies from one to 21 days. Almost every text gives new composition of the pulp. However, every one of them agrees upon with the result of this procedure which is loosening of the *mala*.

The above mentioned procedure is adopted from Rasaratnasamuchchaya.

(2) The Second Procedure : Mardana

The word *Mardana* means to triturate with forward and backward movements of the pestle with pressure. The main objective achieved in this procedure is to mix the contents of the mortar intimately.

The definition of this procedure inrepsect to purification process is as under :

उदितैरोषधैः सार्धं सर्वाम्लैः काञ्जिकैरपि ।
पेषणं मर्दनाख्यं स्याद् बहिर्मलविनाशनम् ।। (रसरत्नसमुच्चय 8:60)

Trituration of Mercury with drugs mentioned which are sour and with *kanji* is called as *Mardana* which destroys *bahirmala*.

The actual process is described as under:

गृहधूमेष्टिकाचूर्णं तथा दधि गुडान्वितम् ।
लवणासुरिसंयुक्तं क्षिप्त्वा सूतं विमर्दयेत् ।।
षोडशांशं प्रतिद्रव्यं सूतमानान्नियोजयेत् ।
सूतं क्षिप्त्वा समं तेन दिनानि त्रीणि मर्दयेत् ।। (र.र.स. 11:27-28)

It means carbon soot, brick powder, curds or jaggery, rock salt and mustard are taken in the quantity of 1/6th part that of Mercury. Trituration of Mercury for three days continuously along with these substances is the process of *Mardana*.

Here we must understand that traditionally few things are taken for granted. e.g. The mortar to be used for trituration is constantly heated during the procedure (*Tapta khalva*). Though this has not been mentioned in this text, other classics of Rasashastra do mention this part of the procedure.

e.g. युक्तं सर्वस्य सूतस्य तप्तखल्वे विमर्दनम् । (Rasapaddhati)
or मर्दने तप्तखल्वके । (Yogaratnakar)
or मर्दयेत् तप्तखल्वे तु । (Rasasara-paddhati)

Another thing to remember is the PROTOCOL or order in which the procedures must be carried out. The eight procedures mentioned previously must be carried out in that order only. i.e. Mercury taken for a particular procedure must have been undergone all previous procedure chronologically. One cannot subject the Mercury to a particular procedure randomly.

The time period for completion of this procedure is supposed to be three days and this period is agreeable to all the texts. However the plant and other material to be used for this procedure change from text to text. Again there is no

ambiguity and different opinions regarding the outcome of this procedure, i.e. removal of *bahirmala*.

After three days, the contents of the mortar are washed carefully to recover the Mercury.

(3) The Third Procedure : Murchchhana

The word *Murchchhana* actually means unconsciousness. But here the implied meaning is loss of liquid nature of the Mercury or 'quickness' of Mercury. The exact defination is as under :

मर्दनाऽऽदिष्टभैषज्यैर्नष्टपिष्टत्वकारकम् ।
तन्मूर्च्छनं हि वङ्गादिभुजकञ्चुकनाशनम् ।। (रसरत्नसमुच्चय 8:61)

Trituration of Mercury with the said matter till its original form is lost is called as *Murchchhana*. It removes bad properties present in Mercury due to Tin and other metals present in one of the layers (*kanchuka*) of Mercury.

The procedure is to be performed as per the following verses:

गृहकन्या मलं हन्यात् त्रिफलावह्निनाशिनी ।
चित्रमूलं विषं हन्यात् तस्मादेभिः प्रयत्नतः ।।
मिश्रित सूतकं द्रव्यैः सप्तवाराणि मूर्च्छयेत् ।
इत्थं सम्मूर्च्छितः सूतो दोषशून्यः प्रजायते ।।
(रसरत्नसमुच्चय 11:31-32

It has been explained in the previous chapter that one of the bad properties (*dosha*) of Mercury is *Naisargika* type which consists of *visha, vahni* and *mala*. This verse should be considered taking into account this knowledge. Aloe vera (*grihakanya*) removes *mala*. Mixture of *Triphala* removes *vahni* and root of *Chitraka* removes *visha*. Mercury is to be intimately mixed till its liquidity is lost. (*Nashtapishtatva*). It makes Mercury '*Dosha-shunya*' i.e. without any impurities.

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Here also exact amount of these substances in relation to Mercury is not mentioned. Traditionally it is taken in 1/6th part of Mercury. Again the Mercury is recovered traditionally by washing it with *kanji* and the procedure is repeated for total seven times. However Ayurvedprakash a famous treatise on Rasashastra states that:

सप्तवाराणि मूर्च्छयेत् इति धातुवादे, न रसेषु ।

It means seven repetitions are to be carried out for '*Dhatu-vada*' only.

Though the terminology "*Murchchhana*" is one and same, the actual procedures differ from text to text, and so are substances to be used. If one refers to texts like Rasendra-mangal, Rasarnava, Anandkanda, Rasendrachudamani, the procedure for recovery of Mercury also changes from text to texts. The outcome of this procedure is stated as '*Doshashunyatva*' of Mercury i.e. all bad properties or impurities are removed. However, the term *Doshashunyatva* should be considered as restricted to *Naisargika* types of bad properties only.

(4) The Fourth Procedure : Utthapana

Recovery of Mercury after completion of the third procedure is *Utthapana*.

Its definition is as under:

स्वेदातपादियोगेन स्वरूपाऽऽपादनं हि यत् ।
तदुत्थापनमित्युक्तं मूर्च्छाव्यापत्तिनाशनम् ।। (रसरत्नसमुच्चय 8:62)

It means recovery of Mercury after third procedure with the help of sunlight, heat etc. is called as *Utthapana*. It removes the unwanted result of the third procedure viz. *Murchchhana* (*Murchchha vyapatti*).

The text here gives freedom to choose nature of exact procedure by writing the word '*etc.*' It has given us mear direction to use heat in the nature of either sunlight or actual fire. The *vyapatti* as mentioned in the above verse is 'bad smell' as will be clear in the next verse. The actual method of this procedure is explained as under :

अस्माद्विरेकात् संशुद्धो रसः पात्यस्ततः परम् ।
उद्धतः काञ्जिकक्वाथात् पूतिदोषनिवृत्तये ।। (र.र.स.11:33)

Meaning thereby - purified in this way (i.e. with *murchchhana* procedure) the Mercury is to be distilled (or washed with and recovered from *kanji* to get rid of the bad smell.

Traditionally however, three different procedures are undertaken.

The solid or semisolid form obtained after the third procedure is mixed with sufficient quantity of lemmon juice in a stone mortar. It is kept in strong sunlight and tritutrated. After the mixture is settled, the supernant fluid is siphoned off. Then the procedure is repeated by using *kanji* and hot water. The Mercury obtained at the bottom is strained and dried. If the loss in weight is much more, the siphoned off fluid is distilled to get remaining Mercury.

(5) The Fifth Procedure : Patana i.e. distillation

Of all the eight procedures being described here this procedure is considered as most important one. Because after this procedure only, we are likely to get chemically pure Mercury. The procedure is defined as under :

उक्तौषधैर्मर्दितपारदस्य यन्त्रस्थितस्योर्ध्वमधश्च तिर्कक् ।
निर्यातनं पातनसंज्ञमुक्तं वङ्गादिसम्पर्कजकञ्चुकघ्नम् ।।
(रसरत्नसमुच्चय 8:64)

It means passing of Mercury (*niryatana*) which is kept in distillation apparatus and which is triturated with said matter is called as *Patana*. The names of these apparatuses are

also given in the verse. These are *Adhah patana, Urdhva patana* & *Tiryak patana yantra.* Mineral impurities in the form of Lead, Tin etc. are removed due to these procedures. Obviously the names are based on direction in which Mercury is distilled off and recollected. *Adhah* means downward direction, *Urdhva* means upward direction and *Tiryak* means oblique direction. The exact method by which these procedures are carried out are described as under:

• **Urdhva Patana**

ताम्रेण पिष्टिकां कृत्वा पातयेदूर्ध्वभाजने ।
वङ्गनागौ परित्यज्य शुद्धो भवति सूतकः ।।
शुल्बेन पातयेत् पिष्टिं त्रिधोर्ध्वं..... ।। (र.र.स.11:34-35)

Copper is mixed with Mercury intimately to get a powdered form (*pishti*). It is to be kept in the lower container of *urdhva patana yantra*. The apparatus is sealed and heated. The evaporated Mercury sticks to the inner surface of the upper container which is covered externally by wet cloth, from where it is collected and the procedure is repeated for two more times, in similar way.

Here again the amount of copper to be mixed with Mercury is not mentioned. Traditionally 1/4th part by wt. is taken. Various texts mention different substances to be mixed in Mercury. e.g. Ayurvedprakash advocates use of Copper Sulphate (*Tuttha*) and Chalkopyrite (*Suvarnamakshika*) for this purpose. Few methods consist of using only plant materials for trituration before distillation.

• **Adhah Patana**

In this process the actual procedure again consists of mixing various substances in the Mercury intimately and distilling it in such a way, that the vapourised Mercury travels in a downward direction and collected there.

It is defined as:

अथोर्ध्वभाजने लिप्तस्थापितस्य जले सुधीः ।
दीप्तैर्वनोपलैः कुर्यादधःपातं प्रयत्नतः ।। (र.र.स. 9:9)

Mercury is applied to the inner surface of upper container and distilled downwards with the help of ignited cowdung cakes with utmost care into the watercontaining lower container.

The actual process is given as under:

त्रिफलाशिग्रुशिखिभिर्लवणासुरिसंयुतैः ।
नष्टपिष्टं रसं कृत्वा लेपयेच्चोर्ध्वभाजने ।
ततो दीप्तैरधःपातमुत्पलैस्तत्र कारयेत् ।। (र.र.स. 11:36)

The materials used are:

Sanskrit name	*English name*	*Botanical/Chemical name*
1. Triphala	Three myrobalans	Emblica officinalis, Terminalia belerica & Terminalia chebula
2. Shigru	Drumstick	Moringa oleifera
3. Shikhi	Leadwort	Plumbago zeylanica
4. Lavana	Rock Salt	KCl + NaCl
5. Asuri	Mustard seeds	Brassica juncea

Mercury is to be intimately mixed with powders of the above-mentioned substances till it becomes a semisolid paste. This paste is to be applied to the inner surface of the upper container of the *Adhahpatana* apparatus. The lower container should be filled with water and the apparatus is now sealed. Heat with the help of cowdung cakes is applied to the upper container and Mercury from the paste is distilled in the water of lower container. This process is to be repeated again for six more times. The amount and duration of heat depends on amount of Mercury. About 8 to 9 hours of continuous heat is required to distilate one kg of Mercury.

• Tiryak Patana

In defining this process, the text has described construction of *Tiryak-patana yantra* in previous chapter. The process again consists of intimately mixing a type of processed Mica (*Dhanyabhraka*) to be described later, so as to make the Mercury in semisolid form. ***Aranala*** a liquid of acidic nature, is used in the process as and when required so as to expediate the process. This mixture is then kept in the *Tiryak-patana yantra* - the distillation apparatus. The vapourised Mercury passes in oblique and downward direction. It is condensed in another container. The heat to be applied in this process should be gradually increased (*kramagni*). The whole process is repeated again and again till the Mercury obtains property of *Vahnisahatva* - Heat resistance. How this property is to be judged? or tested? No explanation has been forwarded!

For this process of oblique distillation, various materials to be mixed with Mercury had been described by various texts, some of which are totally of plant origine, some are mineral, most of them are of mixed variety. After completion of this procedure, the Mercury obtained can be used to prepare medicine. This opinion has been expressed by many texts.

(6) The Sixth Procedure : Rodhan or Bodhan

After undergoing all these procedures, it was believed by the then scientists, that the Mercury becomes 'impotent', or in other words it becomes lithargic or inactive. Perhaps these could be the observations or experiences of the scientists. What exactly happens or what physical and/or chemical changes occur due to previous five procedures, nobody can guess presently. The sixth procedure is aimed at making Mercury potent or active again. All these believes are, it seems, from the point of view of *Dhatuvada*. The so called 'inactivity' or 'impotency' of Mercury must be pointing towards the ultimate object of these procedure. Because while giving and explaining achievements of the 5th procedure, these very texts say that effective medicines can be prepared from the Mercury which has undergone 5 procedures. This would not have been possible, if the Mercury really could be in 'inactive' form.

The actual procedure is described as under:

जलसैन्धवयुक्तस्य रसस्य दिवसत्रयम् ।
स्थितिरास्थापनी कुम्भे याऽसौ रोधनमुच्यते ।। (र.र.स. 8:65)

The actual meaning of this verse is that the Mercury is to be immersed in salt water kept in an earthen pot for three days. That is called as *Rodhana*. Another version of this process is also given in the same text which reads:

सृष्ट्यम्बुजैर्निरोधेन ततो मुखकरो भवेत् ।
स्वेदनादिवशात् सूतो वीर्यं प्राप्नोत्यनुत्तमम् ।। (र.र.स. 11:45)

Mercury when treated with *Srishtyambuja* for *Rodhana* procedure becomes one with 'hungry mouth' (*Mukhakara*), meaning thereby very active, very potent, prone to react. The treatment mentioned here may consist of heating, steaming etc. with *Srishtyambuja*. Apparently the meaning of both verses appear similar however there are vast differences of opinions about what exactly is meant by *Srishtyambuja*. In Dhanwantari Samhita, a popular text, it is stated that:

गोजाविनरनारीणां मूत्रं शुक्रञ्च शोणितम् ।
सृष्ट्यम्बुजाः समाख्याताः षण्ढदोषविनाशकाः ।।

Menses/blood, semen and urine of cow, shegoat, human beings (male and female) are (all) known as *Srishtyambuja*

which destroys the '*Shandha*' property. Eventhough such is the fact, practically and popularly the implied meaning is considered as water prepared by mixing Rocksalt (*Saindhava*) in 5 : 1 proportion.

If this meaning is considered, then this 6th procedure becomes the simplest possible one as it consists of immersing the Mercury in salt water for three days and then washing it. This procedure makes the Mercury 'potent' or 'active' again.

As is common regarding all previous procedures there are various versions of how salt water and Mercury should be treated with each other. Boiling with salt water, Boiling with soar/acidic substances indirectly heating it in a burried form, and so on and so forth.

(7) The Seventh Procedure : Niyamana

The impotency or inactivity of Mercury which is obtained at the end of 5th procedure is corrected after 6th procedure. But it seems that there appears to be 'over correction', as it is stated that after the 6th procedure i.e. *Rodhana* the Mercury obtains '*Virya*' i.e. potency, or activity. It again regains quickness (*chapalatva*). To 'control' this activity and quickness, it is again steam heated (subjected to *swedana*). This procedure is called as *Niyamana*. The original verse is like this:

रोधनाल्लब्धवीर्यस्य चपलत्वनिवृत्तये ।
क्रियते पारदे स्वेदः प्रोक्तं नियमनं हि तत् ।। (र.र.स. 8:66)

The steam heating mentioned above is to be carried out as per the procedure explained below:

नियम्योऽसौ ततः सम्यक् चपलत्वनिवृत्तये ।
कर्कोटीफणिनेत्राभ्यां वृश्चिकाम्बुजमार्कवैः ।
समं कृत्वाऽऽरनालेन स्वेदयेच्च दिनत्रयम् ।। (र.र.स. 11:46)

The procedure is to be carried out exactly like the first procedure (*Swedana*). The plant material mentioned in the verse is to be converted into paste which is again moulded to form a cup. Mercury is to be kept in that cup and steam heated as per the first procedure for three days. The material is:

Sanskrit Name	*English Name*	*Botanical/Chemical name*
1. Karkoti	Cucumber	Luffa echinata
2. Sarpakshi	—	Rauwalfia serpentina
3. Vrischika	Hogweed	Boerhaavia diffusa
4. Saindhava	Rock Salt	NaCl + KCl
5. Markava	—	Elipta albua

There are again many versions about how this procedure is to be carried out. In most of these versions, the plant material changes and rest of the procedure is similar, however few totally different methods are also described by few texts e.g. a method consists of heating the Mercury kept in the crucible made up of Rocksalt, indirectly. Rasasara and Ayurvedprakash these two texts describe such versions with slight difference.

The effects of this procedure are said to be *1.Chapalatva nivritti* (as per Rasaratnasamuchchaya). 2.*Bubhukshitatva* and *3. Vahnimitratva.* The implied meanings of these terms are reduced quickness or activity, hungry - i.e. eager to receive different metals in the form of Bolus and fire-friendly respectively.

(8) The Eighth Procedure : Dipana

Before detailing this procedure, one must understand a terminological word viz. *Grasa*. The literary meaning of this term is a bolus of food to be ingested. The scientists of Rasashastra believed and it seems that they had experi-

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enced few facts which cannot be explained in terms of modern materialistic sciences. It is written in the old texts that Mercury, which has undergone all these purification processes, becomes so active, *Bubhukshita* as referred in seventh procedure, that when chemical substances like Sulphur, Mica etc. and metals like Gold, Silver etc. are mixed in it, such substances are eaten up, digested completely with no trace of them and at the same time weight of the mercury remains constant. The fact is described as if Mercury is living entity. Such process of 'feeding' Mercury is called as *Jarana* and the food in the form of bolus i.e. metals and minerals is called as '*Grasa*'.

In the previous process the effective result is that Mercury becomes *Bubhukshita* i.e. hungry or very active. But it is not ready yet to receive metals and minerals in the form of bolus and digest it completely. But when it becomes ready for such action, it is termed as '*Grasarthi*', one who wishes for the bolus.

The main aim of this eightth process is to convert the mercury in such '*Grasarthi*' form.

Having learned these few concepts, let us now see the definition of this procedure viz. *Dipana*. It is as under:

धातुपाषाणमूलाद्यैः संयुक्तो घटमध्यगः ।
ग्रासार्थं त्रिदिनं स्वेदो दीपनं तन्मतं बुधैः ।। (र.र.स. 8:67)

The steamheating process (*swedana*) of Mercury which is mixed with various metals, minerals and plant products in an earthen vessel for three days so as to make it '*Grasarthi*' is known as *Dipana*.

The metals, minerals and plant substances to be used in this process are explained as:

त्रिक्षारसिन्धुखगभूशिखिशिग्रुराजी-
तीक्ष्णाम्लवेतसमुखैर्लवणोषणाम्लैः ।
नेपालताम्रदलशोषितमारनाले
साम्लासवाम्लपुटितं रसदीपनं तत् ।। (र.र.स. 11:48-49)

The plant and mineral substances are to be intimately mixed together and it is to be coated over a sheet of *Nepali* type of copper. Afterwards this sheet is to be submerged into *kanji* which afterwards becomes too much sour. This very sour *kanji* is to be used for steam heating. Such steam heating for three days makes the Mercury '*Grasarthi*'.

Other classics of Rasashastra describe this process with more or less similar method with little difference in the substances used.

Most of the classics of Rasashastra mention these eight procedures and hence these procedures are collectively called as Ashta-samskara. Few classics like Anandkand and Rasaratnakar however advocate one more procedure called as *Anuvasana*.

(9) The Ninth Procedure : Anuvasana

The ninth procedure is quite simple compared to others, seen before. It consists of mixing the Mercury with lime juice and drying it in hot sunlight. The verses which explain this procedure are as under:

दीपितं रसराजं तु जम्बीररससंयुतम् ।
दिनैकं धारयेद् घर्मे मृत्पात्रे वासितो भवेत् ।। (रसरत्नाकर)

अथानुवासनं कर्म मृत्पात्रे दीपितं रसम् ।
क्षिप्त्वा जम्बीरजद्रावैः तीव्र घर्मेऽनुवासयेत् ।। (आनन्दकन्द)

Discussion and Comments

Until now we have seen in short eight or nine procedures to which Mercury is subjected before it is used to prepare

drugs. We have also noted differences of opinions, mentioned in various other texts. If we analyse these procedures critically, few facts imerge which are worth noting. These are:

(1) Though names of the procedures are similar, there is difference in materials and methods advised by different classics. This fact however, can be explained on the basis of different periods of time in which these classics were written. Interpretation, availability and personal experiences must have played a great role and hence the differences of opinions.

(2) Though the number of procedures is eight (or nine), the actual methods used to accomplish these procedures are four only. They are (i) Steam heating (*Swedana*); (2) Trituration (*Mardana*); (3) Distillation (*Patana*); and (4) Immersion (*Sthapana*).

(3) One substance viz. freshly prepared *Kanji* is used in almost all the procedures either for washing, triturating or steam heating. It must be playing very important role in final convertion of Mercury.

(4) If plant materials used in these procedures are taken into consideration, then it is revealed that most of them are of *ushna* and *tikshna* properties.

(5) The objective itself of the 6th procedure, namely *Rodhana* or *bodhana* is intriguing. The concept of Mercury becomming impotent is strange. The still stranger part is the materials and methods used to treat this impotency. The availability of the materials like semen, menses in such a quantity appear virtually impossible. The substitutes suggested are many and are divergent in their chemical nature and properties. The effective result of the 5th

procedure is mentioned as 'Mercury becomes devoid of all the bad properties' and as per many opinions can be used to prepare medicines. (तदाऽसौ शुद्ध्यते सूतः कर्मकारी भवेद् ध्रुवम्) and suddenly in describing the 6th procedure this 'impotency' is mentioned.

The cause of this impotency is supposed to be various types of triturations, steam heatings, and distillations to which mercury is subjected, in first five procedures (मर्दनैः मूर्च्छनैः पातैः मन्दः शीतः भवेद् रसः). But after the sixth procedure which is meant to cure this impotency the 7th and 8th procedure consist of trituration, steam heating etc. without causing any bad effect. This is quite difficult to understand.

(6) Similar difficulties are faced in understanding various terminologies used in explaining the procedures. e.g. *Bahirmala*. While explaining unwanted properties of Mercury (*Parada dosha*) three types viz. *Naisargika, Yougika* and *Aupadhika* with their subclassifications are stated. Where does *Bahirmala* fit in this system? While explaining the *Saptakanchuka* it is said that all the unwanted properties of Mercury are part of these seven layers and effective result of the second procedure is destruction of *Bahirmala*.

Once this is achieved after the second procedure, there is no purpose for further procedures. It is said that Mercury becomes fire resistant (*Agnisahatva*) after Distillation procedures. After seventh procedure it becomes fire-friendly (*Vahnimitratva*) however the exact nature of these properties and difference between them cannot be stated authoritatively.

(7) The objective of 4th procedure viz *Utthapana* is just to regain the Mercury in the original form. It is not meant for

removal of any bad property, still it has been allotted importance of a separate procedure. However similar procedures to regain Mercury in the original form have been described in almost every procedure, without attaching any significance.

Many such difficulties, obstructions, obstacles, questions do arise in the minds of a critical scholar which remain unanswered, unsolved, unexplained.

In addition, after detailing these procedures, the authors of the same text advocate many 'shortcut' methods. For example it has been stated that Mercury extracted from *Hingula* (Mercury sulphide) with the help of a comparatively simple procedure, need not be subjected to these eight procedures and still it is equally good for use in medicine. There are many such shortcuts explained in various texts. The important question whcih arises after going through all these discussions is whether it is really necessary to follow the eight procedures? What is the point when similar results are obtainable with simpler and short procedures?

Considering the variety and diversity and considering the period of time over which these procedures were in vogue, it seems that the methods of extraction of Mercury from its ore must have been very crude and primary in nature. Naturally the Mercury available must have been very impure. There must be some period in the history when such impure and crude Mercury was used for medicinal purposes. In the forthcoming period bad effects of Mercury on the body were manifested and documented. Experiments were devised to irradicate such bad effects. This process must have been continued for pretty long time. During the period of hundreds of years, this circle of documentation of bad effects - experimentation - observation - redocumentation must have been continued. And therefore the variety in methods, matter required for experimentation and interpretation of the results change from text to text.

The various shortcut purification methods are also result of such experimentation.

The important question which arises is during present time when almost 100% pure Mercury is available in the market is it really necessary to perform these procedures? or if it is not possible at least one of the shortcut procedures on Mercury before converting it into medicinal form?

Before expressing our opinion in this regards, we would like to take cognizance of few research projects. A research project was undertaken in the Rasashastra Department of Tilak Ayurved Mahavidyalaya where it was proved that Boiling point of impure mercury is much less than expected 357.5^{0}C; that of chemically pure is exactly as per expectation and that of mercury subjected to purification process (one of the shortcut ones) is more than 360^{0}C. The changes in physical properties of 'Purified Mercury' are documented elsewhere also.

Now the field is wide open for further research. It will be interesting to see whether medicines prepared from such Mercury are more potent and more effective or not. The changes occuring at the level of molecular structure of such Mercury if any will be also interesting to note.

Rasankusha : The Science and Procedure

These terminologies and entities were in existence in the period when scientists and then research workers were of the firm belief that there is definite role of GOD in learning this science of Rasashastra.

The only mode of propogation and development of this science in that period was transfer of knowledge and experience from teacher to student. The teachers of those days were very very skeptic and selective in choosing their disciples. The process of enrolling a new student for study was known as *Upanayana* which consists of various rituals. One of such rituals is *Rashankusha vidhi* (procedure). The teacher chants specific verses which are in praise of Goddess *Rasankusha* i.e. *Parvati*, at a specific time of the day and in a specific way. A student upon whom such procedure is performed is the one who is eligible to perform experiments on Mercury in the future. The *Rasankusha Vidya* (Science) appears to be some basic knowledge essential for study of Rasashastra. In Rasaratnasamuchchaya, short mention of these words appear in chapter six.

Anyway in our opinion these facts have only historical importance as they are quite obsolete and hence unnecessary in present days.

Chapter 9

Parada : Gati & Bandha

Ways in which Mercury is lost (during experimentations) and various ways to bind the Mercury together.

Uptill now, the properties - both physical and chemical - of Mercury are already studied. Out of the physical properties, two most important ones are especially significant. Those are (1) Liquidity (*Dravatva*) at room temperature (2) Quickness (*Chanchalya*). In the last chapter it was revealed that Mercury, before its medicinal use, is subjected to various procedures which consist of steam heating, trituration, distillation and repeated washing, with or without heat in different forms. Another important property of Mercury is, it evaporates even at room temperature and this process quickens as the temperature increases.

In the period of time in which these procedures were developed and devised, it was common finding that the amount of Mercury lost during such experimentations used to be tremendous as a collective result of these properties. In fact it is stated that only 1/8th portion of Mercury remains after completion of the eight procedures. If the earthen apparatus, methods of sealing the joints of apparatus, methods of washing, methods of controlling heat and methods of storage are taken into consideration, then this is quite likely. In fact scientist of those days must be wondering about the lost Mercury. They must have imagined, and imagined quite correctly at that, that there are Five different ways in which Mercury is lost in various experiments. The texts of Rasashastra have used the word '*Gati*'

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for these ways. This word is derived from the verb *Gama* which means to go. From this word an adjective *Gata* is derived which means gone and *Gati* means way in which something has gone.

The five ways in which Mercury is lost are mentioned as under:

जलगो जलरूपेण त्वरितो हंसगो भवेत् ।
मलगो मलरूपेण सधूमो धूमगो भवेत् ।।
अन्या जीवगतिर्दैवी जीवोऽण्डादिव निष्क्रमेत् ।
स तांश्च जीवयेज्जीवान् तेन जीवो रसः स्मृतः ।।
चतस्रो गतयो दृश्या अदृश्या पञ्चमी गतिः ।
मन्त्रध्यानादिना तस्य रुध्यते पञ्चमी गतिः ।।
इति भिन्नगतित्वाच्च सूतराजस्य दुर्लभः ।
संस्कारस्तस्य भिषजा निपुणेन तु रक्षयेत् ।। (र.र.स.1:82-85)

(1) Jala Gati

It means way of loosing Mercury through water. Mercury has to be recovered in original form through repeated washings in almost all the eight procedures. Due to its liquidity and quickness it is converted into very small and fine particles. Due to heaviness, though most of the Mercury is collected at the bottom of the vessel used in washing, significant amount is lost if water is not kept steady till all particles of Mercury are sedimentated.

(2) Hansa Gati

Hansa maeans swan, a bird which can fly swiftly and gracefully. Due to quickness of Mercury, (*chanchalya*) while transferring it from one vessel to other, or while triturating, small particles bounce off and are lost.

(3) Mala Gati

Actual meaning of the work *mala* means impurities in solid form or matter to be excreted. Impurities present in the

Mercury are made to leave it due to these procedures. In the process some amount of Mercury is also lost due to its adherance to impurities and hence this way of loosing Mercury is called as *Mala gati.*

(4) Dhuma Gati

Dhuma means smoke. Mercury evaporates even at room temperature. During the procedures especially during three types of distillations, if vessels and apparatus used are not properly sealed, the vapours of Mercury escape in air instead of condensing inside the apparatus. Similarly the condensed Mercury may percolate in earthen apparatus itself and becomes difficult to recover. This way of loosing mercury is called as *Dhuma gati.*

(5) Jiva Gati

There is yet another way in which Mercury is lost. The ways which are described previously can be controlled if proper precautions about washing, decanting, sealing, distillating and recovering are observed. But still there is an unexplained way in which Mercury is lost. The scientists of those days have compared it with life. One cannot see the *Prana* or life leaving the body but one can know when it has left it. The similarity is likewise compared while naming the way in which Mercury is lost even after all necessary precautions and with no apparent reason. Some religious rituals like *Mantra, Dhyana* etc. are advocated to prevent loss of Mercury in this way.

Today because of better understanding of physical and chemical properties of Mercury and because of sofisticated apparatuses, ways of controlling heat and improved sealing methods, the loss of Mercury in these ways is minimum if all necessary precautions are taken.

Parada Bandha

(Various ways in which Mercury can be converted into solid/compound form

Mercury which is obtained from its various ores is subjected to various 'purification' procedures. But even when all such processes are complete, it cannot be used internally to cure diseases. This is because of two properties viz. (i) Quickness (*Chanchalya*) and (ii) It is difficult to grab or difficult to absorb in the body (*Durgrahatva*). One must be able to control over these properties by converting it into some other, solid, form so that the Mercury particles will be in the 'bound' form. This 'bound form' of Mercury is called as '*Bandha*'. The word *Bandha* is derived from the verb *Bandha* which means to bind. In the classical texts of Rasashastra 25 such binding processes have been described. Before going into descriptions of individual processes, few important factors must be considered.

All these methods had been invented when the use of Mercury as internal medicine was in experimental stage. Combination of Mercury with various other plant, animal and ocenic products so as to achieve a converted form and the results obtained, are basically described under this heading. Those processes which proved to be useful and effective were developed further while those which proved to be ineffective or harmful were discarded and became obsolete. In detailing these 25 types, many a times a short description of actual process and its expected uses are given. But this is not the rule. The nomenclature used to name a particular process apparently has no relation with either the process or expected results and hence there is no point in translating them into English.

Keeping in mind these points let us study in short the individual *Bandha*.

The original verse from the text explaining the *Bandha* reads as under:

येन येन हि चाञ्चल्यं दुर्ग्रहत्वं च नश्यति ।
रसराजस्य सम्प्रोक्तो बन्धनार्थो हि वार्तिकैः ।। (र.र.स. 11:6)

Matter or substances which destroy the quickness and difficulty of grabbing are to be used for binding the Mercury.

There are 25 *Rasabandhas* have been described in Rasaratnasamuchchaya:

हठारोटौ तथाऽऽभासः क्रियाहीनश्च पिष्टिका ।
क्षारः खोटश्च पोटश्च कल्कबन्धश्च कञ्जलिः ।।
सजीवश्चैव निर्जीवो निर्बीजश्च सबीजकः ।
शृङ्खलाद्रुतिबन्धौ च बालकश्च कुमारकः ।।
तरुणश्च तथा वृद्धौ मूर्तिबद्धस्तथाऽपरः ।
जलबन्धोऽग्निबन्धश्च सुसंस्कृतकृताभिधः ।।
महाबन्धाभिधश्चेति पञ्चविंशतिरीरिताः ।

(रसरत्नसमुच्चय 11:61-63)

(1) Hatha Bandha

When Mercury is converted into *Bandha* without subjecting it to purification processes it is said to be *Hatha bandha*. It is not advisable to consume such a converted form as it leads to certain death or dangerous disease.

(2) Arota Bandha

In this type, Mercury is methodically subjected to purification processes first. The resultant conversion is useful in curing the diseases and rejuvination of the body.

(3) Abhas Bandha

When Mercury is mixed intimately with metals and pulps

of plant, then subjected to controlled heat (*Putapaka*) and thus solidified, it is called as *Abhasa bandha*. No specific uses of this *bandha* are described in the text.

(4) Kriyahina Bandha

When purified Mercury is treated with metals which are not purified then such a form is called as *Kriyahina bandha*.

Medicines prepared from Mercury are so potent, that it is said that the patient need not observe various dietary and other regimes (*Pathya*) strictly. Such regimes if at all advisable then they are limited and simple to follow. But if such *Kriyahina bandha* are to be used, the patients have to observe these regimes very strictly otherwise they have to face serious side effects and unwanted sequelae.

(5) Pishtika Bandha

When Mercury is triturated with force in hot sun (with other substances) so as to get a very fine and butter soft powder, it is termed as *Pishtika bandha*. This is supposed to be of carminative and digestive in action (*dipana* and *pachana*)

(6) Kshar Bandha

When Mercury is triturated with incinerated forms (*bhasma*) of conches, oystershells and cowries the solidified form is called as *Kshar bandha*. Here the word '*Kshar*' is falacious as the incinerated forms cannot be mentioned as *kshar* as per terminologies, however as is explained earlier, development of this *bandha* must have been in the earlier period of development of Rasashastra. And this must be the reason behind use of falacious terminology. One has to accept it as it is with clear understanding.

(7) Khota Bandha

The process which converts Mercury in to a tabloid form which is fire resistant is called as *Khota bandha*, however when subjected to intense heat, it is destroyed gradually. This is supposed to cure 'all diseases' in short time.

(8) Pota Bandha

Methodically purified Mercury and purified sulphur are to be triturated to get a fine black powder which is liquified first with mild heat and then solidified suddenly with pressure. This is called as *Pota bandha*. This actually is the method to prepare very popular and useful dosage form called as *Parpati*. Its types and other details are given elsewhere in the Book. This '*Bandha*' is to be used right from paediatric to geriatric patients so as to cure "all diseases".

(9) Kalka Bandha

When Mercury is converted into a semisolid form like mud by various heat treatments, then it is termed as *Kalka bandha*. It is said that when used along with other medicines, it enhances their actions.

(10) Kajjali Bandha

When purified Mercury and sulphur are intimately mixed in definate proportion so as to get a black powder called as *Kajjali* the *Bandha* is known as *Kajjali bandha*. Chronologically this *Bandha* should have been described before *Pota bandha* as it forms the first step of *Pota bandhaa*. In fact *Kajjali* is the base of many dosage forms.

(11) Sajiva Bandha

When Mercury is converted into '*Bhasma*' form and still does not possess fire resistant property, it is called as *Sajiva*

bandha. It cannot be used to avoid oldage or to cure diseases. Its uses are not described in the texts.

(12) Nirjiva Bandha

Mercury in which Mica (*Abhraka*) and/or sulphur are assimilated, (*Jarita*) when converted into *'Bhasma'* form it is known as *Nirjiva bandha*. It is also known as *Mrita bandha*. It is supposed to cure all diseases.

(13) Nirbija Bandha

When, first Gold is assimilated into mercury in 1/4th quantity, then sulphur is mixed in it in equal proportion, to form a soft powder, terminologically called as *Pishti*, then this *Pishti* is again mixed with equal amount of sulphur and heated in a closed and sealed vessel methodically. This converted form of Mercury is termed as *Nirbija bandha* which is supposed to cure all diseases.

(14) Sabija Bandha

Abhraka sattva, gold, silver, copper and magnetite (*Kanta loha*) are assimilated into Mercury as per method to form *Pishti*. It is then mixed with sulphur taken in 1 : 6 proportion and heated in a proper way in a closed and sealed vessel. This converted form is known as *Sabija bandha*. This has lot of actions on body (*Vipula prabhava*).

(15) Shrinkhala Bandha

When '*Bhasma*' of Mercury prepared with precious stones as constituents and Mercury *Bhasma* prepared without precious stones are mixed together, then such a form is called as *Shrinkhala bandha*. When used, the body becomes disease free and as powerful as steel.

(16) Druti Bandha

Metals and Minerals which are naturally in solid state can be converted into liquid state at room temperature, with certain experiments. Such liquid state is called as *Druti*. When minerals and metals like Mica, Gold etc. are converted into *Druti* form, and then '*Bahya druti*' (experiment mentioned in 18 procedures of purification of Mercury) is performed then such form of Mercury is called as *Druti bandha*. In a very small quantity (1/4th of a mustard seed) it can cure many diseases which are otherwise very difficult to treat.

(17) Balaka Bandha

'*Bhasma*' of Mercury in which mica is assimilated in equal quantity is called as *Balaka bandha*. If consumed in proper quantity, it can prevent many diseases as well as it can be effective in complicated and terminal cases.

(18) Kumara Bandha

The procedure is similar to one described in *Balaka bandha* the only difference being mica is taken in double quantity to that of Mercury. It is to be consumed in quantity equal to weight of one ricegrain for 21 days. It is said that diseases which are supposed to be due to sins of the patient, are cured.

(19) Taruna Bandha

Here, quantity of mica is fourtimes to that of Mercury, otherwise the procedure is same. If consumed for 21 days in correct quantity, it is said to increase power and strength of a person.

(20) Vriddha Bandha

Again a similar procedure except quantity of mica to be

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assimilated in Mercury is six-times here. This is, it is said to be useful in curing the diseases and increasing the longe-vity of life (*Dehavada*) and converting nonprecious metals in to precious ones. (*Dhatuvada*)

(21) Murti Bandha

'*Bhasma*' of Mercury prepared without assimilation of mica, using pulp of devine plants and which is fire resistant is called as *Murti bandha*. If taken with proper vehicle, it is supposed to cure all diseases with good results.

(22) Jala Bandha

When Mercury is solidified with the use of liquids like *Shilatoya*, it is called as *Jala bandha*. Here the reference of *Shilatoya* is given from an old classic called as Rasarnava from its 12th chapter. It reads as under:

गन्धकं तालकं चैव तोयपूर्णं घटे क्षिपेत् ।
यदा तत् बुद्बुदाकारं तदा शैलोदकं भवेत् ।।

When sulphur and yellow orpiment are boiled together in a vessel, full of water, it becomes *Shilatoya*. Exact percentages of Water:, sulphur:, yellow orpiment are not given. How this is to be used to make solid form of Mercury is not explained. It is said that it is used to avoid oldage and death.

(23) Agni Bandha

Mercury alone or mixed with other substances assimilated in it, when heated to make it solid in tabloid form, which is fire resistant then it is called as *Agni bandha*. It makes a person to fly in sky and other such unimaginable functions.

(24) Susanskrit Bandha

Mercuy is triturated with pastes of 14 different plants and urine of cow which is not fertilized yet and the mixture is

heated in a closed vessel in *Valuka yantra* along with various *Mritaloha*. The resultant solid form of Mercury is known as *Susanskrit bandha*. Its exact uses are not mentioned in texts.

(25) Maha Bandha

The twenty four '*Bandha*' which are described till now gave us brief, generalised albeit incomplete idea of its production. But this description of twenty-fifth *bandha* gives us mear characteristics or properties of it, rather than methodology. These characteristics are as under:

1. When heated with either gold or silver, it assimilates them.
2. There is no loss (or gain) in weight.
3. It becomes 'thicker' (*Nibida*).
4. It is heavy.
5. It is turned in to powder form when crushed. (Like salt).
6. The luster of such Mercury is longer lasting.
7. If rubbed (with ?) no impurities are produced.
8. It melts quickly without emitting any order.
9. It is in a tabloid form.

There are apparently many contradictory properties. What exactly is meant by *Nibida*? Dictionary meaning is 'thick'. Then what was the previous consistancy ? If it is thick and heavy, how the property of 'melts in a moment' can be explained ? These and many other such questions remain unanswered as there is no detail explanation. The prefix *Maha* denotes strongness or toughness whereas the properties indicate that it can be easily powdered ! There is no other way but to accept as it is !

Many texts describe one additional *Bandha* viz. *Jalauka*

bandha. This is to be used, in most cases, by females in vaginal pessary form and is intended for getting quicker orgasm in sexual activity of the couple. Again its exact preparation, contents, properties etc. are not mentioned.

As is the usual finding, methods of classification of *Bandha* by different authors differ from period to period. e.g. Rasaprakash Sudhakara, a text of 13th Century had classified '*Bandha*' as *Jalauka, Khota, Pataka* and *Bhasma*. Second chapter of this book describes this in detail.

However, we can classify these '*Bandha*' on the basis of whatever little information we can get and interprete from the old texts. The classification can be based upon the nature of experimentations or procedures advised. These are:

(1) *Bandha* in which the process consists of intimate mixing and trituration of Mercury with various plant and mineral products. e.g. *Kshar, Kriyahina, Pishtika, Jala, Kajjali*, etc. *bandha* are the examples of this group.

(2) The second class can be of those *Bandha* which are associated with the above procedure and heat. *Pota, Kalka, Abhas*, these *Bandhas* can be examples of this class.

(3) In this class Mercury is inevitably converted in to '*Bhasma*' form. *Arota, Sajiva, Nirjiva, Nirbija, Sabija, Shrinkhala, Balaka, Kumara, Taruna, Vriddha, Murti, Susnakrit* types of *Bandha* can be included in this class.

(4) The fourth class is of those *Bandhas* which are described ambiguously, their method of preparation are not mentioned. *Khota, Agni, Maha* etc. *Bandhas* are examples of this class.

Logical conclusions which can be drawn from study of *Bandha* can be summarised as:

(1) Sages and Scientist and Research workers of ancient times were constantly trying to invent various ways in which Mercury can be used internally for medicinal properties.

(2) Toxic effects of Mercury were discovered by them and it was their constant aim to avoid these toxic and other unwanted effects.

(3) Liquidity, instability, constant loss due to vaporization and evaporation were the main problems to be tackled in those periods.

(4) Various experimentations to lessen the toxic effects were grouped under the purification methods and experimentation to achieve solid form of Mercury were grouped under *Bandha*.

(5) Many substances ranging from easily available matter like conches, oyster shells, mica etc. to precious stones like diamonds have been used to achieve solid form of Mercury with the help of mild, moderate or strong heat.

(6) Some of the solid forms achieved were instable while the others were stable.

(7) Many of the solid forms were used in *Lohavada*, procedcures in which methods of converting non-precious metals into precious ones are described. The probable cause of secrecy and ambiguity in describing some of the *Bandha* is this.

(8) These *Bandhas* which are described rather in detail are used as internal medicines even today.

The *Bandha* and short information about their classification and methods of preparation can be seen at a glance from the flow chart given below:

Classification of Bandha

- Impure Mercury is used — *Hatha bandha*
  - Methodology not mentioned.
    - Mahabandha
    - Agni bandha
    - Khota bandha
  - Methodology consists of trituration only.
    - Kriyahina bandha
    - Pishtika bandha
    - Kshar bandha
    - Jala bandha
    - Kajjali bandha
- Purified Mercury is used — *Arota bandha*
  - Methodology consists of trituration & heating
    - Abhas bandha
    - Pota bhandha
    - Kalka bandha
  - Methodology in which 'Bhasma' of mercury is used
    - Arota
    - Sajiva
    - Nirjiva
    - Shrinkhala
    - Balaka
    - Kumara
    - Taruna
    - Vriddha
    - Murty and
    - Susanskrit

Chapter 10

Few Mercurial Formulations

Of all the inorganic substances used in Indian Medicine the most important is mercury. In previous two chapters we have seen how the mercury is processed by *Ashtasamskara* and the various types of *Bandha*, so that to make it stable and suitable to use for medicinal purpose.

In this chapter, we will see how to prepare different mercurial formulations, the proportions of other ingredients used and their methods of preparation. Also we will see in brief, the different therapeutic uses of these formulations along with their media of vehicle (*anupana*).

(1) Kajjali (Black Mercury Sulphide)

Instability of Mercury and its liquid state, are the main hurdles in preparing its medicinal formulations. Since ancient times various procedures have been tried to make it stable. We have seen about them in previous chapter. Amongst all of them, let us see about the *kajjali bandha* or *kajjali*.

The preparation *kajjali* is used commonly as an adjunct or basic ingredient in various formulations and also itself as a medicine, separately. Addition of *kajjali* along with herbal ingredients, in the proportion 1:24, is recommended as it helps to increase their durability and adds to shelf-life, and also reduces their dosage, quantitatively. We have seen the definition of *kajjali*, in the chapter of terminology. There are few other definitions of *kajjali*, mentioned in different texts of Ayurveda.

अर्धसमानद्विगुणमिताद्या गन्धकचूर्णात् पारदकस्य ।
मर्दनजन्या मसृणकाया कज्जलरूपा कज्जलिका सा ।।

(रसतंरगिणी 6:10)

Purified Mercury rubbed with half, equal or double quantity of sulphur becomes soft and black like collyrium. This is known as '*kajjali*' and is used as a base of number of mercurial formulations. (Rasatarangini, 6:10)

योगोक्तमानगन्धेन निर्द्रवो मर्दितो रसः ।
निश्चन्द्रः कज्जलाभासः कज्जलीत्यभिधीयते ।। (रसामृतम् 1)

When the Mercury and sulphur in the recommended proportion, are rubbed together without addition of any liquid; the coryllium like jet black substance, whose shine is lost completely is formed, which is known as '*kajjali*'.

(Rasamrita, 1)

रसेन्द्रे गन्धकं दत्त्वा मर्दयेत्खल्वके शनैः ।
कज्जल्याभा भवेत्तेन कज्जली प्रोच्यते बुधैः ।।

(रसायनसार, परिभाषा-प्रकरण 6)

With the help of pestle and mortar, Mercury and sulphur are slowly rubbed together till the black substance like collyrium is formed. It is known as '*kajjali*'.

(Rasayanasara, Paribhasaha 6)

Different proportions of purified Mercury and sulphur are mentioned in preparing *kajjali*, in different scriptures of Ayurveda. According to modern chemistry, the intimate contact of Mercury and sulphur causes the chemical reaction and a compound mercuric shulphide (HgS) is formed.

According to the law of definite proportion, the compound HgS is formed by combination of Mercury and sulphur in the proportion 6:1. As compared to this modern concept, the proportion of sulphur is much higher in

Ayurvedic formulations of Mercury and sulphur. In many formulations, special *kajjali* is prepared by using sulphur in 1:1, 2:1 or even 6:1 proportions. Eventhough the formulae of such compounds are HgS, this excess of sulphur changes their properties. Clinical trials conducted on these *kajjali* preparations containing different proportions of Mercury and sulphur, will be a good subject for research.

While preparing *kajjali*, the procedure of rubbing of Mercury and sulphur together, is of vital importance. Rubbing enables both the substances to come into intimate contact. To prepare 100 gm *samagandha kajjali* i.e. Mercury and sulphur 50 gm each, it takes 4 to 5 hours, as the rubbing procedure is required to be in slow and steady rhythm. By manual procedure, it requires still more time. The pressure applied during rubbing should be optimum so that *kajjali* will become fine. The rubbing should be continued till the shine of Mercury is lost completely. As the stability of *kajjali* is less, it should be prepared in the amount required for immediate use. It should be kept in airtight bottle. On long term storage, the Mercury gets separated though the colour of *kajjali* remains black.

Medicinal Usage of Kajjali

(1) *Kajjali*, like *Guggulu*, is a superb *yogavahi* i.e. it drags whatever is mixed with it towards the target tissue down into the deeper and most inaccessible parts of the system. When mixed with other medicines, they become more potent and act in low doses. For example, the mixture of camphor, cuscus grass (roots), black pepper (fruits) and rock candy, in equal parts, when combined with *kajjali*, works better to alleviate vomiting. *Kajjali* increases the bio-availability of the drug.

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(2) *Kajjali* along with butter (prepared from cow's milk), works well in gonorrhoea.

(3) *Kajjali*, when mixed with herbal powders or mixtures in proportion 1:24, because of its antimicrobial property it increases the shelf-life of those medicines or powders.

(4) *Kajjali* is well-known for its rejuvenating (*rasayana*) property. It is given along with honey (125 to 250 mg) to achieve its *rasayana* effetcs.

(5) It is used in the preparations like *Parpati, Kupipakva rasayanas, and Khalvi rasayana* like *Rasaparpati, Rasasindura, Sutashekhar, Hemagarbha pottali* etc.

We have learnt that *kajjali bandha* is prepared from the Mercury and sulphur. *Kajjali* is used as base of number of mercurial formulations. Various medicines prepared from *kajjali bandha* undergo specific heating procedure and the drug formed possesses different properties altogether. For example, from *kajjali*, the formulations like *rasaparpati*, *rasasindura* and *rasapottali* are prepared. Let us see about the *parpati* preparations.

(2) Parpati

The Sanskrit word '*Parpata*' denotes a thin crisp wafer. *Parpati* indicates a preparation which is thin, brittle and has a shape of thin crisp wafer. By heating, the *kajjali* is transformed into a thin, flat preparation. In practice, though it possesses a thin, flat shape, it is first powdered and then used for medicinal purpose. The texts like Rasatarangini also mention *parpati* as *parpatika*, meaning the same. But a reference in Bharat Bhaishajya Ratnakar denotes *parpatika* as the bits and fragments left in an iron vessel, during preparing the *parpati*. As it undergoes more heating, than required, it loses its medicinal value.

Procedure

First of all, *Kajjali* is prepared by rubbing pure Mercury and sulphur till it becomes black like collyrium. Then as per the requirements of formulations to be prepared, all ingredients are mixed together and rubbed. The mixture is then transferred into an iron vessel which is coated with a thin layer of ghee from inside and the vessel is then heated. The ghee melts and gets spread on the surface of bottom of the vessel. Then the mixture containing *Kajjali* is poured in the vessel and slowly heated. When the drug substance melts, it is poured on a Banana leaf, which is coated already with a thin layer of ghee. Another similarly colated Banana leaf is kept on the spread substance and the pressure is applied. On cooling on its own (*swangashita*), the banana leaf on the upper surface is removed and the thin crisp wafer, i.e. *parpati* is separated. *Parpati* is finally washed with hot water, then dried and powdered and kept in a bottle. This procedure is commonly followed in the practice.

Sometimes, instead of an iron vessel, the copper vessel or an earthen vessel is also used, as per advise. It seems that the container may be having some effects on the medicinal properties of a drug prepared.

While giving a slow heat, a wooden or an iron stirrer is used. The fuel used for fire is recommended as the wood of *Khadira* (Acacia catechu) or *Badara* (Zizyphus vulgaris) plants. Now a days, liquified petrolium gas or electrical appliances are used.

For spreading the hot liquid drug substance of *kajjali*, various types of leaves are recommended viz. *Kadali* (banana leaf), *Kardali* (plantain leaf), *Nagbela* (betel leaf), *Eranda* (castor oil plant leaf), *Kutaja* (Holarrhena antidysenterica) and *Kakamachi* (Solanum nigrum). Commonly, banana

or plaintain leaves are used. These various types of leaves may be having some effect on medicinal properties of the drug. Finally, when the liquid drug substance is poured on the leaves, gets spread and leaf is placed on it, at this movement, it is very essential to apply an even pressure so that a thin crisp wafer of uniform thickness is formed.

During the procedure, the sulphur in *kajjali* gets liquified and other ingredients become homogeneous with sulphur. The amount of heat given reflects on the final preparation and three types are formed viz. *Mridu paka*, *Madhyama paka* and *Khara paka*.

(1) Mridu Paka

Mridu paka, the final end product after heating is obtained from the drug substance containing *kajjali* by giving mild heat. The black colour of the drug substance changes to turquoise during heating. The *parpati* formed is brittle, breaks without crackling sound. The chemical bondage between Mercury and sulphur is not permanent. Still the *parpati* having *mridu paka* is used for medicinal purpose.

(2) Madhyama Paka

The final end product of *Madhyama paka* is obtained from the drug substance containing *kajjali*, by giving moderate heat. The *parpati* formed is crisp and breaks with a crackling sound. The edges of broken parts are whitish in colour. But the *parpati* formed is in general of blackish colour. The ingredients in this type of *parpati* acquire a good bondage and thus possesses rich medicinal properties. This type of *parpati* is supposed to be the best one.

(3) Khara Paka

Because of severe heat, the *parpati* formed is dry, coarse and reddish in colour. It becomes heavy to digest and is

not recommended for medicinal usage. Only exception is *Rudra parpati*, which is recommended to possess the *khara paka* and is used for medicinal purpose.

Parpati Devoid of Mercury and Sulphur

The drug substance is melted by heating and then cooled and prepared in the form of *parpati*, without the addition of either Mercury or sulphur or both. *Malla parpati* and *Kshara parpati* are the two examples, which do not contain Mercury and sulphur at all. *Shital parpati* does not contain Mercury (Rasayogasagar Vol. II 518).

There is seldom any example of *parpati* which contains Mercury, but no sulphur. The *parpati* preparation wherein sulphur is not used, other substances like *rala* (Shorea robusta) which liquify by heating and get solidified after cooling, are used. *Bhallataka parpati* and *Shweta parpati* are the two examples, which are devoid of sulphur.

Actions of Parpati

The *parpati* preparations possess the hot potency and thus stimulate appetite and improve digestion. Because of these properties it stokes the *agni* and mitigates *ama*, the toxic metabolites in the gastro-intestinal tract (*mahasrotas*). *Parpati* preparations are commonly used in the diseases caused by *ama* in the gut like anorexia, colitis, gout, piles, diarrhoea, dysentery, bronchial asthma, etc.

Various texts of Rasashastra explain in different ways, how *parpati* preparations act spceifically on the colon. One school of thought is that liquified sulphur from *kajjali* coats the mercury and other ingredients and hence it becomes heavy to digest. Thus instead of getting absorbed in the stomach or small intestines, it gets released and is absorbed in the colon. But this view does not explain the

action of the praparation like *Bola parpati*, which acts on the uterus. Another school of thought is that as Mercury and sulphur both are rejuvenatives, alleviate all three *doshas* and are *yogavahi* i.e. catalytic agents. The *parpati* preparations get absorbed into deeper tissues and perform their functions.

The chemical analysis of *kajjali* and *rasaparpati* reveals that both contain little amount of mercuric sulphide (HgS), and large amount of sulphur. But both these preparations possess entirely varied medicinal properties. Thus it should be searched with modern equipments where these *parpati* preparations are absorbed and how they act.

Let us study few different types of *parpati* preparations in brief.

- **Rasa Parpati**

द्रुतकज्जलिका मोचापत्रके चिपटीकृता ।
स पोटः पर्पटी सैव बालाद्यखिलरोगनुत् ।। (र.र.स.11:72)

The *kajjali* prepared from pure Mercury and sulphur is heated till molten, spread on the banana leaf and compressed to form of crisp, thin wafer which is known as *parpati* or *parpati bandha* or *pota bandha*. The *rasaparpati* alleviates nearly all diseases from childhood to old age.

(Rasaratnasamuchchaya, 11:72)

शुद्धपारदगन्धाभ्यां कृता पर्पटिका नृणाम् ।
निहन्ति ग्रहणीं क्षौद्रयुक्ता पथ्यभुजां भृशम् ।।

(रसचण्डांशु-ग्रहणीचिकित्सा 440,
योगरत्नाकर-ग्रहणीचिकित्सा)

The *parpati* prepared from pure Mercury and sulphur is recommended to be taken along with honey as a vehicle

(*anupana*). It alleviates chronic colitis, if dietary regulations are followed along with.

(Rasachandanshu, Grahani-chikitsa 440,
Yogaratnakara, Grahani-chikitsa)

A few mentions have been made in various scriptures of Ayurveda indicating variations in the ingredients of *rasaparpati*. In some of them, in addition to Mercury and sulphur few herbal or mineral ingredients are also incorporated. Whereas, in some references, the basic ingredients Mercury and sulphur are first processed with some herbs and then *rasaparpati* is prepared. Though *rasaparpati* is mainly recommended in treating chronic colitis, it also works well in various diseases when used with different vehicle. For example:

Diseases	*Media of intake (Anupana)*
Unmada (Hysteria)	*Rasna root powder + Ghrita
Apasmara (Epilepsy)	Brahmi juice
Sangrahani (Colitis)	Asafoetida + Cumin seed
Udarashula (Colics)	Castor Oil
Vataja jwara (Fever-Vata type)	Dashamoola decoction
Kaphaja kasa (Cough-Kapha type)	Trikatu powder

* *Rasna* - Vanda roxburghii (root powder)
Brahmi - Bacopa monnieri (plant juice)
Asafoetida (*Hingu*) - Ferula narthex (raisin)
Cumin (*Jiraka*) - Cuminum cyminum (seed)
Castor oil (*Eranda*) - Ricinus communis (seed oil)
Dashamula kwath - Decoction of the 10 roots
Trikatu churna (powder) - *Shunthi, Maricha* & *Pippali.*
Ghrita (*Goghrita*) - Clarified ghee of cow's milk.

Dosage : 250 to 960 mg.

• **Suvarna Parpati**

रसोत्तमं पलं शुद्धं हेमतोलकसंयुतम् ।
शिलायां मर्दयेत्तावद्यावदेकत्वमागतम् ।।
गन्धकस्य पलञ्चैकमयः पात्रे ततो दृढे ।
मर्दयेद् दृढपाणिभ्यां यावत्कज्जलतां व्रजेत् ।।
ततः पाकविधानज्ञः पर्पटी कारयेत्सुधीः ।
रक्तिकादिक्रमेणैव योजयेदनुपानतः ।
ग्रहणी विविधां हन्ति वृष्या सर्वज्वरापहा ।। (रसचण्डांशु)

First of all the purified Mercury and purified Gold are triturated in the pestle and mortar till they are rubbed to form a homogenous form. Then purified sulphur is added and all these ingredients are rubbed together firmly and *parpati* is prepared by routine procedure. [Approximately, 125 mg. *Suvarna parpati* contains 58.8 mg of Mercury and sulphur each and 7.3 mg of Gold.] It mitigates chronic colitis, is an aphrodisiac and relieves the fever.

(Rasachandanshu)

Commonly the pestle and mortar used for grinding is made up of the stone. In this preparation, iron mortar is recommended. *Suvarna parpati* is also extremely useful in tuberculosis and chronic diarrhoea. It should not be used in the patients with psychological imbalance. *Suvarna parpati* is indicated in asthma, anaemia, obstinate urniary disorders, diabetes and debility.

Dosage : 62.5 mg to 250 mg, with milk or vehicles of sweet taste are recommended.

• **Loha Parpati**

रसगन्धकयोः कृत्वा कज्जलं समभागयोः ।
लोहचूर्णं रससमं दत्त्वा संश्लिष्य पर्पटी ।।
कार्या सा विधिना सेव्या रोगिभिः पथ्यभोजिभिः ।

(रसचण्डांशु-ग्रहणीचिकित्सा)

Equal quantity of purified Mercury and sulphur is taken and *kajjali* is prepared. Then *loha churna* (iron) is added into it, in equal quantity to that of Mercury and *parpati* is prepared. It is useful in colitis, colics, anaemia, diarrohea, oedema and enlargement of liver and spleen.

(Rasachandanshu, Grahani)

Dosage : 120 to 960 mg, with approximate vehicle, as per disease.

• **Tamra Parpati**

रसगन्धकताम्राणां चूर्णं कृत्वा समांशिकम् ।
पुटपाकविधौ पक्त्वा मधुनालोड्यसंलिहेत् ।।
सर्वरोगहरं चैतत्पर्पटाख्यं रसायनम् ।

(रसरत्नाकर-वाजीकरणचिकित्सा 302-3)

As per routine procedure, *kajjali* is prepared with the purified Mercury, sulphur, *tamra bhasma* and *parpati* is prepared. It should be given alongwith honey as a vehicle and is highly praised as a rejuvenative and alleviates most of the diseases. (Rasaratnakar, Vajikarana-chikitsa 302-3)

मृतं ताम्रं त्रिभागं च रसं गन्धं च तत्समम् ।
भागमेकं वत्सनाभकज्जली खल्वमध्यगम् ।।
गोघृतेन कृतं कल्कं लोहपात्रे विपाचयेत् ।।
ढालयेदर्कपत्रस्था पर्पटी रससिद्धये ।

(रसचण्डांशु, कासरोगचिकित्सा 28-29)

Tamra bhasma 3 parts, pure Mercury 1 part, pure sulphur 2 parts and purified roots of *Vatsanabha* (Aconitum ferox) 1 part are taken and *kajjali* is prepared. It is then molten in an iron vessel with ghee and *parpati* is prepared.

(Rasachandanshu, Kasaroga 28-29)

These two procedures are followed to prepare *tamra parpati*. Before using this *parpati*, one should confirm that *amritikarana* of *tamra bhasma* is properly done (i.e. it is

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heated with ghee on mild fire by which it excels in properties like nectar). Otherwise raw *tamra bhasma* will exert toxic effects.

Tamra parpati is recommended in many diseases with a specific vehicle or medium of intake. It is shown below in the tabular form.

Diseases	*Vehicle for tamra parpati*
Tuberculosis	Long pepper (*Pippali*) + Honey
Anaemia	Decoction of three myrobalans (*Triphala*)
Colics	Castor oil
Vata-Pitta disease	Aloe vera juice
Ringworm infection	Psoralia decoction (*Bakuchi kwatha*)
Diabetes	Three myrobalans (*Triphala*) and honey
Skin diseases	Decoction of Catechu (*Khadira kwatha*)
Toxic fever	Ginger juice

Dosage : 75 to 125 mg 2 times a day.

• **Vijay Parpati**

Equal quantity of *rasasindura, hiraka bhasma* (incinerated diamond), *suvarna bhasma* (incinerated gold), *roupya bhasma* (incinerated silver), *mouktika bhasma* (incinerated pearl), *tamra bhasma* (incinerated copper) and *abhraka bhasma* (incinerated mica) is taken and to its total quantity, equal quantity of purified sulphur is added and rubbed together and then *parpati* is prepared. *Vijay parpati* is devoid of mercury, but as it contains *rasasindura*, it indirectly contains mercury, though in very small quantity.

Vijay parpati is the remedy for various diseases like chronic colitis, colics, diarrhoea, haemorrhoids, oedema, tuberculosis, hepatitis, anaemia, tumour, ascites, splenic enlargment and skin diseases.

It works well in chronic cases of colitis, abdominal pain due to *ama*, diarrohea and dysentery. It is an effective panacea for gout, anorexia, dyspesia and distaste. Ancient texts of Ayurveda quote that *Vijay parpati* bestows a hundred years of healthy life. It boosts up intelligence and is aphrodisiac.

Dosage : 125 to 250 mg., once a day, with honey.

• **Panchamrit Parpati**

लोहाभ्रार्करसं समं द्विगुणितं गन्धं पचेत्कोलिका-
काष्ठाग्नौ मृदुले निधाय सकलं लोहस्य पात्रे भिषक् ।
सर्वं गोमयमण्डले विनिहते रम्भादले विन्यसेत्
तस्योर्ध्वं कदलीदलं द्रुततरं वैद्येश्वरो निक्षिपेत् ।।
स्यात् पञ्चामृतपर्पटी..... ।। (योगरत्नाकर-ग्रहणीचिकित्सा)

There are various versions of *Panchamrit parpati*, in different texts. Ideally, it should contain five ingredients in equal quantity, but in few texts more than five components are also mentioned. It contains, commonly, purified Mercury and sulphur along with *bhasmas* (calxs) of *abhraka* (mica), *tamra* (copper) and *loha* (iron). The quantity of sulphur is 2 parts, whereas all other ingredients incorporated in 1 part each. Another version indicates that sulphur should be taken 4 parts and other ingredients 1 part each, so that sulphur contents should be in large quantity. Here, in this version of *Panchmrit parpati*, one part each of *loha bhasma, abhraka bhasma, tamra bhasma*, and pure Mercury and eight parts of purified sulphur are recommended in the composition. The routine procedure is followed to prepare first *kajjali* and then its *parpati*.

(Yogaratnakar, Grahani-chikitsa)

Panchamrit parpati is recommended in various diseases like chronic diarrhoea, dysentery, colitis, acid-peptic disease,

tubercular intestinal diseases etc. It is highly praised as one of the best *parpati* preparations. It works well in chronic colitis associated with anaemia, as it contains *loha bhasma* (iron calx) it augments the haemoglobin.

Dosage: 240 to 360 mg, with asafoetida, cumin seeds or rock salt.

(3) Rasapushpa

शुद्धं तोलकपञ्चकं रसवरं काशीसकं सैन्धवं
दत्त्वा चैव समं समं सुमसृणे खल्वे ततः पेषयेत् ।
कूपीमध्यगतं पचेत्तु सिकतायन्त्रेऽथ यामद्वयं
नीहारप्रभमूर्ध्वभागनिचितं पुष्पं रसाद्यं हरेत् ।। (रसतंरगिणी 6:29)

The mixture of purified Mercury, pure *Kasisa* (Ferrous sulphate) and rock salt, in equal quantity, is rubbed together till it becomes homogeneous. The mixture is taken in a glass bottle. The bottle is then covered with several layers of mudcloth. After drying, it is systematically heated in *Valuka yantra*. The white flakes at the neck of bottle are collected, which is *Rasapushpa*.

In *murchchhana* process of Mercury, this preparation is mentioned. To counteract the instability of Mercury though sulphur is commonly used, other substances also can be used in *murchchhana* process of Mercury. This process is performed by two ways viz. by heating in which smoke is produced, called as *Sadhuma* and without heating wherein no smoke is produced is known as *Nirdhuma*. *Rasapushpa* is an example of *sadhuma murchchhana*.

The chemical nature of *Rasapushpa* is mercurous chloride (Hg_2Cl_2) and is also known as calomel in English. In modern medicine, it is used as a purgative. By modern methods in chemistry, it is obtained by mixing hydrochloric acid into mercurous alkali.

$$Hg_2(NO_3)_2 + 2HCl \rightarrow Hg_2Cl_2 \downarrow + 2HONO_3$$

It is also known as *Rasasuma*, *Rasakusum* or *Sudhanidhi rasa*. The test for good quality of *Rasapushpa* is that take a drop of water and add few particles of *Rasapushpa* in it and keep it in an iron vessel. After two minutes, remove the water and see. If it stains black on an iron vessel, it is not of a good quality and vice-versa.

Rasapushpa is used as a purgative, in hiccup, syphilis and in preparation called *rasapushpa malahara*.(*Shatadhouta ghrita* 1 part + *Rasapushpa* 4 parts) which is used topically.
Dosage : 60 to 240 mg, as a purgative.
Vehicle (*Anupana*) : As per disease.

(4) Rasakarpura (Corrosive sublimate) $HgCl_2$

पिष्टं पांशुपटुं प्रगाढममलं वज्रम्बुणानैकशः ।
सूतं धातुगतं खटीकवलितं तं सम्पुटे रोधयेत् ।।
अन्तस्थं लवणस्य तस्य च तले प्रज्वाल्य वह्निं दृढम् ।
घस्त्रं ग्राह्यमथेन्दुकुधवलं भस्मोपरिस्थं शनैः ।।
(रसराजसुन्दर, रसरत्नसमुच्चय 11, रसमंजरी 2:44)

Purified Mercury and rock salt are taken together and triturated and then it is processed (*bhavana*) with the juice of *Snuhi* (Euphorbia neriifolia). The mixture is rubbed for a long time and then is dried. It is then kept in an iron vessel, properly sealed with rags and mud. Iron vessel is kept in *lavana yantra* and is subjected to gradual heating for 12 hours. After cooling on its own, the sealing is removed and the white calx is gathered from the upper part, where is it collected. (Rasarajsundar, Rasaratnasamuchchaya 11, Rasamanjari 2:44)

Other methods of preparing *Rasakarpura* are mentioned in different texts, with few variations in the ingredients. It is mentioned in the texts like Sharagndhar, Rasaprakash Sudhakar, Rasamanjari etc. But with these methods along

with *Rasakarpura* ($HgCl_2$), *Rasapushpa* (Hg_2Cl_2) is also formed, which resembles with each other and cannot be separated.

Another method of preparing *Rasakarpura* is mentioned in Rasatarangini, which is as follows :

पलसंमितं प्रयत्नात् विमलीकृतं रसेशम् ।।
सपलार्द्धकं पलैकं विमलञ्च गन्धकाम्लम् ।।
चषकोपमे विशुद्धं निदधीत काचपात्रे ।
विनिधाय काचपात्रं त्वयसस्त्रिपादिकायाम् ।।
ज्वलिते सुराप्रदीपे संशोषयेज्जलांशम् ।।
अथ शोषिते तु चूर्णे त्ववतार्य वै प्रदीपात् ।।
समभागिकं तु दद्याल्लवणं तु सैन्धवाख्यम् ।।
परिमेल्य चूर्णमेतन्निदधीत काचकुप्याम् ।
युगसङ्ख्यकैस्तु यामैः सिकताख्ययन्त्रसंस्थम् ।
विपचेदतिप्रयत्नात् रसतन्त्रकर्मविज्ञः ।।
अवबुध्य काचकूपीं स्वत एव शीतलाङ्गीम् ।।
घनसारनामधेयं रसमाहरेद्रसज्ञः ।। (रसतंगिणी 6:65-70)

Purified Mercury 1 part and sulphuric acid (*gandhakamla*) 1.5 part is taken in a glass vessel, which is placed on a tripod. It is heated with a spirit lamp till the mixture becomes dry. Then equal amount of rock salt is added to it and the mixture is kept in a bottle, properly sealed with rags and mud. The bottle is subjected to heating for 24 hours in *Valuka yantra*. On cooling on its own, the bottle is opened and *Rasakarpura* gathered at its neck is collected.

It will be interesting and useful to see chemical reactions which undergo during the procedure.

$$Hg + H_2SO_4 \xrightarrow{heat} HgSO_4 + H_2 \uparrow$$

When Mercury and sulphuric acid are heated together, the sulphate of Mercury is formed and hydrogen will be released.

$$HgSO_4 + 2NaCl \xrightarrow{heat} HgCl_2 + Na_2SO_4$$

The rock salt added to sulphate of mercury, when heated, *Rasakarpura* ($HgCl_2$) and Sodium sulphate (Na_2SO_4) will get formed.

To avoid the formation of *Rasapushpa* (Hg_2Cl_2), the small amount of MnO_2 is added. *Rasakarpura* thus formed, is used as an antidote of toxins (*gara visha*). It is also useful as an antidote in lion and tiger bites, serpant bites and toxins caused by trauma of stones etc.

Rasakarpura possesses antidiarrhoeal, antidermatosis, antimicrobial properties and is also an alterative (blood purifier). It is useful in dysentery, distaste, skin diseases and syphilis.

Rasakarpura is a very toxic formulation and hence should be used in very small dosages, cautiously. The recommended dose of *Rasakarpura* is 2-4 mg only. To calculate this small dose, it is practically difficult and thus *Rasakarpura* is mixed or diluted with other substances and is then given. It also helps to eliminate or minimise its toxic effects. Different modes of administration of *Rasakarpura* have been mentioned in Ayurvedic texts.

Of which, it is recommended to give *Rasakarpura* with 16 times of its weight of water, so that it gets properly absorbed. Another reference quotes that *Rasakarpura* should be mixed with few substances like *Navasagar* (salammoniac - ammonium chloride) 625 mg + *Rasakarpura* 625 mg and the mixture is rubbed and water 60 ml is added into it. About 30 to 60 drops of that water is the dose of *Rasakarpura*, advised.

One more combination recommended is that, first

Rasakarpura is triturated with lemon juice. Then *Rasakarpura* 125 mg and *tvak* (cinnamon) powder 5 gm. is triturated till the mixture becomes homogenous and from that, 125 mg of *Rasakarpura* is to be taken as a recommended dose.

Sometimes, even administering *Rasakarpura* with the permutations and combinations mentioned above, it exerts some toxic effects like severe vomiting, retrosternal burning, burning sensation in the stomach, abdominal pain etc., wherein the egg-white should be given to the patients immediately, as it works well as an antidote. The egg-white is rich in albumen, which interacts with *Rasakarpura* and forms a nontoxic substance, which is insoluble in water.

Chemical properties of *Rasakarpura* are as follows:

1. It is a white, crystalline substance.
2. It is soluble in water.
3. It is highly toxic.
4. In dilution 1:2000 it works well as an antiseptic. It was used to dress the wounds and wash the hands etc. in the past. Now a days, it has been replaced by dettol and savlon etc.

(5) Rasasindura (Red Mercury Sulphide)

पलद्वयं शुद्धरसं पलार्धं शुद्धगन्धकम् ।
कर्षार्धं नवसारं च जम्बीरेण विमर्दयेत् ।।
काचकूप्यां क्षिपेद्यैव सप्तधा मृदकर्पटैः ।
विलेप्य काचकूपीं तामातपे शोषयेत् दृढम् ।।
छिद्रभाण्डे ततः कूपीं न्यसेत्सिकतयन्त्रके ।
कूपिकां कण्ठमानेन पूजयेदिष्टदेवताः ।।
पञ्च पूज्याः कुमार्यश्च ततश्चूल्यां विनिक्षिपेत् ।
पचेद्यामाष्टकं चैव कूपिकां च क्षणे क्षणे ।।
संशोध्य पाचयेद्यन्त्रे स्वाङ्गशीतं समृद्धरेत् ।
ग्राह्यं दरदाकारं देवदानवदुर्लभम् ।। (योगरत्नाकर)

There are different methods and ingredients mentioned under the name *Rasasindura* in various scriptures of Rasashastra. Variation in the proportions of the Mercury and sulphur and even *Rasasindura* devoid of *navasagar* and *Rasasindura* without using *kupipakva* method are also mentioned. The most popular and commonly prepared method of *Rasasindura* is mentioned here.

Purified Mercury 2 parts, purified sulphur 1/4 part and purified *navasagar* (Ammonium chloride) 1/16 part are rubbed together in stony mortar and then processed with the juice of *jambira* (Citrus limonum). The powder is then filled into a bottle which is covered seven times with rags and mud. After drying , the bottle is kept in *Valuka yantra* and the sand is filled upto the neck of bottle. Then it is subjected to gradual heating for 24 hours. The mouth of the bottle is kept open with the help of a red hot iron strirrer. After cooling on its own, the bottle is broken tactfully and the *Rasasindura* gathered at the neck of bottle is collected. While taking out, it looks bluish in colour.

(Yogaratnakar)

Rasasindura is recommended with specific medium of intake (*anupana*) in different diseases:

Diseases	*Anupana (medium of intake)*
Diabetes - Vata type	Pippali (Piper longum) powder+Honey
Diabetes - Pitta type	Triphala (Three myrobalans) powder + Sugar
Cough,Dyspnoea, Colic	Trikatu (Three pungents) powder + Honey
Hepatitis, Anaemia	Triphala (Three myrobalans) powder
Blood disorders	Haridra (Turmuric) and Sugar
Dysuria	Shilajitu (Black bitumen)
Tuberculosis,Pleurisy	Ardraka (Ginger) juice.

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Rasasindura mitigates *Kapha dosha* because of its hot potency and is highly praised as a drug of choice in respiratory diseases like bronchitis, pneumonia, pleurisy, dyspnoea, chronic cold and asthma. Because of its hot potency it clears off the blockades in subtle channels (*srotorodha*) and works well as an antipyretic drug also. Dyspnoea due to aggravated *Kapha* leading to blocked phelgm is relived by *Rasasindura* as it alleviates *Kapha dosha*. Moreover, *Rasasindura* works well as a catalyst and increases the potency of a drug with which it is mixed. While administering to the patient, the hard piece of *Rasasindura* is rubbed with force over a stone having rough surface alongwith vehicle and the mixture is used. The piece of *Rasasindura* can be converted to powder form and used.

Dosage : 15-30 mg. with appropriate vehicle.

The preparation of *parada bhasma* is now almost outdated. So, when *parada bhasma* is mentioned, *Rasasindura* is used instead of it.

(6) Makaradhvaja

पलं मृदुस्वर्णदलं रसेन्द्रात् पलाष्टके षोडशगन्धकस्य ।
शोणैः सुकार्पासभवैः प्रसूनैः सर्वं विमर्द्याथ कुमारिकाद्भिः ।।
तत्काचकुम्भे निहितं सुगाढं मृत्कर्पटैः तद् दिवसत्रयं च ।।
पचेत्क्रमाग्नौ सिकताख्ययन्त्रे ततो रसः पल्लवरागरम्यः ।
तन्त्रान्तरे प्रसिद्धोऽयं मकरध्वजनामतः ।

(रसयोगसागर, योगरत्नाकर)

First of all thin, fine sheets of gold (1 part) and purified mercury (8 parts) are rubbed together till the gold becomes homogenous with mercury. Then purified sulphur (16 parts) is added into it and rubbed together till *kajjali* is formed. This *kajjali* is processed (*bhavana*) with the juice of red flowers of *Karpasi* (Gossypium herbaceum) i.e. red cotton plant, for 3 times. Further, it is processed with the juice of *Kumari* (Aloe vera) and filled in a glass bottle (*kupi*) and covered with rags and mud for eleven times. It is then heated gradually for 3 days. After cooling on its own, the bottle is broken tactfully and *Makaradhvaja* gathered at the neck of bottle is collected and *Suvarna-bhasma* (calx of gold) gathered at the bottom is also collected separately. Alongwith *Suvarna bhasma*, sometimes gold and collyrium is also found gathered at the bottom.

(Yogaratnakar)

Makaradhvaja preparation is also known as ***Chandrodaya Rasa***. Various variations have been mentioned in different texts, describing the preparation of this formulation. Some of them are *khalvi rasayanas* i.e.prepared by rubbing and few are *kupipakva rasayanas* i.e.prepared by heating in the bottle. In some of the methods, it is devoid of gold also. The above mentioned procedure described in Yogaratnakar, which is commonly followed, is described here.

As the gold and *Suvarna bhasma* can be gathered at the bottom of the bottle, whether *Makaradhvaja* preparation contains gold or not remains controversial. But similar preparation like *Rasasindura*, which is devoid of gold shows entirely different properties. Hence, it is supposed that *Makaradhvaja* does contain the traces of gold. It is necessary to prove it with modern parameters of chemistry.

(7) Siddhamakaradhvaja

Makaradhwaja mentioned above, is first prepared. About 40 gm. of it is taken and equal amount of camphor (*karpura*) is added into it. Moreover, nutmeg (*jatiphal*, clove (*lavanga*), musk (*kasturi*) and cuttle fish or sepia (*samudraphena*) 3 gm. each is added to above mixture and triturated till it becomes homogeneous. This mixture is further processed with (*bhavana*) the juice of betel leaf and

dispensed in a form of 120 mg tablet. This preparation is known as *Siddhamakaradhvaja* or *Purnachandrodaya Rasa*. Both, *Makaradhvaja* and *Siddhamakaradhvaja*, are the best aphrodisiac preparations and are used in depletion of tissues (*dhatu-kshaya*). These preparations are rejuvenating i.e. delay the ageing process and prevent wrinkling and hairfall.

Dosage : 15-30 mg.

Vehicle *(Anupana)* : Betal leaf or ghee or ghee and honey (1:1).

(8) Hingulottha Rasa

जम्बीरनिम्बुनीरेण मर्दितो हिङ्गुलो दिनम् ।
उर्ध्वपातनयन्त्रेण ग्राह्यः स्यान्निर्मलो रसः ।।
कञ्चुकैर्नागवङ्गाद्यैर्निर्मुक्तो रसकर्मणि ।
विना कर्माष्टकेनैव सूतोऽयं सर्वकर्मकृत् ।। (रसेन्द्रसारसंग्रह 1:51-53)

Purified *hingula* (Cinnabar) powder is rubbed with the juice of *Jambira* (Citrus limonum) for 24 hours and the fine paste formed is coated on the inner surface of lower pot of *Urdhvapatana yantra*, which is subjected to heat. A thin layer of Mercury is obtained on the inner surface of upper pot. It is to be collected. It is the purest form of Mercury, which can be used for medicinal purpose as it is without the rituals and procedures described previously.

(Rasendrasarasangraha 1:51-53)

To procure Mercury, wheather natural form of *hingula* (cinnabar) should be taken, is controversial. Now a days, it is difficult to get the natural form of *hingula*, hence artificial one is used, which also renders all properties of 'purified' Mercury.

एतस्मात् आहृतः सूतः जीर्णगन्धसमो गुणैः । (र.र.स. 3:141)

During the formation of *hingula* (Cinnabar) either in natural form or synthetic, the process of heat on the combination of Mercury and sulphur is of vital importance, which probably might be eliminating the impurities in Mercury.

(Rasaratnasamucchaya, 3:141)

Today, more scientific research is required on this aspect. Though the mention has been made that the Mercury procured by this method, can be directly used for medicinal purpose; it is also mentioned that before use the Mercury is processed (*bhavana*) with the juice of betel leaf. Moreover, it is mentioned that Mercury should be processed with lemon juice, rock salt and then washed off with lukewarm water, before use.

(9) Mrittyunjaya Rasa

विषस्यैकस्तथा भागो मरिचं पिप्पली कणा ।
गन्धकस्य तथा भागो भागः स्याट्टङ्कणस्य वै ।।
सर्वत्र समभागः स्याद् द्विभागं हिङ्गुलं भवेत् ।
जम्बीरस्य रसेनात्र हिङ्गुलं भावयेद्भिषक् ।
रसश्चेत्समभागः स्याद् हिङ्गुलं नेष्यते तदा ।
गोमूत्रशोधितञ्चात्र विषं सौरविशोषितम् ।।
चूर्णयेत् खल्लमध्ये तु मुद्गमात्रां वटीं चरेत् ।
मधुना लेहनं प्रोक्तं सर्वज्वरनिवृत्तये ।।

(भैषज्यरत्नावली-ज्वरचिकित्सा 510-513)

Purified *Vatsanbha* (Aconitum ferox), *Maricha* (Piper nigrum), *Pippali* (Piper longum), *Gandhaka* (Sulphur), *Tankana* (Borax) each one part, purified *Hingula* (Cinnabar) 2 parts or *Parada* (Mercury) 1 part should be taken together. *Vatsanabha* should be purified by soaking it in cows' urine for three days and dried in sunlight. *Hingula* should be purified by rubbing it in *Jambira* (Citrus limonum)

All these ingredients are rubbed together in ginger juice or

Jambhira juice and the fine semi-solid pulp formed is taken and small tablets weighing about 30 mg each are prepared. This preparation when given alongwith honey, alleviates all types of fevers.

(Bhaishajyaratnavali - Jwarachikitsa 510-513)

It alleviates particular type of fever, when given alongwith a particular vehicle. For example, when this preparation is given alongwith whey (watery part of curd), it alleviates *Vataja* type of fever, whereas, with the ginger juice, it mitigates *Sannipatika* type of fever. With the fruit juice of *Jambira* (Citrus limonum), it alleviates fever of *ajirna* (indigestion) origin and with jaggery and cumin seeds - *Jiraka* (Cuminum cyminum) it mitigates *Vishama jvara. Mrittyunjaya rasa* alleviates *Vata-pittaja jvara* or in fever associated with burning sensation. It should be followed with coconut water or sugar and water.

Dosage : Adults - 3 to 4 tablets, children and old individuals - 1 tab.

(10) Rajamriganka Rasa

रसभस्मत्रयो भागा भागैकं हेमभस्मकम् ।
मृतताम्रस्य भागैकं शिलातालकगन्धकम् ।
प्रतिभागद्वयं तत्राप्येकीकृत्य निधापयेत् ।
वराटिका तेन पूर्या चाजाक्षीरेण टङ्कणम् ।।
पिष्ट्वा तेन मुखं रुद्ध्वा मृदो भाण्डे निधापयेत् ।
शुष्कं गजपुटे पाच्यं चूर्णयेत्स्वाङ्गशीतलम् ।
रसो राजमृगाङ्कोऽयं चतुर्गुञ्जं क्षयापहम् ।
दशपिप्पलिकैः क्षौद्रैर्मरिचैकविंशकैः ।।
सघृतैर्दापयेद्वातपित्तश्लेष्मोद्भवे क्षये ।

(भैषज्यरत्नावली, राजयक्ष्माचिकित्सा 157-161)

Incineration of mercury or *Rasasindura* 3 parts, calx of gold and copper 1 part each, purified orpiment, realgar and sulphur 2 parts each are taken.

First calx of Mercury and purified sulphur, are rubbed together till a homogeneous compound is formed. Then all other ingredients mentioned above are added into it and rubbed together. This mixture is then filled in purified cowries. The open sides of cowries are sealed with a mixture of borax and goat's milk. Then these cowries are dried and sealed inside the soucers and subjected to heating, by giving one *gajaputa*. After cooling on their own, the drug substance inside the cowries is finely powdered, alongwith cowries. The final preparation formed in known as *Rajamriganka rasa*.

Dosage and Medium of Intake

About 480 mg. (4 *gunja*) of *Rajamriganka rasa* is mixed with fine powder of 10 *Pippali* (Piper longum) fruits and 21 *Maricha* (Piper nigrum) fruits. The mixture is then given along with 2.5 ml honey and 2.5 ml ghee. This formulation mitigates tuberculosis, caused by *Vata*, *Pitta* and *Kapha doshas*. (Bhaishajyaratnavali, Rajayakshmachikitsa, 158-161)

(11) Hemagarbha Pottali

शुद्धं सूतञ्चतुर्भागं द्विभागं गन्धकस्य च ।
भागमेकं सुवर्णञ्च त्रिभागं शुल्बभस्म च ।।
कुमारीरससंयुक्तं सप्ताहं मर्दयेद् दृढम् ।
गुटिकां कारयेत्तान्तु बध्नीयात्खरकर्पटे ।।
वस्त्रे किञ्चिद्बलिं दत्त्वा तत्र गोलं निधाय च ।
बध्नीयात्पोट्टलीं गाढां पश्चाद्वस्त्रेण वेष्टयेत् ।।
सर्वभागसमं गन्धं दत्त्वा मृन्मयभाजने ।
तन्मध्ये पोट्टलीं न्यस्य मुखे मुद्राञ्च कारयेत् ।।
विधाय छिद्रं मुद्रास्थं द्रावं दृष्ट्वा शलाकया ।
पाचयेत्सिकतायन्त्रे रसोऽयं मृदुवह्निना ।।
यामार्धेन सुसञ्जातं स्वाङ्गशीतं समुद्धरेत् ।
कासे श्वासे क्षये वाते कफे ग्रहणिकागदे ।।
सर्वरोगेषु दातव्या हेमगर्भाख्यपोट्टली ।। (रसयोगसागर 632)

Purified Mercury 4 parts, sulphur 2 parts, calx of gold 1 part, calx of copper 3 parts are taken together and finely rubbed till *kajjali* is formed. Then it should be rubbed with the juice of aloe (Aloe vara - *kumari*) for 7 days. Of this mixture, small pyramid shaped-*matras* are prepared. A four-layered silk cloth is taken and pure sulphur powder is sprinkled and spread on it. On the surface of this cloth, single pyramid is placed and wrapped in a form of a pouch (*pottali*). This pouch is placed in a saucer, at the base of which pure sulphur powder is already spread. Then another saucer is kept upside-down on the pouch and both the saucers are properly sealed with the rag and mud. Before sealing, sulphur powder is also spread on the upper surface on the pouch. After drying of the sealing, a small hole is made on the upper saucer. The sealed saucers (*sharava samputa*) is then subjected for slow heating. During heating, it is confirmed with the help of a stick that the sulphur spread on the surface of pouch is burnt off. Then heating is stopped and after cooling on its own (*swanga shita*), the suacers are opened and *matras* are cleaned by a dry cloth.

Uses: It is useful in cough, dyspnoea, tuberculosis, colitis of *Vata* and *Kapha* origin.

Dosage: 360-480 mg. with proper *anupana*.

(Rasayogasagar, 632)

(12) Sarvajvarahara Loha

चित्रकं त्रिफला व्योषं विडङ्गं मुस्तकन्तथा ।
श्रेयसी पिप्पलीमूलोशीरं देवदारु च ।
किराततिक्तकं बालं कटुकी कण्टकारिका ।
शोभाञ्जनस्य बीजञ्च मधुकं वत्सकं समम् ।।
लौहतुल्यं गृहीत्वा तु वटिकां कारयेद्भिषक् ।
सर्वज्वरहरो लौहः सर्वज्वरकुलान्तकृत् ।।
वातिकं पैत्तिकं श्लेष्मं द्वन्द्वजं सान्निपातिकम् ।

जीर्णज्वरञ्च विषमं रोगसङ्करमेव च ।
प्लीहानमग्रमांसञ्च यकृतञ्च विनाशयेत् ।।

(भैषज्यरत्नावली-ज्वरचिकित्सा 1170-74)

Fine powder of 20 plant parts is taken (1 part each) together. These are *Chitraka* (Plumbago zeylanika) root, *Haritaki* (Terminalia chebula) fruit, *Bibhitaka* (Terminalia belerica) fruit, *Amalaki* (Phyllanthus emblica) fruit, *Shunthi* (Zingiber officinale), *Maricha* (Piper nigrum), *Pipalli* (Piper longum) and *Pippalimula*, alongwith *Gajapippali* (Piper longum), *Vidanga* (Embelia ribes), *Motha* (Cyperus rotundus), *Ushira* (Vetiveria zizanioides), *Devadara* (Cedrus deodara), *Kiratatikta* (Swertia chirata), *Katuka* (Picrorrhiza kurroa), *Kantakari* (Solanum xanthocarpum), *Shigru* (Moringa oleifera) seed, *Yashtimadhu* (Glycyrrhiza glabra), *Vasa* (Adhatoda vasica) and *Netrabala*, a variety of *Ushira*.

Equal quantity (20 parts) of incineration (*bhasma*) of iron (*loha*) is mixed in the above ingredients and the mixture is rubbed together with water and tableted. Each tablet of 120 mg. is prepared.

(Bhaishajyaratnavali, Jwarachikitsa, 1170-74)

Usage : *Sarvajvarahara loha* is useful to alleviate fevers of all types like *Vataja, Pittaja, Kaphaja, Dvandvaja, Sannipatika, Jirna* and *Vishama jvara*. It is also useful in hepatosplenomegaly and dilatation of heart.

Dosage : 1-2 tablets (120 to 240 mg), with proper vehicle *(anupana)*.

(13) Vatakulantaka Rasa

मृगनाभिः शिला नागकेशरं कलिवृक्षजम् ।
पारदं गन्धकं जातीफलमेलालवङ्गकम् ।।
प्रत्येकं कार्षिकञ्चैव श्लक्ष्णचूर्णञ्च कारयेत् ।

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जलेन मर्दयित्वा तु वटीं कुर्याद् द्विरक्तिकाम् ।
यथाव्याध्यनुपानेन योजयेच्च चिकित्सकः ।
अपस्मारे महाघोरे मूर्च्छारोगे च शस्यते ।।
वातजान् सर्वरोगांश्च हन्यादचिरसेवनात् ।
नातः परतरं श्रेष्ठमपस्मारेषु वर्त्तते ।।
ब्रह्मणा निर्मितः पूर्वं नाम्ना वातकुलान्तकः ।।

(भैषज्यरत्नावली-अपस्मारचिकित्सा 26-30)

Musk, purified realgar (*Manahshila*), *Nagakeshara* (Mesua ferrea), *Bibhitaka* (Terminalia belerica), purified mercury and sulphur, *Jatiphala* (Myristica fragrans), *Ela* (Elettaria cardamomum) and *Lavanga* (Syzygium aromaticum) are taken in fine powder form, 1 part each. First, *kajjali* is prepared from purified Mercury and sulphur and all other ingredients are added into it and rubbed together. Small quantity of water is added, as per requirement, during rubbing. Then tableting is done. (Each tablet of 240 mg)

(Bhaishajyaratnavali, Apasmarachikitsa, 26-30)

Usage : *Vatakulantaka* is used in epilepsy. It also alleviates various *Vataja* diseases effectively.

Dosage : 1-2 Tablets (240 - 480 mg), with proper vehicle.

(14) Ramabana Rasa

पारदामृतलवङ्गगन्धकं भागयुग्ममरिचेन मिश्रितम् ।
जातिकाफलमथार्धभागिकं तिन्तिडीफलरसेन मर्दितम् ।।
माषामात्रमनुपानयोगतः सद्य एव जठराग्निदीपनः ।
सङ्ग्रहग्रहणिकुम्भकर्णकं सामवातखरदूषणं जयेत् ।।
वह्निमान्द्यदशवक्त्रनाशनो रामबाण इति विश्रुतो रसः ।।

(भैषज्यरत्नावली-अग्निमान्द्यादिचिकित्सा 90-92)

Purified Mercury, sulphur, *Vatsanabha* (Aconitum ferox) and *Lavanga* (Syzygium aromaticum) are taken in 1 part each, with *Maricha* (Piper nigrum) 2 parts. To it *Jatiphala* (Myristica fragrans) 0.5 part is added and all ingredients

are rubbed in tamarind (Tamarindus indica) water and tablating is done (each tablet of 30 mg).

Ramabana rasa is used with great benefit in colitis, rheumatic fever and anorexia.

Dosage required is 1-2 tablets (30-60 mg) and is given alongwith cumin powder-*Jiraka* (Cuminum cyminum) and honey.

(Bhaishajyaratnavali, Agnimandyadi chikitsa 90-92)

(15) Kumarakalyana Rasa

सिन्दूरं मौक्तिकं हैम व्योमायो हेममाक्षिकम् ।
कन्यारसेन सम्मर्द्य कुर्यान्मुद्गमिता वटी ।।
वटिकां वटिकार्धं वा वयोऽवस्थां विविच्य च ।
क्षीरेण सितया सार्द्धं बालेषु विनियोजयेत् ।
कुमाराणां ज्वरं श्वासं वमनं पारिगर्भिकम् ।
ग्रहदोषाश्चं निखिलान् स्तन्यस्याग्रहणं तथा ।।
कामलामतिसारश्च कृशतां वह्निवैकृतम् ।
रसः कुमारकल्याणो नाशयेन्नात्र संशयः ।।

(भैषज्यरत्नावली-बालरोगचिकित्सा 119-122)

Rasasindura, *Muktapishti*, incineration (*bhasma*) of gold, mica and iron alongwith *Suvarnamakshika bhasma* is taken, in equal quantity, and is processed together in aloe juice (*bhavana*). Then tablating is done (each tablet of 30 mg).

Kumarakalyana rasa, meaning useful for the welfare of infants and children, is beneficial in treating loss of appetite, vomiting, fever, dyspnoea, hepatitis, debility and diarrhoea in young ones. Dosage required is 1 to 2 tablets (30-60 mg). *Anupana* used commonly, is honey.

(Bhaishajyaratnavali, Balaroga-chikitsa, 119-122).

(16) Garbhapala Rasa

हिङ्गुलं नागवङ्गौ च त्रिजातं च कटुत्रयम् ।।
धान्यकं कृष्णजीरं च चव्यं द्राक्षा सुरद्रुपः ।

कर्षमानं पृथक् सर्वं कर्षार्धं लोहभस्म च ।।
सप्ताहं मर्दयेत्खल्ले विष्णुक्रान्तारसेन च ।
गुञ्जामात्रा च वटिका द्राक्षाक्वाथेन योजयेत् ।
मासप्रथममारभ्य नवमासान्तमेव च ।
गर्भिणीरोगनाशार्थं गर्भपालरसः स्मृतः ।।

(रसचण्डांशु-गर्भिणीरोगचिकित्सा 637-640)

Purified cinnabar (*Hingula*), *bhasmas* of lead (*naga*) and tin (*vanga*), *Tamalapatra* (Cinnamomum tamal), *Ela* (Elettaria cardamomum) i.e. cardamum, *Shunthi* (Zingiber officinalis) i.e. dry ginger, *Maricha* (Piper nigrum) i.e. black pepper, *Pippali* (Piper longum), *Dhanyaka* i.e. Coriander seed (Coriandrum sativum), *Krishnajiraka* (Carum carvi), *Draksha* (Vitis vinifera), *Chavya* (Piper chaba) and *Deodara* (Cedrum deodara) are taken in equal quantity (10 gm each) and incineration of iron (*loha bhasma*) is taken 5 gm in quantity and all these ingredients are rubbed together in juice of *Vishnukranta*, for one week. Then it is dried and tableted (120 mg tablet, each). *Garbhapala rasa* is recommended in pregnancy, from the first month of gestation. It alleviates and prevents diseases during pregnancy, moreover it facilitates the proper growth of the foetus. (Rsasacandanshu, Garbhiniroga-chikitsa, 637-40)

Dosage : 1 tab, twice a day, with decoction of raisins.

(17) Pratapalankeshvara Rasa

एकेन्दुचन्द्रानलवार्धिदन्तीकलैकभागं क्रमशो विमिश्रम् ।
सूताभ्रगन्धोषणलोहशंखवनयोत्पलाभस्म विषं च पिष्टम् ।
प्रसूतिवातेऽनिलदन्तबन्धे सार्द्राम्भसा वल्लममुष्य लिह्यात् ।
वातामये श्लेष्मगदेऽर्शसि स्यात्पुरामृतार्द्रात्रिफलायुतोऽयम् ।
सशृङ्गबेरद्रव एष हन्ति ससन्निपातं ज्वरमुग्ररूपम् ।।
निजानुपानैर्निजपथ्ययुक्तः सर्वातिसारग्रहणी विकारान् ।
प्रतापलङ्केश्वरनामधेयः सूतः प्रयुक्तो गिरिराजपुत्र्या ।।

(रसचण्डांशु-सूतिकारोगचिकित्सा 658-660)

Purified Mercury, incinerated mica (*Abhraka bhasma*), purified sulphur and *Vatsanabha* (Aconitum ferox) 1 part each; black pepper i.e. *Maricha* (Piper nigrum) 3 parts, incinerated iron (*Loha bhasma*) 4 parts, calx of conch (*Shankha bhasma*) 8 parts and calx of cowdung cakes 16 parts, are taken together and triturated.

It is the best remedy for postpartum diseases, especially, due to aggravated *Vata dosha*. It is given alongwith ginger juice, 250 to 500 mg.

This preparation is given alongwith *Guggulu* (Commiphora mukul), *Guduchi* (Tinospora cordifolia), Ardraka (Zingiber officinalis) and decoction of *Triphala*, in diseases of *Vata* and *Kapha*, and piles. It relieves the fever caused by aggravation of all *doshas* (*Sannipatika jvara*), when given alongwith ginger juice.

Pratapalankeshvara rasa mitigates all types of dysenteries and colitis, when given with proper media of intake and necessary dietary regimen.

(Rasachandanshu, Sutikaroga-chikitsa, 658-660).

(18) Lakshmivilas Rasa : (Kasa)

शुद्धसूतं सतालञ्च तालाङ्कुरं सखर्परम् ।
वङ्गं ताम्रं घनं कान्तं कांस्यकं च पलं पलम् ।।
केशराजरसेनैव भावयेद्दिवसयत्रम् ।
कुलत्थस्य रसेनापि भावयेच्च पुनः पुनः ।।
एला जातीफलाख्यं च तेजपत्रं लवङ्गकम् ।।
यवानी जीरकञ्चैव त्रिकटु त्रिफला समम् ।
नतं भृष्टं वंशगर्भं कर्षमात्रञ्च कारयेत् ।
भावयेच्च रसेनाथ गालयेत्सर्वमौषधम् ।।
छायाशुष्का वटी कार्या चणकप्रमिता तथा ।
शीताम्बुना पिबेद्धीमान् सर्वकासविवृत्तये ।।
मत्स्यं मांसं तथा क्षीरं पथ्यं स्यात्स्निग्धभोजनम् ।
खयं कासं तथा श्वासं ज्वरं हन्ति न संशयः।।

(भैषज्यरत्नावली-कासचिकित्सा 130-135)

Purified mercury (or *Rasasindura*), purified orpiment (*Haratala*) and realgar (*Manahshila*), purified Zinc carbonate (*Rasaka*) and incinerations (*bhasmas*) of lead (*vanga*), copper (*tamra*), mica (*abhraka*), bronze (*kasya*), iron, a type (*kantaloha*) are taken in equal quantity. They are rubbed together till become homogeneous. Then it is processed (*bhavana*) with *Bhringaraja* (Eclipta alba) juice for 3 days. Then it is again processed with *Kulattha* (Dolichos biflorus) decoction, for 7 times. To this, *Ela,Jatiphala, Lavanga, Ajamoda, Jiraka, Triphala, Trikatu, Tvak, Tejapatra, Tagara* and *Vamshalochana* powders (10 gm each) are added. Finally, the mixture is processed with juice of *Bhringaraja* and the decoction of *Kulattha*, for once each. Then the mixture is dried and tableted. (each tablet - 240 mg).

Laxmivilasa rasa prepared by this method, is the best panacea for all types of coughs. It is given alongwith cold water. During treatment fish, flesh, milk and oleated food items should be included in the diet.

It alleviates diseases like tuberculosis, cough, asthma, fever, jaundice, anaemia, oedema, abdominal colic, piles, diabetes mellitus, etc; when given with proper *anupana*. During treatment sour substances and roasted food is restricted and exposure to fire should also be avoided.

(Bhaishajyaratnavali, Kasachikitsa, 130-135)

(19) Lakshmivilas Rasa : (Rajayakshma)

सुवर्णतारभ्रकताम्रवङ्गत्रिलोहनागामृतमौक्तिकानि ।
एतत्समं योज्य रसस्य भस्म खल्ले कृतं स्यात्कृतकज्जलीकम् ।
सुमर्दयेन्माक्षिकसम्प्रयुक्तं तच्छोषयेद् द्वित्रिदिनं च घर्मे ।
तत्कल्कमूषोदरमध्यगामि यत्नात्कृतं तार्क्ष्यपुटेन पक्वम् ।।
यामाष्टकं पावकमर्दितं च लक्ष्मीविलासो रसराज एषः ।
क्षये त्रिदोषप्रभवे च पाण्डौ सकामले सर्वसमीरणेषु ।।

शोफप्रतिश्यायप्रणष्टवीर्यं मूलामयं चैव सशूलकुष्ठम् ।
हत्वाग्निमान्द्यं क्षयसन्निपातं श्वासं च कासं च हरेत्प्रयुक्तम् ।
तारुण्यलक्ष्मीप्रतिबोधनाय श्रीमद्विलासो रसराज एषः ।।

(भैषज्यरत्नावली-राजयक्ष्माचिकित्सा 222-225)

Incinerations (*bhasma*) of gold, silver, copper, mica, tin and *triloha* i.e. *tikshna*, *munda* and *kanta*, types of iron, lead, alongwith purified *Vatsanabha* (Aconitum ferox) and calx of pearl (*mouktika bhasma*) are taken, 1 part each, equal quantity (9 parts) of incinerated Mercury is added and the mixture is processed (*bhavana*) with honey. Then it is dried in sunlight for 2 to 3 days and is subjected to heating, by giving one *Kukkuta puta*. On cooling on its own (*svanga shita*), the mixture is processed with juice of roots of *Chitraka* (Plumbago zeylanica). It is dried and finally tableted.

Laxmivilasa rasa, prepared by this procedure, is useful in treating tuberculosis (*Rajayakshma*), anaemia, hepatitis, *Vata* diseases, oedema, oligospermia, piles, skin diseases, anorexia, asthma, cough and tuberculosis caused by aggravation of all three *doshas*. It is rejuvenating too. This *Laxmivilasa rasa* is praised as the king of medicines.

(Bhaishajyaratnavali, Rajayakshma-chikitsa, 222-225)

(20) Gandhaka Vati

रसार्द्धं गन्धकं शुद्धं शुण्ठीचूर्णं च तत्समम् ।
लवङ्गं मरिचं चापि प्रत्येकं तु पलं भवेत् ।।
सैन्धवं त्रिपलं ग्राह्यं त्रिपलं च सुवर्चलम् ।
चणकाम्लं पलद्वन्द्वं क्षारं मूलकजं तथा ।।
मर्दयेन्निम्बुकद्रावैर्यामान् सप्त खरांशुभिः ।
बदरप्रमाणमात्रा सर्वाजीर्णप्रणाशिनी ।।

(भैषज्यरत्नावली, अग्निमान्द्यादि-चिकित्सा, 241-243)

Purified Mercury (40 gm), sulphur and *Shunthi* i.e. dry

ginger powder (20 gm each), clove and black pepper 40 gm each, rock salt and black salt 120 gm each; sour juice of gram shrub, and alkali of radish 80 gm each are taken together. The mixture is processed (*bhavana*) with lemon juice for 7 times and dried in intense sunheat. Finally, it is tableted (500 mg each) and given twice a day, with lukewarm water. It mitigates indigestion, caused by various aetiology.

(Bhaishajyaratnavali, Agnimandyadi-chikitsa, 241-243)

(21) Chandrakant Rasa

मृतसूताभ्रकं तीक्ष्णं ताम्रं गन्धं समं समम् ।
स्नुहीक्षीरैर्दिनं मर्द्यं भक्षयेद्रक्तिकोन्मितम् ।।
मधुना मर्दितं सेव्यं लौहपात्रं दिने दिने ।
सप्ताहात्सूर्यावर्त्तादीञ् शिरोरोगान् विनाशयेत् ।।

(भैषज्यरत्नावली, शिरोरोगचिकित्सा 53-54)

Incineration of Mercury (*Parada bhasma*) or *Rasasindura*, calx of mica (*Abharaka bhasma*), calx of a type of iron (*Tikshna loha bhasma*), calx of copper (*Tamra bhasma*) and purified sulphur (*Shuddha gandhaka*) are taken in equal quantity and rubbed in the latex of *Snuhi* (Euphorbia nerifolia) for one day. Then it is tableted. The tablets are kept in an iron-container. The medium of intake (*anupana*) is honey. It alleviates sinusitis (*Suryavarta*) and other disorders of head. Dose is 1 or 2 tablets (240-500 mg), with honey. (Bhaishajyaratnavali, Shiroroga-chikitsa, 53-54).

(22) Abhraparpati

कृष्णाभ्ररसगन्धानां भागान्द्विगुणवृद्धिकान् ।
एकत्र मर्दयेत्खल्वे तच्चूर्णं कज्जलोपम् ।।
घृताक्ते लोहपात्रेऽग्नौ द्रुतत्वादेकतां गतम् ।
निक्षिपेत्कदलीपत्रे तेनैव च पिधापयेत् ।।
ऊर्ध्वाधो गोमयं चार्द्रमूर्ध्वायो वर्तिपत्रयोः ।

दद्यात्तच्छीतलं चूर्णं गुञ्जैकद्वित्रिमानतः ।
हीनमध्योत्तमा मात्रा कटुत्रयसमन्विता ।
दत्ता श्लेष्मोल्बणे कासे क्षये श्वासे त्वरोचके ।।
पाण्डुरोगे कफाढ्ये च दिनानां सप्तसप्तकैः ।
सर्वानेतान् गदान्हन्ति स्वादुमृद्वन्नभोजनात् ।।
क्षाराम्लतीक्ष्णवृन्ताकद्विदलान्नस्य वर्जनात् ।
अभ्रपर्पटिका नाम रसोयं श्लेश्मले गदे ।। (रसयोगसागर)

Mica of black variety (*Krishna abhraka*), purified Mercury and sulphur are taken together in 1:2:4 proportion and *kajjali* is prepared as per routine procedure. (Though it is mentioned here, to take mica powder, it will be preferred to take incineration of mica like *Shataputi Abhraka bhasma*.)

Usage: The *parpati* prepared, is useful in cough due to aggravated *kapha dosha*, asthma, tuberculosis and distaste. It also works well in anaemia. The duration of regimen of *Abhraparpati* is said to be of 49 days. During the regimen, one should avoid sour, salty and spicy food.

(Rasayogasagar)

Dosage: 120-360 mg with honey or *trikatu churna*. *Abhraparpati* is also known as '*Vyomaparpati*' or '*Gaganaparpati*.'

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Chapter 11

Classification of Substances and Few General Procedures

It has been already stated in the previous chapters that along with Mercury, many other substances of animal, plant origines as well as various oceanic products are used to prepare potent medicines. The range of these substances vary from simple and easily available substances like Mica, to potently poisonous drugs like Arsenic compounds, from comparatively cheaper substances like *Gairika* to precious stones like Diamonds, purely plant products like *Kampilla* to still ambiguous substances like *Kankushtha.*

All these substances were used by the ancient research workers in experimentations upon Mercury. If development of Rasashastra over period of hundreds of years is considered, it can be seen that many of the substances were proved of little use while many useful new substances were discovered. Hence need to classify these substances was felt and every famous researcher and author of the classical texts developed his own method of classification of substances. Many new concepts were cleared over a period of hundreds of years and hence it is natural that the criteria on which classification is based and nomenclature of various classes, change from text to text.

In this book, the classification stated in one of the still respected and honoured text viz. Rasaratnasamuchchaya is considered as base line for comparison with other systems of classification.

In this text the available substances were mainly included in following classes:

(i) *Maharasa*
(ii) *Uparasa*
(iii) *Sadharana rasa*

Obviously it seems that the prefix *'Maha'* means great, the prefix *'Upa'* means secondary and the prefix *'Sadharana'* means common or ordinary. *Rasa* in this context means matter or substance. Apparently the classification appears to be based on utility in experiments on Mercury or potency of the drugs which are created out of those substances. But when the actual names of the substances included in the class are considered, this proves to be wrong. The most important and useful substance, which has importance second only to Mercury, viz. Sulphur is mentioned in *Uparasa*. Another Mercury compound Cinnabar is mentioned in *Sadharana rasa* and substances which are hardly ever use to prepare medicines or used in experiments on Mercury like *Chapala* and *Kankushtha* are included in *Maha* and *Upa rasa* categories respectively. Therefore, utility of the substance, its importance in drug production and other experimentations cannot be considered as criteria on which this classification is based. Another possible criterion is property of *Sattva* (which means the basic, principally acting part of the substance which can be separated by certain experiments). This is mentioned in Rasahridaya Tantra. It is observed that all the substances included in *Maharasa* category are capable of producing *Sattva*. But this common factor cannot be considered as base for classification as there are other substances which are capable of producing *Sattva* and are not included in the class.

It will be interesting to note few variations in the names of the substances included. e.g. in Rasaprakash-Sudhakara, and Rasarnava, the name *Rajawarta* appears instead of *Chapala.* Rasarnava also includes *Hingula* and *Srotonjana* in the list of *Maharasa* while omitting *Vaikrant* and *Abhraka* and so the variation goes on from text to text. What is important to note here is, there was a system of classification, though the basic criteria on which these classifications are based are not mentioned in any of the classical text books. Similar such changes can be observed in other two main classes. Though the nomenclature of the classes is similar, the contents vary. Rasatarangini, a text book of Rasashastra written in twentieth century has followed a totally different path. Kaviraj Sadananda Sharma, the author, has considered chemical formulae of the substances as the basis of classification. Each metal and its compounds are grouped together for description. Detailed individual description of each of the substances will be followed in respective chapters.

After considering these three main classes, the other classes are explainable as they are based either on their physical or medicinal properties.

In these the important class is that of Metals. Metals as we know them today were known in the Indian culture for thousands of years, however, their medicinal use, especially internal medicinal use started since period of Charaka and was developed further alongwith development of Rasashastra. The available metals at that time were Gold, Silver, Copper, Iron, Lead, Tin, Brass, Bronze (*Kansya*). In addition *Vartaloha, Chandrarka, Shulbanaga, Ghosha* are other names of metals which are mentioned but hardly ever used to prepare medicines. Probably they are important from the point of view of *Dehavada.*

The metals which are used for preparation of medicines in the form of *Bhasma* are classified in three groups:

(i) *Shuddha loha*
(ii) *Puti loha*
(iii) *Mishra loha.*

The prefix *Shuddha* means pure, *Puti* means dirty and *Mishra* means mixed. *Loha* means a metal. Gold, Silver, Copper and Iron are included in the first group. Lead and Tin are grouped under 2nd group while alloys like Brass and Bronze are included in the third group. Rasarnava and Rasakamadhenu, another well known classic on Rasashastra uses nomenclature *Sara loha*, *Sadharana loha* and *Puti loha*, and include Gold and Silver in the first group viz. *Sara loha*; Iron and Copper in the second group viz. *Sadharana loha* and Tin and Lead in *Puti loha*. These books do not mention alloys; Zinc, though included in the list in the later period is traditionally included in *Puti loha* class.

Similar such variations can be seen if other books on Rasashastra are referred. As is written earlier these methods of classification depend upon availability, utility and properties of the substances. And the nomenclature is based on believes and experiences prevalent in those periods. e.g. It was prevalent belief that Gold is the 'ultimate' metal, as if it is the last form of metal in which all other metals can be converted and hence the words '*Sara*', '*Shuddha*' etc. are used. It must have been their experiences that metals like Lead and Tin, when melted give away abnoxious and dirty smell and hence the word '*Puti*'. Presently, however, we do not experience this phenomenon.

The metals which were used to prepare various medicines were thus classified.

Man is known to know about precious stones from thousands of years. Basically the precious stones were used for decorative and ornamental purposes. In later period it was postulated that various planets in the sky do have either bad or good effects on human fate and precious stones can be used to either avoid bad effects and enhance good effects.

Depending upon their preciousness (which in their turn depend upon availability and occurance) they are classified as *Ratna, Upa ratna* and *Kshudra ratna,* which can easily and correctly translated in to English as Precious, Semiprecious and Nonprecious stones. The detail classification will be dealt with in the respective chapters.

Another entity underwhich various minerals are classified is known as *Upadhatu.* In the later period of development of Rasashastra, it was revealed to then research workers that most of the minerals which are used to prepare medicines are infact biproducts of some of the known metals and being such, their properties are similar. Such substances were, therefore, called as '*Upadhatu*'. Naturally as the knowledge expanded with passage of time, newer and newer substances were included in the group. The term *Upadhatu* is not defined any where. Only the names of the *Upadhatu* are given by different authors. It could be very well observed that the names change from book to book.

Ayurveda Prakash mentions the following seven *Upadhatu*:

ताप्यं च विमला तुत्थं कांस्यं पित्तलकं तथा ।
सिन्दूरं शैलनिर्यासः स्मृताः सप्तोपधातवः ।।

Bhavaprakasha notes the following seven *Upadhatu*:

सप्तोपधातवः स्वर्णमाक्षिकं तारमाक्षिकम् ।
तुत्थं कांस्यश्च रीतिश्च सिन्दुरश्च शिलाजतु ।
उपधातुषु सर्वेषु तत्तद् धातुगुणा अपि ।।

Though the number is same, Bhavaprakasha drops *Vimala* (Iron sulphide) and mentions *Taramakshika* (a type of chalcopyrite) instead.

Rasachandanshu - the latest of the three treatises mentions the original metals with which their properties match. The verse goes like this:

स्वर्णजं स्वर्णमाक्षिकं तारजं तारमाक्षिकम् ।
तुत्थं ताम्रभवं ज्ञेयं कङ्कुष्ठं वङ्गसम्भवम् ।
रसकं जसदाज्जातः नागात् सिन्दूरसम्भवः ।
लोहाज्जातं लोहकिट्टं ते सप्तोपधातवः ।।

It will be interesting to note that the alloys viz. Brass (*Riti*) and Bronze (*Kansya*) mentioned by previous authors are omitted and so is *Shilajatu.* And three new substances viz. *Rasaka, Lohakitta* and *Kankushtha* are substituted. These changes and additional knowledge of the original metals are definately due to knowledge of Chemistry which was quite advanced upto that period.

The original concept of similarity in properties appears to have changed to metals from which they are originated in the latest treatise. However few of the concepts have been proved wrong with the advent of knowledge of Chemistry e.g. It is proved that Chalkopyrite (*Suvarnamakshika*) does not contain Gold and similarly *Taramakshika* does not contain any Silver. The substances like *Kankushtha* are still ambiguous and many new substances like *Kasisa, Gairika, Mriddarashringa* can be added to the list. Basically the concept of *Upadhatu* must have been developed so as to facilitate use of substitutes when original metals are not available to prepare medicines.

Yet another class of substances is the '*Sudha varga*'. This is totally a new concept and is completely based on know-

ledge of Chemistry. There are many oceanic products which are commonly used to prepare medicine either collectively or severely, e.g. Corals, Conches, Oystershells, Cowries, Sepia, Back of tortoise and many others. All these are basically animal products and the animals can be found in oceans, hence can be called as oceanic products also. Most of these substances are produced by the animals as their protective covers and are chemically various salts of the calcium, like carbonates, phosphates etc. Most of these animals belong to Phyllum mollusca. All these substances are classified as *Sudha varga*. The word *Sudha* here means Calcium. But animal products like back of Tortoise, horns of Deer, Egg shells and few minerals e.g. Calcite, Gypsum and ocenic products mentioned earlier are all grouped under this class. The common factor of them all is they are all calcium compounds. Some minerals like *Kousheya* (Asbestos) and some substances mentioned and used predominantly in Unani system of medicine does not contain calcium. But still it is customory to group them in this class. This classification come into existence quite late in the texts of Rasashastra.

In this chapter until now, classifications of various substances used in Rasashastra are explained. The time period in which they were classified is very vast and the geographical area over which it occured is also quite large. The concepts of classification also changed from time to time though in most of the cases the nomenclature remained same.

If this point is taken into consideration, then the fact that inclusion of a substance in more than one classes can be explained very easily. e.g. Let us take *Vaikrant* (Tourmaline). It is included in *Maharasa* class and *Uparatna* class as

well. Many of the substances mentioned in the *Upa-dhatu* class are mentioned in *Maharasa* and *Uparasa* class.

Toxic substances like Arsenic oxide (*Somala*), Arsenic disulphide (*Manahshila*) and Arsenic trisulphide (*Haratal*) are seen grouped in to a class called as *Visha* (They are grouped in *Uparasa*) which means poison. Copper, which is a metal is considered as Poison. Less poisonous substances like Copper sulphate (*Sasyaka*) is considered as *Upavisha*. It is considered as *Maharasa* also.

Hereafter it will be beneficial for the reader to know about few processes by which the raw material or substances having medicinal properties and which are mostly mineral in origine, are converted into medicinal forms. These processes have been devised by then scientists and research workers. Before finalizing the processes those research workers must have taken many many trials before incorporating them in the respective compendia. These processes can be enlisted as:

1. *Shodhana*
2. *Marana*
3. *Amritikarana*
4. *Sattvapatana*

Out of these processes, the first is already explained in previous chapters. It was discussed in detail there that even though the actual meaning of the word *Shodhana* is purification, the meaning in context with Rasashastra is quite different and consists of many different processes. It neednot be repeated here again.

Marana

This word is derieved from the original Sanskrit root *'Mri'* which means to die. The causal form of this root becomes

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Marayati which means to kill. The causal noun becomes *Marana* which means process of killing. The basic concept behind these is very simple. The metals and minerals are subjected to various experiments so as to convert them in to such a form, so that it will not be converted back to original form and which will be easily absorbed and assimilated into body. As the original form of Metals and Minerals is irreversably changed, the word *Marana*, process of 'killing', is used. Another word viz. *Bhasma* is often used to indicate final product after the process of *Marana*. The meaning of word *Bhasma* is Ash. Plant material, when it is subjected to heat is converted into Ash, from which original substance cannot be regained. In the similar way, most of the '*Marana*' processes consist of applying intense heat to the minerals and they are converted into irreversible form and therefore termed as '*Bhasma*'.

Marana or *Bhasmikarana* (process of preparing *Bhasma*) usually consists of three or four different steps. These are (i) Pulverization, (ii) Mixing of liquid substances so as to assimilate them in the substance, (iii) Controlled heating, (iv) *Amritikarana*. It is observed that the fourth one viz. *Amritikarana* may not be necessary for every *Marana*.

It will be appropriate to have rather elaborate knowledge about each of these steps.

(1) Pulverization:The '*Purified*' substance is first converted into fine powder. Depending upon the quantity, many instruments can be used ranging from simple mortar and pestle to mechanized electrical pulverisors. Aim of this process is to reduce particle size. Reduction in the particle size creats more available surface area for conversion process. It also enhances absorption from the G.I. tract. As this process is carried out on 'Purified' substances, most of them are

already in brittle form. Infact to make substances brittle is one of the objectives of 'purification' processes. This process is carried out till one gets fine and uniform powder.

(2) Mixing of liquid substances so as to assimilate them in the powdered substance:This process is very important one. Terminologically this is called as '*Bhavana*'. The powdered substance taken in a stone mortar is completely covered with the liquid substance and the mixture is gradually and slowly triturated using adequate force. This is continued till all the liquid substance is dried up and/or absorbed into the original substance. This completes one *Bhavana*. Many such *Bhavana* processes are usually advised before the substances are subjected to intense heat. This process is useful in two ways. It is a firm belief of Ayurveda that properties of liquids used for this purpose are incorporated in the final product viz. *Bhasma* e.g. one of the methods of preparing *Bhasma* from Tin (*Vanga*) consists of using decoction of Raw Morphine for *Bhavana* with the belief that the binding action of Morphine will be incorporated in the final product. (Some scholars do not believe in this as they think the property gets destroyed on heating. Investigations and clinical trials appear to be the only way to resolve the conflict.) The other way is it helps in determining the final chemical nature of the '*Bhasma*'. When only plant products are used in preparing *Bhasma*, the final product is usually in the form of chloride or oxide.

(3) Controlled heating:This is the most important part of *Marana*. After the previous procedure, the semisolid substance is ready for heating. It is first converted into round slices of suitable size and are dried. These slices are called as *chakrika*. Usually they are kept in a closed vessel and heated for definate number of times. In few cases the finely

powdered mixture after the *Bhavana* process is subjected to heat in open air. Chemically the conversion occuring in the substance is in the form of oxides as there is abundant supply of air. The mode of heat and amount of heat had been decided by the ancient research workers who must have undertook many trials which are not documented. Only the final results are mentioned. For controlling the temperature and time for which heat is given, the ancient workers had used type of fuels and quantity of fuel to be used as measures. The detailed description is given in the Chapters on *Puta* and *Yantra*. Becuase of heat given in perticular way, the original metalic and mineral substance is converted into such a form so that when used internally it gets absorbed from the G.I. tract very easily and is effective in small dosage. It must be remembered here that the medicinal properties of the substances are properties of their *Bhasma* and not the raw substances.

There are few exceptions. Few substances like Sulphur, *Gairika*, Arsenic oxide, disulphide and trisulphide, Allum etc. are not subjected to *Bhasma* process. They can be used internally after 'purification' process only. The reason behind this is obvious. Such substances can be absorbed and assimilated effectively in their original form and if heat is applied to them, they either get evaporated or destroyed. Another point which can be observed is substances of plant or animal origine (which are organic in nature) require simpler *Shodhana* and *Marana* processes as compared with the purely metalic substances. Because conversion of organic matter into absorbable form occurs quicker.

Amritikarana

This process is advisable after the tedious, long and complicated process of *Marana*. If it is found out that *Bhasma* prepared, when used on patients internally, shows some untowards effects, then only this process is carried out. Instead of throwing away such a precious product obtained after hard work, it is subjected to this process so as to remove the property of producing ill effects. The ill effects which are usually manifested are in the form of symptoms of increased *Pitta* activity and hence the simplest process consists of roasting the *Bhasma* on fire with little amount of Ghee (*Goghrita*). For *Bhasma* of Copper, which is notorious in producing such effects, a separate, rather elaborate method had been described, which will be explained in the respective chapter.

Tests of Bhasma

Uptill now the principles and processes of preparation of *Bhasma* have been described. Whether the final product viz. the *Bhasma* is ready to be used on patients or not is decided after making sure with certain tests. Basically these tests are designed to detect the fineness of the *Bhasma* and to detect whether the conversion is complete or not. These tests can be grouped as (1) General (*Samanya*) and (2) Specific (*Vishesha*).

- General tests

मृतं तरति यत्तोये लोहं वारितरं हि तत् ।
अङ्गुष्ठतर्जनीस्पृष्टं यत्तद्रेखान्तरे विशेत् ।।
मृतलोहं तदुद्दिष्टं रेखापूर्णाभिधानतः ।
गुडगुञ्जासुखस्पर्शमध्वाज्यैः सह योजितम् ।।
नायाति प्रकृतिं ध्मानादपुनर्भवमुच्यते ।
तस्योपरि गुरु द्रव्यं धान्यं चोपनयेद्ध्रुवम् ।।
हंसवत्तीर्यते वारिण्युत्तमं परिकीर्त्तितम् ।
रौप्येण सह संयुक्तं ध्मातं रौप्येण नो लगेत् ।
तदा निरुत्थमित्युक्तं लोहं तदपुनर्भवम् ।। (र.र.स.8:26-30)

(1) *Rekhapurnatva*: *Rekha* means line pattern of ridges on tips of fingers. *Purnatva* means filling. When the *Bhasma* is handled in between the tips of fingers, the pattern of ridges on the finger tips can be clearly seen. This indicates that the *Bhasma* prepared in fine enough for ingestion.

(2) *Varitaratva: Vari* means water. *Taratva* means abilty to float. When the *Bhasma* is slowly sprinkled over steady surface of water, it floats over it. It is obvious that for this test to be positive the *Bhasma* must be so fine that after it is sprinkled over water, the combined force created due to its weight and gravitation is less than the surface tension of water. This test cannot be applied to such *Bhasma* which are completely or partially soluble in water for obvious reason.

(3) *Unam or Uttam Test*: The word *Unam* is probably derived from the original word *Unnam* as a coloquial spoken form which means to hangover or appear. The word *Uttam* means the best. The test itself demands that if the *Bhasma* to be tested is sprinkled over water it should float over the surface and if a food grain is kept over the spread *Bhasma* it also should float as a swan floats over sufface of water.

(4) *Nirdhumatva*: It means smokelessness. If a small quantity of prepared *Bhasma* is put over fire, it should not produce any smoke. The implied meaning of this test is, it should not contain any organic matter in free state indicating sufficient amount of heat had been applied during preparation of the *Bhasma*.

(5) *Nirutthatva*: Aim of this test is to see whether there is any free metalic particles in the *Bhasma*. The procedure consists of addition of measured quantity of silver into

measured quantity of *Bhasma* and heating the mixture. Later, the silver is separated from the mixture and weighed. It should not show gain in weight. If there are free metalic particles in the *Bhasma*, they will combine with the silver to form alloy and will show weight gain.

(6) *Apunarbhavatva*: Actual meaning of the word is non-reformation or non-reproduction. This test is designed so as to detect loose bondage in the compound formed as *Bhasma*. Mixture of Jaggary, Abrus precatorius (*Gunja*), Borax, Ghee and Honey, collectively called as *Mitrapanchaka*. The prepared *Bhasma* is mixed with *Mitrapanchaka* in a crucible and heated intensely. After cooling, the mixture is inspected to detect free metal particles. If the original process of *Bhasma* preparation is faulty, then there is every possibility that the conversion required to form *Bhasma* is not complete or final. If after this test one can observe free metalic particles, one can conclude that the procedure is faulty and *Bhasma* is not ready for internal use.

It goes without saying that these last two tests are meant for *Bhasma* of metals only.

All the tests seen until now come under common category. There are few tests which are meant only for specific *Bhasma* and hence they are grouped under the heading special tests.

• Special Tests

(1) Test for Copper *Bhasma*: Small amount of *Bhasma* is mixed in sour curds and the mixture is examined after 5 to 6 hours. If the colour of mixture changes to blue or it shows bluish streaks, the *Bhasma* is not good.

This test is carried out traditionally as no reference is available for this test in the text books. It also would be inter-

esting to see the validity of the test. Basically it seems to be devised on presumption that free copper reacts with sour curds (or with any sour substance for that matter) to produce cupric or cuprous salts which are bluish in colour. But chemistry says that any copper compound reacts with acidic substance. And hence there is every possibility of false positive results in this test.

(2) Test for Iron *Bhasma*: This is another traditional test. Prepared *Bhasma* of iron is sprinkled over cut surface of fresh fruit of Phyllanthus emblica (*Amalaki*). If it is not of good quality, the surface becomes blackish permanently.

(3) Test for *Bhasma* of oceanic products: The test consists of tasting a pinch of prepared *Bhasma* over tongue. It should not produce 'Burning' or 'Hot' or 'Pungent' sensation. It is already learnt that such substances are basically made up of Calcium corbonate. During preparation of *Bhasma*, intense but controlled heat is given. The test is devised to rule out excess amount of Calcium oxide or hydroxide in the *Bhasma*. If it is present in more than optimum, it will produce symptoms mentioned above.

(4) Test for *Bhasma* of Mica (*Abhraka*): The test consists of spreading a little amount of *Bhasma* over finger tips and observing minutely in bright light. For a good preparation there should not be even a single shining particles. It proves that even a small particle of mica is converted into *Bhasma*.

In addition to these, softness and tastelessness are also qualities of good *Bhasma* preparations. But most important test is therapeutic test. When it is administered in a correctly diagnosed and well indicated condition of a patient, it should prove its effectiveness.

Sattvapatana

This word is madeup of two distinct terms viz. *Sattva* and *Patana*. The former means active principle or basic substance and the later means separation or extraction. It was thought during the developmental period of Rasashastra that the medicinal properties of various minerals are due to a principal or active substance present in it. Various attempts were made to separate this active principle from the minerals and hence the process is called as *Sattvapatana*. It mainly consists of heating the mineral in a crucible with intest heat. The substance to be mixed in this procedure from *Amlavarga* (acidic substance), *Ksharvarga* (alkaline/acidic salts) and *Dravaka varga*. (mainly substances of Plant & Animal origine which are supposed to be used for melting metals). The combined effects of this procedure is the minerals are reduced to original metals in Element form. It is supposed to have all the medicinal properties of the original mineral substance.

The '*Sattva*' thus extracted, especially *Sattva* of Mica is supposed to be very useful in experiments of '*Dhatuvada*' branch of Rasashastra, however, its medicinal uses have also been described. Before it is used for such purpose, it has to be subjected to procedures like softening (*Mridvikarana*), *Nirmalikarana* (Purification), *Marana* etc.

The procedure of *Sattvapatana* in general can be explained in the following steps:

(1) The mineral from which *Sattva* is to be extracted is finely powdered along with various acidic, alkaline substances and plant and animal products so that thin semi-solid slices can be prepared from the mixture.

(2) Such dried slices are intensly heated in crucibles. When

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flames of various different colours are observed, it indicates that the procedure of separation of *Sattva* from the original substance has started. When the flame of white colour appears, it indicates that the procedure is complete.

(3) The crucible is taken out of fire and is inverted in to a container to cool and solidify.

(4) Many time the *Sattva* in a metallic form is formed in a tabloid form which can be separated easily or it may be formed in small particles of metals. In such cases the mixture is poured into water where due to heaviness, the metallic particles can be separated.

As has been stated earlier the concept of *Sattva* was conceived in the developmental period of Rasashastra and was exclusively used for experiments concerning *Dhatuvada*.

Though their medicinal properties are described, it is hardly used anywhere for that purpose.

Chapter 12

Maharasa

In the last chapter we studied how Ayurvedic texts have categorised the minerals; how medicines are prepared from them and which are the common processes performed. We are going to study about these minerals in detail, in this chapter. That is we are going to study about these minerals, from the references mentioned in various texts. The information about each substance will be given under following heads, viz. 1) Synonyms; 2) English name; 3) Chemical formulation; 4) Occurrence; 5) Cha-racteristics; 6) Physical properties; 7) Varieties; 8) Appro-val; 9) Purification; 10) Incineration; 11) Bhasma Pariksha; 12) Properties and Usage; 13) Dosage and *anupana*; 14) Extraction of *Sattva* and 15) Formulations etc.

The substances grouped under '*Maharasa*' are as follows:

अभ्रवैक्रान्तमाक्षिकविमलाद्रिजसस्यकम् ।
चपलो रसकश्चेति ज्ञात्वाऽष्टौ संग्रहेद्रसान् ।। (र.र.स.2:1)

Abhraka (mica), *Vaikranta* (fluorspar), *Makshika* (chalcopyrite), *Vimala* (cubic sulphide of iron), *Shilajatu* (black bitumen), *Sasyaka* (blue vitriol), *Chapala* and *Rasaka* (zinc ore) are the eight *Maharasas,* which should be collected.

(Rasaratnasamuchchaya 2:1)

(1) Abhraka (Mica)

Synonyms: *Abhraka* i.e. Mica, has numerous synonyms in Sanskrit, like *Gagana, Bhringa, Abhra, Kha, Vyoma, Vajra, Ghana, Girija, Bahupatra, Anantaka, Akash, Ambara, Shubhra, Amala, Megha, Antariksha, Girijabija, Gouriteja* etc.

Moreover, synonyms to *Akash, Megha* i.e. sky and clouds are also used as synonyms of *Abhraka.*

• English name: Mica.

• Occurrence

India is the leading producer of sheet mica, followed by Brazil and Madagascar. In India the chief sources are in Bihar and Nellore (Andhra Pradesh). Moreover it is also found in Ajamer (Rajasthan), Madhya Pradesh and Karnataka. Mica is found in igneous and metamorphic rocks.

• Appearance

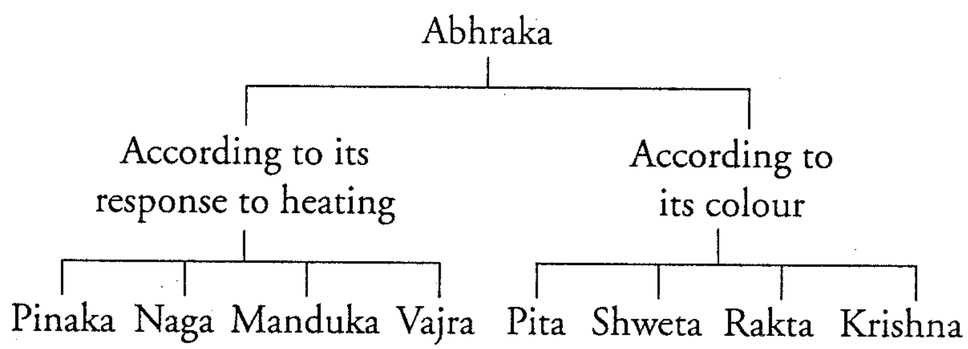
Mica is a group of minerals that contain atoms of aluminium, oxygen and silicon bounded together into flat sheets. Mica has perfect *cleavage* - that is, it splits cleanly into thin sheets or layers. These sheets of mica are tough, flexible and elastic. Mica may be colourless, black, brown, green or violet.

• Physical Properties

Mica is soft and fragile, but few varieties are flexible. It is insoluble in water and the bad conductor of heat and electricity. It is found in different colours as per its varied chemical composition.

• Varieties

According to Ayurvedic classification, it is categorised as follows :



According to its response to heating: A big piece of mica is heated intensely in a fireplace till it becomes red. On heating, it shows specific manifestations. The following types are based on these manifestations.

(1) ***Pinaka***: On heating, the piece of mica starts getting separated and creates a sound that resembles the sound of an arrow. Rasendrasara Sangraha has described it as '*chit-chit*' sound.

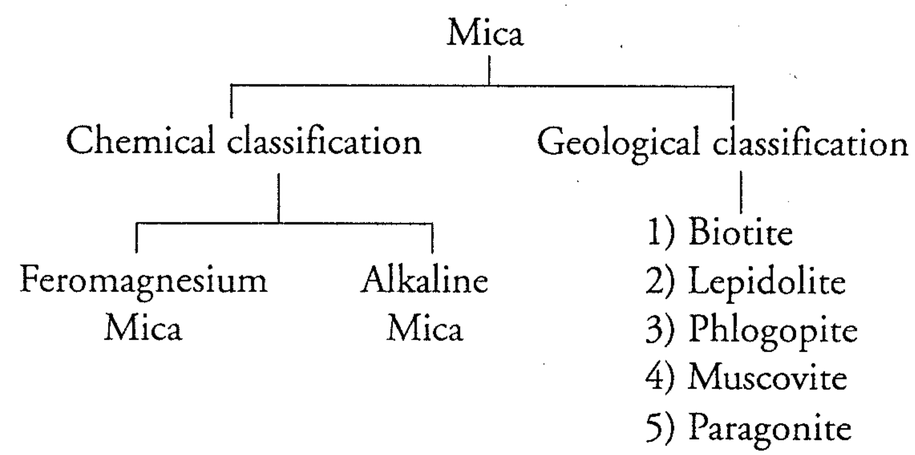
(2) ***Naga***: This variety of mica when heated, creates a sound that resembles to hissing of enraged snakes.

(3) ***Manduka***: The sheets of mica on heating get thrown out which resembles the jumping of frogs. It is mentioned in Rasendrasara Sangraha that it creates the sound that of a croaking frog.

(4) ***Vajra***: In this variety of mica, neither sound is created at all and nor any visual effect is seen. It remains as it is and shows no ovbious changes.

According to its colour: Four varieties of mica e.g. white, yellow, red and black are found, among which the last one is regarded as the best one.

According to modern science, the kinds of mica found can be classified chemically and geologically.



• Chemical Classification

Feromagnesium mica contains more amount of Iron and Magnesium. Whereas, alkaline mica contains Sodium and Potassium, chiefly. All varieties of mica contain aluminium silicate — $Al(SiO_4)_3$ as a basic substance. Moreover, other elements like rubidium, magnesium, manganese, iron, hydrogen, chlorine etc are found in some proportion.

• Geological Classification

The chief kinds of mica, in order of abundance, are muscovite, biotite, phlogopite and lepidolite. They differ from one another according to the atoms of various substances that occur in layers between the aluminium - oxygen - silicon sheets and hold the sheets together.

(1) **Biotite:** Contains iron, magnesium and potassium and is black. Its chemical formula is $H_2K(Mg,Fe)_3 Al(SiO_4)_3O_7$.

(2) **Lepidolite:** Contains aluminium and lithium and is pale violet. Its chemical formula is $(OH,F)_2 KLiAl_2Si_3O_{10}$.

(3) **Phlogopite:** Contains magnesium and potassium and is pale brown or colourless. It is also known as Amber mica. It is soft and flexible than other varieties. Its chemical formula is $H_2KMg_3Al(SiO_4)_3$.

(4) **Muscovite:** Contains aluminium and potassium and may be colourless or pale green. Muscovite got its name because Russians, or "Muscovites", once used it as window glass. It is the costliest variety of mica. Its chemical formula is $H_2KAl_3(SiO_4)_3$.

(5) **Paragonite:** It is yellowish in colour and its chemical formula is $H_2NaAl_3(SiO_4)_3$.

The minerals of mica containing iron and magnesium are dark in colour. These can be correlated with the red (*rakta*) or black (*krishna*) varieties of mica, mentioned in Ayurvedic texts. Whereas, the minerals of mica containing sodium and potassium are pale or colourless, can be correlated with the yellow (*pita*) or white (*shweta*) varieties of mica, mentioned in Ayurvedic texts. Sometimes, greenish or pale-brown coloured varieties of mica are also found.

• Approval

Mica, which is soft, shining, heavy, clean and having collyrium-like and separable scaly parts is regarded as the best and acceptable one.

Mica, which is black in colour and of *'vajra'* variety according to its response on heating, is the best one. The mica of black colour, found 5-7 feet underground in the mines should be used.

From the description about the approval of the variety of mica, it seems that the varieties like *pinaka, naga* and *manduka* were found in abundance, in those days. Today these varieties are rearely found.

• Purification

प्रतप्तं सप्तवाराणि निक्षिप्तं काञ्जिकेऽभ्रकम् ।
निर्दोषं जायते नूनं प्रक्षिप्तं वाऽपि गोजले ।।
त्रिफला क्वथिते चाऽपि गवां दुग्धे विशेषतः ।। (र.र.स.2:16-17)

The pieces of mica are heated till they become red and dipped in the decoction of *Triphala* or sour gruel or cow's urine or cow's milk and cooled. This procedure is repeated for seven times. Mica gets purified.

(Rasaratnasamuchchaya 2:16-17)

There are many other procedures mentioned, wherein the red hot mica is dipped in the juice of *Nirgudi* (Vitex ne-

gundo), juice of *Kadali* (Musa sapientum) or buttermilk like liquids. Also, it is mentioned that mica is steamed (*swedana*) in the juice of *Bhringaraj* (Eclipta alba), decoction of *Kulattha* (Dolichos biflorus), cow's urine, cow's milk or decoction of various plants.

The basic requirement in purification of mica is to separate out the soil, grit etc. first, then to get more and more separation of mica sheets and finally to get mica in fragile and soft form. One can choose any of the juices or decoctions to purify mica as per convenience.

Dhanyabhraka

After purification and before incineration procedure of mica, one procedure is required. It is known as '*Dhanyabhraka*'.

चूर्णाभ्रं शालिसंयुक्तं वस्त्रबद्धं हि काञ्जिके ।
निर्यातं मर्दनाद्वस्त्राद् धान्याभ्रमिति कथ्यते ।। (र.र.स.2:21)

Purified mica is powdered and 1/4 part of covering paddy added, is put in a blanket-rag and tied firmly. Then it is kept in sour gruel for a day and there after, it is rubbed, with hand so that mica entirely gets out into the sour gruel. This is taken out and washed and dried in the sun. It is '*Dhanyabhraka*' which is used for incinerating the mica.

(Rasaratnasamuchchaya 2:121)

Pure mica being flexible, cannot be easily powdered and it does not lose its shine. For this reason, *Dhanyabhraka* process is required. It also facilitates incineration of mica earlier.

• Incineration

There are different methods of preparing incineration (*bhasma*) of mica, mentioned in various texts. We will see

the common methods generally approved to prepare calx of mica.

गन्धर्वपत्रतोयेन गुडेन सह भावितम् ।
ऊर्ध्वाधो वटपत्राणि निश्चन्द्रं त्रिपुटैः खगम् ।। (र.र.स.2:26)

(1) Equal amount of jaggery is mixed with *dhanyabhraka* and is processed (*bhavana*) with the leaves juice of *Eranda* (Ricinus communis) and made into small discs which are dried in the sun and heated in the sealed saucers (*sharava samputa*). The leaves of *Vata* (Ficus bengalensis) are placed above and beneath the discs before heating. When this procedure is repeated for three times, a lustreless (*nishchandra*) incineration (*bhasma*) of mica gets ready.

(Rasaratnasamuchchaya 2:26)

(2) *Dhanyabhraka* is processed with the juice of *Kasamarda* (Cassia occidentalis) and subjected to *gajaputa*. After repeating this procedure for ten times, incineration ofmica gets ready.

(3) Instead of *Kasamarda, Mustaka* (Cyperus rotundus) and *Tanduliya* (Amaranthus bittum) can also be used.

Mica is subjected to heating from twenty to hundred times (*shataputi*) for curative purpose, while for promotive uses it is heated upto thousand times (*sahasraputi*). More and more heating increases the '*laghu*' property of mica incineration and potentiates it further. *Shataputi Abhraka-bhasma* is commonly used in practice.

Amritikarana of Bhasma

During the procedure of incineration, mica is processed with various substances, which makes mica sharp (*tikshna*). To reduce this sharp attribute of mica, *amritikarana* process is done.

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The incinerated mica is mixed with equal quantity of cow's ghee and heated on mild fire till the mixture becomes dry. Then it is processed (*bhavana*) with the juice of *Kumari* (Aloe vera). Mica, after this procedure excels in properties like a nectar.

Amritikarana reduces the sharp attribute of mica incineration, but at the same time loses its lustre. Thus it is to be decided whether *amritikarana* is required or not.

• Tests for Incinerated Mica

All the common tests, mentioned previously are applicable to incinirated mica, in addition '*Nishchandratva*' is a special test for *Abhraka*.

The lustrelessness of mica incineration is tested by applying a thin film of calx on the palm. If the surface of palm shows some shining particles, it indicates that the calx has not lost its lustre. Similarly it can be tested under microscope. When it has not lost its lustre, it is subjected to more heating.

The lustreless calx of mica is scarlet in colour and with more heating, it turns red in colour. It is fine, unctuous and does not produce smoke when put on fire (*nirdhuma*). Such is the best quality calx of mica.

• Usage

Incinerated mica is used in diseases like diabetes mellitus, dermatoses, tuberculosis, asthma, cough, anaemia, colitis, epilepsy and hysteria etc. It promotes physical and mental vigour, sexual power and immunity.

• Dosage

Dashaputi Abhraka bhasma - 120 to 240 mg; with honey.
Shataputi Abhraka bhasma - 60 to 120 mg; with honey.
Sahasraputi Abhraka bhasma - 15 to 60 mg; with honey.

• Extraction of Essense

पादांशटङ्कणोपेतं मुसलीरसमर्दितम् ।
रुन्ध्यात् कोष्ठ्यां दृढं ध्मातं सत्त्वरूपं भवेद् घनम् ।। (र.र.स.2:28)

Mica combined with 1/4 borax powder is rubbed with the juice of *Musali* (Asparagus adscendens) for 3 times (*bhavana*) and prepared into small discs, dried in the sun. These discs are put into *Koshthi yantra* (furnace) and subjected to intense heating. Thus the pure extract comes out. It is known as '*Abhraka sattva*'. (Rasaratnasamuchchaya 2:28)

Abhrakasattva contains mainly iron, aluminium and other metallic elements. Now a days it is not much used for medicinal purpose. It is used in the procedure called as '*gras*' in processing of the Mercury.

• Formulations

Brihadvatachintamani, Chandrakala rasa, Vasantakusumakar, Mahalaxmivilas rasa, Panchamrita parapti, Arogyavardhini, Sutikabharana rasa, Mahavatavidhwansa rasa, Ekangavira rasa, Mahayogaraj guggulu, Prataplankeshwar rasa etc. are few of the commonly used formulations.

(2) Vaikranta (Tourmaline)

• Synonyms: *Vaikrant* i.e. Tourmaline, has various synonyms in Sanskrit, like *Vikrant, Jirnavajraka, Kuvajraka, Churnavajra and Kshudrakulisha.*

• English Name: Fluorite or Fluorspar or Tourmalline

There are three different minerals which are having more or less similar properties and physical appearance which is a kin to *Vaikranta* as described in the texts. They are Felspar, Fluorspar and Touramaline. All of them are compounds of Calcium and Fluorine. However it is customary to consider Tourmacine as *Vaikranta*.

• Occurrence

Canada, South Africa, Peru, Mexico, Thailand, Norway, England, Germany etc. In India it occurs in Gujarat and Rajasthan.

• Characteristics

It occurs in wide range of colours (including yellow, blue, pink, purple and green). It is fragile, octahedral, and may be faceted.

• Properties

1. It is heavy and has a cubic structure.
2. Hardness is 4 as per Mohs' scale.
3. Its specific gravity is 3.18.
4. Refractive index of fluorite is 1.43.
5. Chemical composition is CaF_2.
6. In ancient times, it was used as substitute for diamond.
7. On heating, it shines but with further heating it gets molten.
8. It is insoluble in water.

The word *Vaikranta* is grammatically a compound word. It could be solved as विक्रमयति लोहानि or विकृयन्ति लोहानि. Here another property of it is highlighted. During the extraction of metals from their ores, ancient metallurgists used to mix *Vaikranta* in the ore, which has ability to melt, mix with the impurities of the metals and float over the molten metals from where it used to be separated.

• Varieties

Ancient texts have mentioned eight varieties of *Vaikranta* according to its colour viz. white, red, blue, yellow, grey, blackish, black and multicoloured.

• Approval

Though eight varieties had been mentioned, all of them are not used for medicinal purpose. Amongst eight varieties, the black *Vaikranta* is used, whereas yellow and white varieties are not to be used for medicinal purpose.

The occurrence of fluorite in India is very rare. Various colours in fluorite are due to the elements of metals it contains. Fluorite chiefly contains calcium and fluorine. These basic elements have medicinal properties. Hence it will not be rational to say that the blue and blackish variety of fluorite should not be used.

• Purification

कुलत्थक्वाथसंस्विन्नो वैक्रान्तः परिशुद्ध्यति । (र.र.स.2:66)

Vaikranta is purified by steaming it in the decoction of *Kulattha* (Dolichos biflorus) for nine hours in *dola yantra*.
(Rasaratnasamuchchaya 2:66)

• Incineration

म्रियतेऽष्टपुटैर्गन्धनिम्बूकद्रवसंयुतः । (र.र.स.2:67)

Purified *Vaikranta* is mixed with equal quantity of pure sulphur and the mixture is processed with the lemon juice and subjected for 8 *gajaputas*. A fine incineration of fluorite gets formed. (Rasaratnasamuchchaya 2:67)

• Tests

A good quality *Vaikranta bhasma* is pinkish-white in colour, soft, tasteless and odourless. It fills the ridges of tips of fingers and floats on the water, when sprinkled .

• Properties and Usage

आयुःप्रदश्च बलवर्णकरोऽतिवृष्यः
प्रज्ञाप्रदः सकलदोषगदापहारी ।

दीप्ताग्निकृत् पविसमानगणस्तरस्वी
वैक्रान्तकः खलुः वपुर्बललोहकारि ।। (र.र.स.2:55)

Vaikranta bhasma is cold in potency, has sweet post-digestive effect and alleviates all three *doshas*. It promotes the body strength, improves complexion, increases memory, stimulates appetite and is aphrodisiac and rejuvenating.

(Rasaratnasamuchchaya 2:55)

It is used in fever, skin diseases, leprosy, tuberculosis, diabetes mellitus, piles, tumous and ascites.

• Dosage: 5 to 10 mg.

(3) Makshika (Chalcopyrite)

Synonyms: *Makshika* i.e. Chalcopyrite, has many synonyms in Sanskrit, like *Suvarnamakshika, Tapya, Tapija, Dhatumakshika, Makshikadhatu, Madhumakshika, Kshaudradhatu, Kadamba, Garuda* and *Chakranama* etc.

• English Name: Chalcopyrite.

• Chemical Formula: $CuFeS_2$.

• Occurrence

Chalcopyrite is one of the most widespread copper ores and an important source of pure copper. Chalcopyrite consists copper 34.5%, iron 30.5% and sulphur 35%. It has a brassy-yellow colour and a metallic lustre. In many cases, it developes a deep blue, green or black tarnish. Chalcopyrite looks like gold but is slightly harder, more brittle, and less resistant to chemicals. The golden colour of Chalcopyrite is because of the copper it contains.

Major deposits of Chalcopyrite occur in Canada, Japan, England, Spain and the United States. In India, it is found in Bihar, Rajasthan and Andhra Pradesh. In Ayurvedic

texts it is mentioned to be found in Sumeru mountains, across the Tapi river, in Kanouja, Bhutan and China.

• Appearance

Chalcopyrite looks like grayish stones, with golden dots or lines on the cut surface. Chalcopyrite is also called copper pyrites. Other varieties of copper pyrites are white pyrite and arsenic pyrite.

• Physical Properties

1. Chalcopyrite is brittle and can be easily powdered.
2. The cut surface has golden yellow dots or lines.
3. When chalcopyrite is rubbed, the hands get blackish stains.
4. It burns on fire with white fumes and emits the smell like sulphur.
5. It is insoluble in water.

• Varieties

Ayurvedic texts have mentioned three varieties of *Makshika* viz. *Suvarnamakshika, Roupyamakshika* and *Kansyamakshika. Suvarnamakshika* and *Makshika* are the same one. *Roupyamakshika* contains comparatively little quantity of copper and sulphur. It is known as Whitepyrite. Whereas, *Kansyamakshika* contains some amount of arsenic, which is known as Arsenopyrite.

Suvarnamakshika has more blackish colour on the surface and its cut surface shows golden-yellow dots or lines. *Roupyamakshika* is whitish in colour and harder. *Kansyamakshika* is more blackish and contains more stony elements.

• Approval

Out of three varieties, only *Suvarnamakshika* is used for

medicinal purpose. *Kansyamakshika* is not used at all. Sometimes *Roupyamakshika* is used for medicinal purpose.

Chalcopyrite which is smooth, heavy, shining, externally with dark tinge but on rubbing on grind-stone with golden lustre, is acceptable.

• Purification

एरण्डतैललुङ्गाम्बुसिद्धं शुद्ध्यति माक्षिकम् ।
सिद्धं वा कदलीकन्दतोयेन घटिकाद्वयम् ।।
तप्तं क्षिप्तं वराक्वाथे शुद्धिमायाति माक्षिकम् ।। (र.र.स.2:83)

Suvarnamakshika is purified by roasting it in castor oil i.e. *Eranda* (Ricinus communis) *taila* or juice of *Matulunga* (Citrus medica) or juice of rhizome of *Kadali* (Musa sapiens) for 48 minutes (2 *ghatika*). Instead of *Matulung* the lemon juice can also be used.

(Rasaratnasamuchchaya 2:83)

It is also purified by heating on intense fire and then dipping it into decoction of *Triphala*. Also, it can be purified by steaming (*swedana*) it in the juice of rhizome of *Kadali*, with the help of *Dola yantra*.

Makshika which contains more quantity of copper, is purified, by rubbing *Makshika* powder 3 parts along with Rock salt (*saindhava*) 1 part and then mixed with *Matulunga* (Citrus medica) juice and *Jambira* (Citrus limonum) juice. This mixture is then heated till the container becomes red hot. Then cooling on its own, the mixture is washed in water couple of times and dried in the sun. The substances like sour juices and rock salt produce hydrochloric acid, which acts on the copper contents of chalcopyrite and forms copper chloride, which is soluble in water and gets washed out during washing process.

During purification of *Suvarnamakshika*, its powder is mixed with equal amount of castor oil and heated in an iron vessel. The fumes of sulphur start coming out and sulphur catches fire and gets burnt out. It indicates that in these procedures, the intention is to reduce the copper element and eleminate the sulphur from chalcopyrite during purification.

• Incineration

अजामूत्रेऽथवा तैले कषाये वा कुलत्थजे ।
तक्रे वा घर्षितं पक्वं म्रियते स्वर्णमाक्षिकम् ।। (रसचण्डांशु)

Suvarnamakshika purified, is rubbed with sesame oil or shegoat's urine or decoction of *Kulattha* (Dolichos biflorus) or buttermilk and heated, thus incineration (*bhasma*) of *Suvarnamakshika* gets ready. (Rasachandanshu)

Another procedure mentioned in the texts, is powdered purified *Suvarnamakshika* is mixed with equal amount of pure sulphur and processed (*bhavana*) with the juice of *Jambira* (Citrus limonum) and sealed in a crucible and subjected to *Varaha putas* for five times. It is also mentioned in Rasaratnasamuchchaya, that *Suvarnamakshika* can be incinerated with using castor oil or cow's ghee or the juice of *Matulunga* (Citrus medica).

The incinerated *makshika* prepared by above three procedures shows variation in its colour, like brickred, haematite coloured and blackish, respectively. Apart from procedures, the colour of calx depends upon the copper contents of *Suvarnamakshika*.

• Tests for Calx

Routine tests for the calx or incineration like *varitara, rekhapurnatva* etc. are carried out. The *bhasma* of *Suvarnamakshika* is reddish, brick-red in colour.

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• Medicinal Usage

Suvarnamakshika bhasma is used in treating various diseases like anaemia, anasarca, hyperacidity, burning sensation in the body, diabetes mellitus, piles, dermatoses, bleeding disorders etc. It works well as rejuvenative, aphrodisiac, beneficial to the eyes and promotes longevity.

Though it is tasteless, it shows effects like sweet in taste, pungent in the post digestive effect, cold in potency, light in attribute and alleviates *Kapha* and *Pitta doshas*.

• Dosage: 60 to 120 mg.

• Media of intake: Cow's ghee, honey, butter or suitable for the disease.

• Extraction of Essense

क्षौद्रगन्धर्वतैलाभ्यां गोमूत्रेण घृतेन च ।
कदलीकन्दसारेण भावितं माक्षिकं मुहुः ।।
मूषायां मुञ्चति ध्मातं सत्त्वं शुल्बनिभं मृदु । (र.र.स.2:89)

Makshika is processed (*bhavana*) with honey, castor oil, cow's urine, cow's ghee and juice of *Kadali* (Musa sapiens) for 7 times each, and then heated in a crucible. The *sattva* of *makshika* looks like copper. It is red in colour, can be easily liquified and has cold attribute in predominence.

(Rasaratnasamuchchaya 2:89)

(4) Vimala (Cubic Sulphide of Iron)

• Synonyms: There are no synonyms to *Vimala*.

• English Name: Cubic Sulphide of Iron, Iron Pyrite (Geological name)

• Occurrence

In nature, iron always occurs in chemical combination with other elements, especially oxygen, carbon, sulphur

and silicon. The principal ores from which iron is obtained include haematite, magnetite, limonite, pyrite, siderite and taconite. Iron pyrite is about half iron and half sulphur. It has a shiny, metallic appearance and looks like gold. In India, it is found in Bihar, Kashmir, Madhya Pradesh and Karnataka. According to Ayurvedic texts, *Vimala* is found near the sources of silver and lime.

• Appearance

Vimala is in a form of pale yellowish cubic pieces, unctuous looking, with multiple surfaces and angles. Its yellow colour resembles to that of brass.

• Physical Properties

1. Cubic sulphide of iron (*Vimala*) is more hard and heavy than Chalcopyrite.
2. Hardness of *Vimala* is 6 and specific gravity is 5.
3. On intense heating, sulphur burns out from *Vimala*.
4. When scratched on grindstone it creates blackish-white lines.

• Chemical Composition

Vimala is a compound of iron and sulphur. Hence, it is known as Iron pyrite. It contains about 46.6% iron and 53.4% sulphur. It also contains some other elements in traces.

In Rasatarangini, it is mentioned that *Roupyamakshika* (white pyrite) and *Vimala*, are the same substance. But considering their chemical composition, it is unlikely to be the same substance. Because white pyrite contains copper, iron and sulphur, whereas, *Vimala* contains only iron and sulphur. White pyrite contains more quantity of iron sulphide than copper sulphide and *Vimala* contains only iron

sulphide. Thus the surfaces of both the substances are yellow in colour. The yellowishness of *Makshika* is golden, whereas, it is brassy that of *Vimala*.

• Varieties

Three varieties of *Vimala* are mentioned as :

1. *Suvarna Vimala* - Which is golden in colour.
2. *Roupya Vimala* - Whitish in colour.
3. *Kansya Vimala* - Looks like a bronze.

• Approval

Ancient texts have mentioned that *Kansya Vimala* is the best one, but it is mentioned in the same texts that *Suvarna Vimala* is the best one and *Roupya Vimala* is better than *Kansya Vimala*. Any variety can be used for medicinal purpose, as all of them contain only iron and sulphur as basic elements. *Vimala*, which is heavy, shiny and is hexagonal or octagonal in shape, is supposed to be the best variety for medicinal usage.

• Purification

आटरूषजले स्विन्नो विमलो विमलो भवेत् ।
जम्बीरस्वरसे स्विन्नो मेषशृङ्गीरसेऽथवा ।।
आयाति शुद्धिं विमलो धातवश्च यथाऽपरे ।

(र.र.स.2:98-99)

Vimala is purified by steaming (*swedana*) it in the juice of *Vasa* (Adhatoda vasica) or lemon juice or in the juice of *Meshashringi* (Gymnema sylvestrei).

(Rasaratnasamuchchaya 2:98-99)

It is mentioned in Ayurveda Prakash, that *Vimala* is purified by processing it for 3 times, in the juice of lemon or *Meshashringi*, or *Karkoti* (Luffa acutangulata) and then dried in the sun.

• Incineration

गन्धाश्मलकुचाम्लैश्च म्रियते दशभिः पुटैः । (र.र.स.2:100)

Purified *Vimala* is powdered and equal quantity of pure sulphur is added. This mixture is processed (*bhavana*) with the juice of *Lakucha* fruit and then subjected to heating. This procedure is repeated for ten times to incinerate *Vimala*. Finally all sulphur gets burnt out and the calx in a form of iron remains. *Vimala bhasma* is brownish-red in colour. (Rasaratnasamuchchaya 2:100)

• Tests for Calx

Routine tests like *Varitara, Rekhapurnatva* etc. are sufficient. There are no special tests for the incinerated *Vimala*. It is brownish-red coloured.

• Properties and Usage

Vimala bhasma is pungent and bitter in the taste, pungent in the post digestive effect and has hot potency. It alleviates *Vata* and *Pitta doshas*. It is mainly used as a rejuvenative and aphrodisiac.

• Dosage: 60 to 120 mg.

• Media of intake: Milk or sugar.

• Extraction of Essense

सटङ्कलकुचद्रावैर्मेषशृङ्ग्याश्च भस्मना ।
पिष्टो मूषोदरे लिप्तः संशोष्य च निरुध्य च ।।
षट्प्रस्थकोकिलैर्ध्मातो विमलः सीससन्निभः ।
सत्त्वं मुञ्चति तद्युक्तो रसः स्यात् स रसायनः ।। (र.र.स.2:101-2)

The fine powder of *Vimala* is mixed with borax and calx of *Meshashringi* (Gymnema sylvestrei) and processed with the juice of *Lakucha* fruit. The paste of this mixture is applied on the inner surface of a crucible and after it is dried, the crucible is properly sealed and subjected to heating

with the coal-fire. Finally, *Vimala sattva* gets ready. It looks likes lead. When it is mixed with mercury, it works as a rejuvenative. (Rasaratnasamuchchaya 2:101-102)

(5) Shilajatu (Black Bitumen)

• Synonyms: Black Bitumen, i.e. *Shilajatu* has various synonyms in Sanskrit, like *Shaileya, Ashmaja, Gaireya, Girija, Adrijatu, Shilasweda, Ashmajatu, Shilamaya, Ashmalaksha* etc.

• English Name: Black Bitumen or Mineral pitch.

• Occurrence

Shilajatu is named as it comes out of the stones heated by the sun in summer in the form of thick exudation having many shades. It is found in Himalayan regions, Kashmir, Bhutan and Tibet. It also occurs in the vicinity of petrolium and coal mines.

• Appearance

As it is a black coloured exudation from the rocks, it contains various elements in traces. As mentioned above, it is found near coal mines. When it gets solidified, it is collected from the rocks in a form of big chunks. There is always a possibility of adulteration.

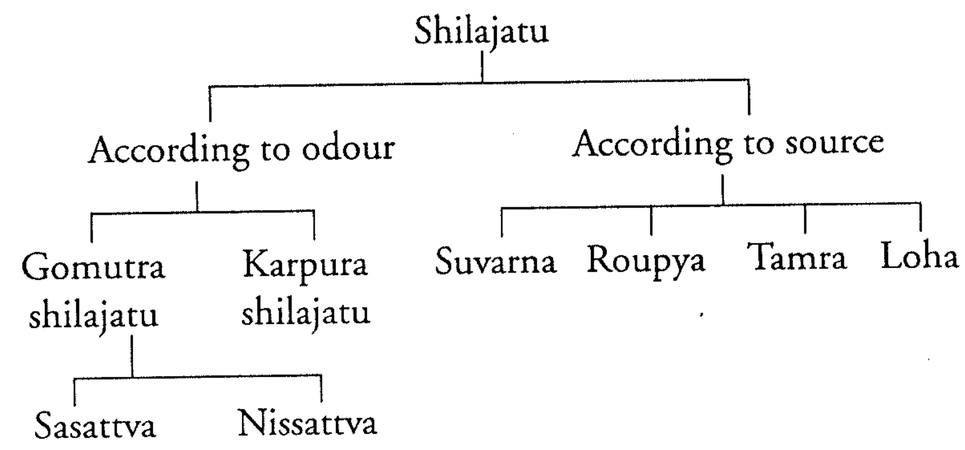
• Physical Properties

1. *Shilajatu* is black in colour and shiny.
2. It is heavy and burns on fire without fumes or smoke.
3. It slowly dissolves in water and render yellowish colour.
4. *Shilajatu* is insoluble in alcohol, eather and chloroform.
5. As it is moist and sticky, it is used for tablating.
6. It has a pungent smell like cow's urine.

• Chemical Composition

Black bitumen contains minerals 38.65%, organic substances 36.2%, water 9.5%, nitrogenous substances 1.30%, lime 7.8% and mica 1.35%. The organic substances, mainly urea, causes its pungent odour. The chemical composition of it varies in wide range, hence its chemical formula cannot be derived.

• Varieties



Gomutra Shilajatu has odour like cow's urine. From it, when reasonable amount of extract can be yielded, it is known as *Sasattva gomutra shilajatu*, whereas when it is not yielded, it is called as *Nissattva gomutra shilajatu.*

Karpura Shilajatu is yellowish in colour and sand-sized. There is one more method to classify i.e. the criterion used to classify is presence of metallic ores of Gold, Silver, Copper and Iron, in the place where *Shailajatu* occurs.

(1) ***Suvarna Shilajatu***: It is red in colour like chinese rose. It is sweet, pungent and bitter in tastes, pungent in the post digestive effect and has cold potency. It is a rejuvenative.

(2) ***Roupya Shilajatu***: It is yellowish in colour, heavy, sweet in taste and alleviates *Pitta* disorders.

(3) ***Tamra Shilajatu***: It is solid, bluish in colour and heavy. It is bitter in taste and has hot potency. It alleviates *Kapha* and *Vata doshas* and is useful in tuberculosis.

(4) ***Loha Shilajatu***: It looks like *Guggulu* (Commiphora mukul). It is bitter and salty in taste, pungent in the post digestive effect and has a cold potency. It is rejuvenating and alleviates all three *doshas*.

• Approval

Sasattva gomutra Shilajatu and *Suvarna Shilajatu* are the best varieties. But the other varieties mentioned above are not available, only *Loha shilajatu* is available in the market.

A good quality *Shilajatu* shows following characteristics:

1. It is black or blakish-brown in colour.
2. It has odour like cow's urine.
3. On fire, it does not create smoke and melts, and becomes reddish in colour.
4. When put in the water, sinks to bottom while descending and creates yellowish streaks.

When all these characteristics are present, *Shilajatu* is accepted for medicinal purpose.

• Purification

Procedure 1:

क्षाराम्लगोजलैर्धौतं शुद्धयत्येव शिलाजतु । (र.र.स.2:116)

Shilajatu is washed in salt water first, then sour liquids and cow's urine, one after another. It gets purified. In this procedure, there is no mention of any specific sour or salty substances for washing and their quantity used.

(Rasaratnasamuchchaya 2:116)

It should be washed in dilute solutions for a short duration. Because *Shilajatu* is soluble in water and will get

wasted, if washed for longer time. The basic requirement is to clean the surface and scrape out the impurities stuck on the surface.

Procedure 2 :

मुख्यां शिलाजतुशिलां सूक्ष्मखण्डप्रकल्पिताम् ।
निक्षिप्यात्युष्णपानीये यामैकं स्थापयेत्सुधीः ।।
मर्दयित्वा ततो नीरं गृह्णीयाद्वस्त्रगालितम् ।
स्थापयित्वा च मृत्पात्रे धारयेदातपे बुधः ।।
उपरिस्थं घनं यत्स्यात् तत् क्षिपेदन्यपात्रके ।
धारयेदातपे धीमानुपरिस्थं घनं नयेत् ।।

(शा.सं.म.खं 11:92-94)

The big chunks of *Shilajatu* are first broken into small pieces and soaked in hot water for three hours. Then it is rubbed and strained through cloth. This water is kept in an earthen vessel in the intense sun. The blackish thick material emerged on the surface of water is collected and put in another vessel for the same process. This is repeated till the clean *Shilajatu* is obtained on the supernatant layer.

Both these procedures are useful to clean *Shilajatu* externally.

Procedure 3 :

Insatead of water, used in second procedure, in this procedure liquids like cow's milk, cow's urine, juice of *Bhringaraj* (Eclipta alba), decoction of *Triphala* or some liquids are used. After washing, it is very important to dry *Shilajatu* completely. If it remains moist, it gets foul smell. Hence if milk is used for washing, one should wash it with decoction of *Triphala* at the end, for the similar reason.

The choice of liquid substance to dissolve *Shilajatu* can be selected with a view in which diseases it is to be used.

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• Incineration

शिलया गन्धतालाभ्यां मातुलुङ्गरसेन च ।
पुटितो हि शिलाधातुर्म्रियतेऽष्टगिरिण्डकैः ।। (र.र.स.2:119)

Incinceration (*bhasma*) of *Shilajatu* is prepared by rubbing pure *Shilajatu* with pure orpiment (*haratala*), realgar (*manahshila*) and pure sulphur (*gandhaka*) and then subjecting it to heat. (Rasaratnasamuchchaya 2:119)

It is mentioned in few texts, that *Shilajatu* should not be Incinerated, as it does not require incineration. In practice, *Shilajatu bhasma* is neither prepared nor used. Only purified *Shilajatu* works well.

• Properties

Shilajatu is bitter and pungent in the taste, pungent in the post digestive effect and has hot potency. It alleviates *Kapha dosha*. It is rejuvenative (*rasayana*), catalyst (*yogavahi*) and reducing (*lekhana*) in properties.

• Usage

Shilajatu acts mainly to purify and strengthen the genitals and the urinary tract. It is used in numerous diseases like diabetes mellitus, urinary stones, dysuria, anaemia, skin disorders, oedema etc. It is the best rejuvenative and strengthens immunity and promotes strength. It also works well as a powerful aphrodiasiac. As a rejuvenator, it is used in patients suffering from tuberculosis, asthma, chronic bronchitis, chronic digestive diseases, diseases of the nerves and fractures. It is the best adjunct in treating obesity, as it scrapes out *meda* (fats) and *Kapha dosha*.

• Dosage

Generally 140 to 260 mg.
As a *Rasayana*, 10 - 40 gm for 1 - 7 weeks.

• Media of intake: Milk.

• Extraction of Essense

पिष्ट्वा द्रावणवर्गेण साम्लेन गिरिसम्भवम् ।
क्षिप्त्वा मूषोदरे रुद्ध्वा गाढैर्ध्मातं हि कोकिलैः ।।
सत्त्वं मुञ्चेच्छिलाधातुस्तत्क्षणात् लोहसन्निभम् । (र.र.स.2:122)

Shilajatu is rubbed with sour liquids, dried in the sun and intensely heated in sealed crucible. The extract, looking like iron, is obtained. No special uses of the extract are mentioned in the texts. They are the same as that of *Shilajatu*.
(Rasaratnasamuchchaya 2:122)

Karpura Shilajatu

Ayurvedic texts mention that *Karpura Shilajatu* is slightly yellowish, sand like substance. Traditionally, *sora* (KNO_3) is used as *Karpura Shilajatu*. It is purified by processing (*bhavana*) with hot infusion of Cardamom, in which it dissolves completely. Then the liquid is filtered and dried, and *Karpura Shilajatu* is obtained. Purification augments its cooling attribute. There is no mention about its incineration process or extraction of its essence. It is used in dysuria, diabetes mellitus, urinary calculi, hepatitis and anaemia.

Controversy in Genesis of Shilajatu

Since centuries *Shilajatu* is known to Indians and ancient scholars of Ayurveda had mentioned vividly about its source, varieties, purification and medicinal uses etc. So far we have studied that *Shilajatu* has its origin as a mineral.

More than 150 years ago, European scientists Stiffenson and Campbell (1833) had done an elaborate research on the chemical composition of Black bitumen i.e. *Shilajatu*. They had found that it contains impure form of mineral as

'Bitumen or Mineral resin'. They had also correlated Black bitumen with coal and related minerals.

A geological survey of various samples of *Shilajatu* from Western Himalayas, was done by Indian scientists Rajnath and Prasad (1942). They found that inflammable mineral substance bitumen or the rocks from which *Shilajatu* exudes, are not related with the genesis of *Shilajatu*. They observed that a plant resembling *Snuhi* (Euphorbia nerifolia) grows in the vicinity of rocks which exude *Shilajatu*.

Indian scientist Chopra (1958) showed by chemical analysis that *Shilajatu* contains albuminoids, gums, resins, benzoic acid, fatty acids and hippuric acid etc. He also solicited that *Shilajatu* is a plant originated substance and moreover, the hippuric acid albuminoids (which are found in animal urine), has an animal origin also. The scientists Sing and Sharma (1970) endorsed the postulate of Chopra. The plant resembling common milk hedge (*Snuhi*), which is known as '*Euphorbia royalina*', that exudes ample amount of latex is the origin of *Shilajatu* was postulated by the scientist Pande (1973). Scientists Joshi and Lal (1976) analysed the rocks which exude *Shilajatu* and showed that both are totally unrelated chemically. The rocks contained very insignificant amount of iron. (Ayurvedic texts mention that *Loha Shilajatu* contains iron in ample quantity). From these observations it is clear that the interrelation between the rocks and their exudation, *Shilajatu*, is very feable. Moreover, the scientists enlightened that the variation in colours of *Shilajatu* are due to changes in the colour of latex of *Euphorbia royalina*, due to atmosphere. First it is golden yellow, then turns into red-brownish and finally, black.

Another endorsement to *Shilajatu* is a plant originated

substance, was submitted by scientists Ghoshal, Reddy and Lal (1976). They compared the chemical analysis of *Shilajatu* and latex of *Euphorbia royalina* and proved the similarity; and stated the possibility of *Shilajatu* to be of plant-originated.

Ayurvedic texts had mentioned that *Loha, Tamra, Suvarna,* and *Roupya* varieties of *Shilajatu* are found in the vicinity of the mines of these metals and *Shilajatu* is formed as an exudate from these rocks. But *Shilajatu* is not found either in Khetri (Rajasthan) where there are coper mines or in Bihar, where there are iron mines. All these regions are well-known as hot places, still no *Shilajatu* is found there. Further, there are many similarities between the plant *Snuhi* (Euphorbia nerifolia) and *Shilajatu*.

From these views it seems that *Shilajatu* may be a plant-originated substance. But still controversy remains as there are Ayurvedic scholars who believe only in ancient texts of Ayurveda.

(6) Sasyaka (Blue Vitriol)

- Synonyms: Blue Vitriol, i.e. *Sasyaka*, has few synonyms in Sanskrit, like *Tuttha, Tutthaka, Mayurtuttha, Mayurkantha, Tutthanjana, Shikhigriva* and *Tamragarbha* etc.
- English Name: Blue Vitriol, Bornite, Peacock ore.
- Chemical Formula: $CuSO_4$, $5H_2O$.
- Occurrence

Blue Vitriol in mineral form should be called as *Sasyaka*, whereas, the synthetic crystalline form as *Tuttha* or *Mayurtuttha*, is mentioned in Rasajalanidhi. But in practice, both the names are used without differentiation. Blue Vitriol, in mineral form, is found in Khetri and Singhana

(Rajasthan). It is also found in little amount in the mines, with Chalcopyrite (*Suvarnamakshika*).

• Appearance

Blue Vitriol i.e. *Sasyaka* in mineral form in smooth, heavy, unctuous looking and having a colour like that of peacock's neck i.e. bluish-green. In synthetic form, it is bluish and crystalline.

• Physical Properties

1. It is bluish-green in colour.
2. Synthetic form is only bluish in colour and opaque.
3. It is easily soluble in water.
4. It loses all the water of crystallisation when heated upto 250°C and forms white amorphous powder.

   $$CuSO_4, 5H_2O \rightarrow CuSO_4 + 5H_2O \uparrow$$

   Anhydrous copper sulphate

   It becomes blue when few drops of water are added to it.
5. On electrophoresis, copper gets separated from its solution.
6. Its solution is acidic, hence blue-litmus turns red, when dipped in its solution.

• Chemical Composition

Mineral form of Blue Vitriol has chemical composition $Cu_5\ FeSO_4$. It contains 50-70% copper, 15-16% iron and sulphur. The chemical composition of synthetic form is $CuSO_4, 5H_2O$.

• Varieties

Blue Vitriol has two varieties, viz. natural-mineral and synthetic. Both varieties can be used. (Rasajalanidhi).

• Approval

Sasyaka (mineral), which is smooth, heavy and having lustre like that of peacock's neck is acceptable. But it is not easily available in the market. Both varieties, mineral as well as synthetic, are used as the *bhasma* and *sattva* obtained from both, shows equal efficacy.

• Purification

सस्यकं शुद्धिमाप्नोति रक्तवर्गेण भावितम् ।
स्नेहवर्गेण संसिक्तं सप्तवारमदूषितम् ।। (र.र.स.2-129)

Sasyaka is purified by first processing with the decoctions of *Manjishtha* (Rubia cordifolia) or *Khadira* (Acacia catechu) or *Laksha* (Lacifera lacca) and then it is processed with ghee. (Rasaratnasamuchchaya 2:129)

The mineral form of *Sasyaka* is purified by steaming it in cow's urine in *Dola yantra*. As the mineral form is seldom used today, this procedure is not required.

• Incineration

लकुचद्रावगन्धाश्मटङ्कणेन समन्वितम् ।
निरुध्य मूषिकामध्ये म्रियते कौक्कुटैः पुटैः ।। (र.र.स.2:131)

Sasyaka, sulphur and borax are taken in equal quantity and mixed together. The mixture is processed with juice of *Lakucha* fruit and discs are prepared and dried. They are sealed in the crucible and subjected to *Kukkutaputa* for 3 times. A white coloured *Tuttha bhasma* is obtained.

(Rasaratnasamuchchaya 2:131)

• Properties

Sasyaka is a rejuvenative and detoxifying. It alleviates all three *doshas*. It is beneficial to eyes. It works both as an emetic and purgative, in different dosages.

• Usage: It has *lekhana* property i.e. scrapping of excessive tissue growth.

• External: In ointment form, it is used in conjuctivitis and trachoma. It renders chemical cauterization. It is also useful in treating the wounds and ulcers, with hypergra-nulation tissue, for the same reason. *Tuttha drava* is used to give *uttara basti*. It is useful in skin diseases, syphilis, gonorrhoea, vitiligo, diabetes, abdominal pains and worms.

• Dosage

For external use required quantity.
For internal use - 15-30 mg for emesis.

• Formulations: *Nilakantha rasa, Tuttha-haritaki, Haratala mishrana, Jatyadi ghrita* etc.

• Extraction of Essense

सस्यकस्याथ चूर्णं तु पादसौभाग्यसंयुतम् ।
करञ्जतैलमध्यस्थं दिनमेकं निधापयेत् ।।
अन्धमूषामध्यस्थं ध्मापयेत् कोकिलाग्निना ।
इन्द्रगोपाकृतिश्चैव सत्त्वं भवति शोभनम् ।। (र.र.स.2:132-133)

One part of *Sasyaka* powder and 1/4 part of borax are mixed together and rubbed. It is put in *Karanja taila* (Pongamia glabra/seed oil) for one day. Then the oil part is separated and the pulp is subjected to intense heating in sealed crucible. A reddish coloured *sattva* is obtained.

(Rasaratnasamuchchaya 2:132-133)

The properties of this *Sattva* seem to be similar to that of copper.

(7) Chapala

• Synonyms: There are no synonyms to *Chapala*. In Rasarnava, it is mentioned as '*Shaila*' and one more name '*Rasaraj sahay*' is quoted as an adjective.

• Varieties

Four varieties of *Chapala* are mentioned in Rasaratnasamuchchaya as :

1. *Goura* - yellowish in colour.
2. *Shweta* - white coloured.
3. *Aruna* - pinkish-red in colour.
4. *Krishna* - black coloured.

Of these, two varieties viz. *Goura* and *Shweta* are used for *Rasabandhana* - to achieve the stability to mercury. Other two varieties readily melt on heating, hence, are not used.

• Purification

जम्बीरकर्कोटकशृङ्गवेरैर्विभावनाभिश्चपलस्य शुद्धिः ।
(र.र.स.2:147)

Chapala is purified by processing it with the juices of *Jambira* (Citrus limonum), *Karkotika* (Benincasa hispida) and *Ardraka* i.e. ginger (Zingiber officinalis), for seven times, each. (Rasaratnasamuchchaya 2:147)

• Incineration

Not mentioned in the texts. The only reference in Rasarnava denotes that, it is mixed with *Karpura Shilajatu* and incinerated. But this procedure is not much used. Probably, *Chapala* being used mainly for *parada-bandhana*, its incineration procedure is not mentioned.

• Properties

Chapala is sweet, hot, sharp, unctuous, heavy and alleviates all the three *doshas*. It is a potent aphrodisiac and also strengthens the body.

In Rasashastra, the references about *Chapala* are very scarce. There are no references about its dosage or formulations.

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• Extraction of Essense

शैलं तु चूर्णयित्वा तु धान्याम्लोपविषैर्विषैः ।
पिण्डं बद्ध्वा तु विधिवत् पातयेत् चपलस्तथा ।। (र.र.स.2:148)

The mineral form of *Chapala* is powdered and processed with the sour gruel, decoctions of *Bhanga* (Cannabins sativa), *Dhattura* (Datura metel), *Karavira* (Nerium odorum) and *Vatsanabha* (Aconitum ferox) and dried. Then it is subjected to heating and with a routine procedure, its extraction is done. (Rasaratnasamuchchaya 2:148)

Controversies about Chapala

There are two schools of thought, about exact chemical nature of *Chapala*. In Bharatiya Rasashastra, written by Dr. V.G. Desai, it is mentioned that *Chapala* means bismuth, as both have a low melting point (271°C). The varieties of *Chapala* as mentioned in Ayurvedic texts correlate with the compounds of bismuth. For example, bismuth oxide is yellowish-white in colour (*Shweta chapala*), bismuth sulphide is black in colour (*Krishna chapala*), whereas bismuth sulphide, when rich in iron oxide, looks red in colour (*Aruna chapala*).

But none of the properties of *Chapala*, mentioned in Ayurvedic texts, are found in bismuth. Moreover, it is mentioned that *Chapala* melts like *Vanga* (tin). The melting point of tin is 232°C, as against that of bismuth is 271°C.

Acharya Narendranath Mitra has proved that the properties and description of *Chapala* match with that of Selenium. The properties, varieties and medicinal properties of Selenium are as follows :

(1) Selenium looks like steel, shining grey in colour. *Goura* variety of *Chapala* is also grey in colour and it resembles its one of the properties. The cut surface of selenium shows flowery designs. It correlates with' '*Pushpakriti*' as described in Ayurvedic texts.

(2) One variety of selenium is red, which melts between 170°-180°C. *Aruna* and *Krishna* varieties of *Chapala* mentioned in texts, melt quickly i.e. they have a low melting point.

(3) Pure Selenium melts at 217°C, which is near to that of tin (232°C). Ayurvedic texts have quoted that *Chapala* melts like *Vanga*.

(4) Selenium crystals are hexagonal in structure. The same has been desdribed in texts of Rasashastra.

(5) Selenium, in modern medicine, is used in sterility, debility, orchitis etc. Similarly, *Chapala* is aphrodisiac and strengthens the body.

Though selenium is invented recently, the similarities between *Chapala* and Selenium indicate that the ancient Ayurvedic scholars knew this metal since those days.

The inference drawn from the similarities between *Chapala* and Selenium, does not indicate that precisely *Chapala* means Selenium. But the traditional thought that *Chapala* means Bismuth, is far from the truth.

(8) Rasaka

• Synonyms: *Rasaka* has various synonyms in Sanskrit, like *Kharpara, Kharpariyaka, Yashadakarana, Gobhadda, Kshitikitta, Rasodbhava, Netrarogari* and *Tamra-ranjaka* etc.

• Occurrence

Jasada (Zinc) mines are abundent in Rajasthan. The other sources are Kashmir, Sikkim and Himachal Pradesh. *Rasaka* is a zinc containing mineral.

• Appearance

Rasaka is found in a form of a mineral. It is chiefly a min-

eral, containing zinc compounds. Zinc is never found pure in nature. It occurs combined with sulphur in a mineral called 'Sphalerite' or 'Zinc blende'. It is also known as Black Jack or Mock lead or Falls Galena. It is yellowish to brownish in colour and contains 67% zinc and 33% sulphur. Along with it, often lead compounds are found, hence it is known as Lead-Zinc ore.

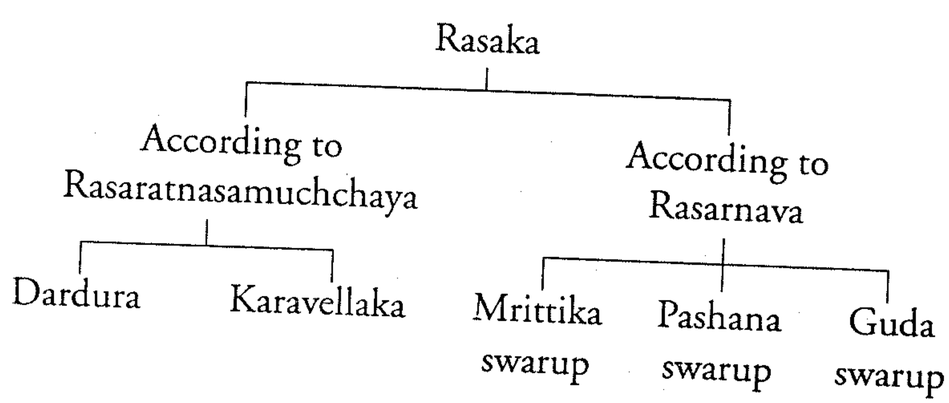
Another mineral, Smithsonite, contains zinc carbonate ($ZnCO_3$). It is formed by action of carbonated water on zinc sulphide (ZnS). It is commonly white in colour but sometimes it is green, blue or brownish also.

Other zinc-containing minerals are Calamine, Zincite, Franklinite and Willemite.

In practice, instead of *Rasaka*, the Mangalore tiles are used as a substitute. But it does not contain zinc at all. It contains only sand and iron.

- Physical Properties
  1. *Rasaka*, available in a form of Mangalore tiles, is brick-red in colour, with a slightly soily smell.
  2. It absorbs water.
  3. It is resistant to heat.
- Varieties

In Rasashastra, *Rasaka* is categorised into different varieties as follows :



(1) ***Dardura***: It is formed in layers. The essence of its extract can be obtained (*Sattvapatana*).

(2) ***Karavellaka***: It is not formed in layers. It is used for medicinal purpose.

(3) ***Mrittika Swarup***: It is yellowish in colour and looks like a soil. When heated, it does not lose its weight. From this variety, sufficient quantity of an extract can be obtained. It is categorised as the best one. From its description it can be said that it contains zinc oxide (ZnO) in large amount.

(4) ***Guda Swarup***: It looks like a jaggery. From its description it seems to contain zinc sulphide (ZnS). It is rated as a medium variety of *Rasaka*.

(5) ***Pashana Swarup***: This variety of *Rasaka* is hard like a stone. It is an inferior variety. It contains zinc carbonate ($ZnCO_3$) or zinc silicate ($ZnSiO_3$).

- Approval

Mrittika Swarup is the best one, *Guda swarup* is medium and *Pashana swarup* is an inferior variety. For extraction purpose, *Dardura* variety is commonly used and for medicinal purpose *Karavellaka* variety is used. At present, a variety of *Rasaka*, is used for medicinal purpose. This is the marketed form of *Rasaka*, called as '*Kalakhapari*'. It does not contain zinc at all.

- Purification

खर्परः परिसन्तप्तः सप्तवारं निमज्जितः ।
बीजपूरं रसस्यान्तं निर्मलत्वं समश्नुते ।।
नृमूत्रे वा अश्वमूत्रे वा तक्रे वा काञ्जिकेऽथवा ।
प्रताप्य मज्जितं सम्यक् खर्परं परिशुद्ध्यति ।। (र.र.स.2:155-156)

Rasaka is purified by heating till it becomes red and then

dipping it in the juice of *Jambira* (Citrus limonum) or in human male's urine or horse's urine or buttermilk or in a sour gruel. It becomes purified after repeating this process for 7 times. (Rasaratnasamuchchaya 2:155-156)

• Incineration

खर्परं लोहपात्रस्थं चुल्ल्यां दत्त्वा विपाचयेत् ।
गलिते सैन्धवं चूर्णं दत्त्वा दत्त्वा विमर्दयेत् ।।
भूयः पलाशदण्डेन यावद् भस्मीभवेत्तु तत् । (रसजलनिधि)

Purified *Rasaka* is heated in an iron vessel till it melts. Then rock salt is added into it in small amount and rubbed with the stick of *Palasha* (Butea frondosa), till the incineration is obtained.

The *Rasaka*, available now a days in the market, will not be liquified. So, in the heated powder of *Rasaka*, the rock salt is added little by little quantity and rubbed with the stick of *Palasha* (Butea frondosa). (Rasajalanidhi)

• Properties and Usages

Rasaka alleviates *Kapha* and *Pitta doshas*. It strengthens the body tissues. It is useful in all types of *Prameha* (diabetes), diseases of eyes and works well in asthma, diarrhoea and tuberculosis. Now a days, *Jasada bhasma* i.e. incineration of zinc is used instead of *Rasaka*. It is given in a dose of 250 to 500 mg. with honey or water.

We have studied about *Rasaka*, as mentioned in the Ayurvedic scriptures. In present time the *Rasaka*, which is available in the form of Mangalore tiles does not contain any amount of zinc. So, the procedures like *Shodhana, Marana* and *Sattvapatana*, which are mentioned in the texts, are applicable to presently available *Rasaka* or not is doubtful. Traditionally, still these procedures are followed.

• Extraction of Essense

साभयाजतुभूनागनिशाधूमजटङ्कणम् ।
मूकमूषागतं ध्मातं सत्त्वं मुञ्चति खर्परम् ।। (र.र.स.2:163)

Equal quantity of *Haritaki* (Terminalia chebula), *Shilajatu* (Black bitumen), *Bhunaga* (Earthworm), *Haridra* (Curcuma longa), *Grihadhuma* (Smoke deposits) and *Tankana* (borax) are taken (1 part each) and added into 4 parts of *Rasaka*. All this mixture is rubbed, sealed in a crucible and heated in coal. *Rasaka sattva* is obtained, which basically contains zinc. (Rasaratnasamuchchaya 2:163)

In modern methods of chemistry, zinc is obtained from its compounds like zinc oxide (ZnO) and zinc carbonate ($ZnCO_3$), by intensely heating them with coal. In this process, first the compounds get converted into zinc oxide and carbon dioxide (CO_2) gets released and pure zinc is obtained. This procedure and *Sattvapatana* procedure have a similarity, that in both, the carbon is used.

Rasaka sattva is further incinerated by the same procedure that is mentioned earlier, for incineration of *Rasaka*.

Few Comments about Rasaka

From various synonyms of *Rasaka* like *Tamraranjaka* (one which gives (yellow) colours to copper, meaning zinc) *Ritikrita* (means one, which is responsible for forming brass) etc. It is clear that it is a compound of Zinc. Because Zinc and Copper when mixed in definate proportion forms Brass, a yellow coloured metal.

However, it is also a proved fact that the present samples, of *Rasaka* which are available in the market have no Zinc in them.

These facts can be partially explained if following points are taken into consideration:

- It is known fact that in the mines of lead, other metallic ores of Tin and zinc coexist.
- While extracting Lead from ores, often significant amount of Tin and Zinc compounds are formed as waste product, which till no so long ago, used to be thrown away.
- In the period of British India, there used to be a working Lead mine in Burma. (presently known as Myanmar) called as Brahma Mines.
- This mine was closed down due to various reasons in late nineteenth century. There used to be large mountains of such waste products scatterd around the site of the mine. Till about 50 to 60 years back, such waste product, converted into form of samll 'Manglore Tiles' were sold in India as '*Rasaka*'.
- In the pre-Independance era, *Rasaka* used to be imported from Gulf countries. Both these produces were rich in Zinc.
- Presently it appears that both these sources of '*Rasaka*' have exhausted.
- The product which is available in market under the pretext of *Rasaka* is devoid of any zinc.
- There are many important and potent drugs which contain *Rasaka*. e.g. all the drugs of '*Vasantha*' types. The original formullae of these drugs include *Rasaka* having Zinc compounds. But because presently such *Rasaka* is not available in market it is better to use incinerated form of Zinc instead of *Rasaka*. Many Ayurvedic Scholars even advocate use of incinerated forms of Zinc, Lead and Tin in definite proportions instead of *Rasaka*.

Chapter 13

Uparasa

In the previous chapter we studied the substances categorised under *Maharasa*. In this chapter we are going to study the substances classified under *Uparasa*.

गन्धाश्मगैरिकासीसकांक्षीतालशिलाञ्जनम् ।
कङ्कुष्ठं चेत्युपरसाश्चाष्टौ पारदकर्मणि ।। (र.र.स.3:1)

Sulphur (*Gandhaka*), Haematite (*Gairika*), Green Vitriol (*Kasisa*), Alum (*Kankshi*), Orpiment (*Haratala*), Realgar (*Manahshila*), *Anjana* and *Kankushtha* are the eight substances categorised as *Uparasa*. These are useful in experiments on Mercury.

(1) Gandhaka (Sulphur)

- Synonyms: In Sanskrit, *Gandhaka* i.e. Sulphur, has various synonyms describing its smell or usefulness in a disease, viz. *Gandha, Shulbari, Shulbaripu, Bali, Gandhapashana, Sougandha, Durgandha, Pamari, Kushthari, Balivasa* etc.
- English Name: Sulphur
- Chemical Formula: 'S'.
- Occurrence

Sulphur occurs in free state in nature near volcanoprone areas and in waters of hot springs and it is also found in coal, crude oil, natural gas, oil shales and many minerals. The most abundant of all sulphur minerals is a compound of sulphur and iron, called *Pyrite*.

Before 1900, many industries obtained sulphur from volcanic deposits, sulphur mines in Sicily, and roasted pyrites.

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The United States has been the leading producer of sulphur since 1900. Most of the country's sulphur is produced in Lousiana and Texas. Other countries that produce sulphur include Canada, Japan, Poland and the Soviet Union.

In India, sulphur is found as a mineral in the form of calcium sulphate, chalcopyrite and iron pyrite, in Bihar, Rajasthan and Andhra Pradesh. It is also found throughout the world in the form of sulphates and sulphides of metals. The volcanic deposits contain sulphur in a form of gypsum i.e. calcium sulphate.

The atmosphere of Venus contains sulphur, and some scientists believe the core of Mars consists of pure iron sulphide, another compound of sulphur and iron. Astronomers have found sulphur compounds in interstellar clouds and in meteorites.

• Properties

(1) Sulphur has property of allotropism. This property is its important characteristic. Physical state is same, chemical is same, but forms and physical properties are different.
(2) It has an atomic weight of 32.064 and its atomic number is 16.
(3) Sulphur melts at 120°C if it is heated slowly, and 113°C if it is heated rapidly. It boils at 444.8°C.
(4) At temperatures above 150°C, sulphur becomes thick and viscous. Above 250°C, it becomes more fluid again and its colour changes from yellow to red. It is dark brown at its boiling point.
(5) Sulphur is a very reactive element. At 250°C, it ignites with air. As it burns, it combines with oxygen to form sulphur dioxide (SO_2), a colourless gas.

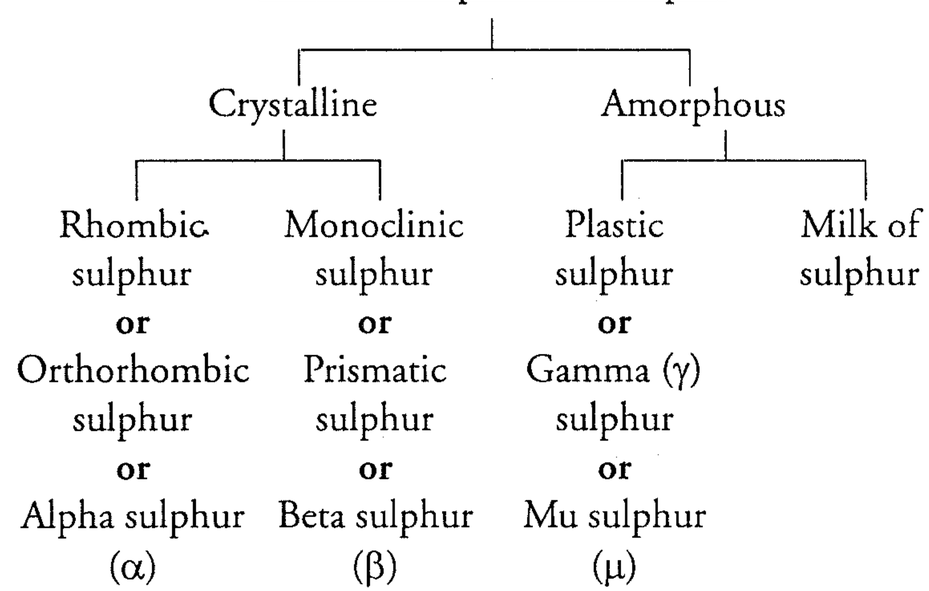
(6) It is a bad conductor of heat and electricity.
(7) It is insoluble in water, but dissolves in carbon disulphide, benzene and turpentine.

Ayurvedic Classification of Sulphur

Ancient texts of Ayurveda have classified sulphur into 4 varieties according to its colour, viz. *Shveta* (white), *Pita* (yellow), *Rakta* (red) and *Krishna* (black). Of which the white variety is known as *Khatika Gandhaka*, yellow variety is called as *Amalasara Gandhaka* or *Shukapichchhabha* - meaning yellowish like parrot's feathers, and red variety is known as *Shukatundakhya* - denoting the red colour as that of parrot's beak. Amongst all variety, the black one is a scarce one.

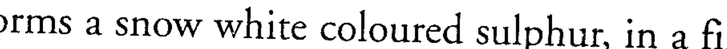
Modern-Chemical Classification of Sulphur

Forms of Sulphur (Allotropes)



The rhombic sulphur is a lemon-yellow, crystalline material that is stable at room temperature. Monoclinic sul-phur is stable only between 94°C and 120°C. It occurs in long, almost colourless, needlelike crystals. Plastic sulphur is soft and sticky and stretches like rubber. Both mono-clinic sul-

phur and plastic sulphur change to the rhombic form at room temperature. Milk of sulphur is a precepitate formed during various chemical reactions. For example:



$$CaS_5 + 2HCl \rightarrow CaCl_2 + H_2S + 4S$$

It forms a snow white coloured sulphur, in a fine powder form. When it is heated, it turns yellow in colour, which is commonly used for medicinal purpose.

Rhombic sulphur is prepared in several ways for commercial use. For example, fine grains of sulphur are produced when sulphur vapour condenses. These grains are called 'flower of sulphur' because they occur in flowerlike patters. 'Roll sulphur' is made by hardening liquid sulphur in cylinder-shaped moulds. 'Sulphur nuggets' are prepared by spraying molten sulphur into a water bath.

The varieties of Sulphur described in Ayurvedic texts can be correlated with the modern description of allotropes of sulphur. *Shveta gandhaka* with milk of sulphur, yellow sulphur with *Gandhaka pushpa* and plastic sulphur may be correlated with *Krishna gandhaka*, which is scarcely found because of its instability. About *Rakta gandhaka* (literally, red sulphur), we can say that the sulphur, when heated above 250°C, it becomes more fluid again and its colour changes from yellow to red. It can be a transient stage, when sulphur is red in colour.

• Approval

Ayurvedic texts have mentioned various uses of all varieties of sulphur and their special uses as well. The following are the peculiar uses of a particular variety.

White variety : Useful for *lepana* and *dhatu marana.*
Red variety : The best one for *dhatuvada.*

Black variety : Ultimate for *rasayana karya.*
Yellow variety : The best one for medicinal usage.

स चापि त्रिविधो देवी शुकचञ्चुनिभो वरः ।
मध्यमः पीतवर्णः स्याच्छुशुक्लवर्णोऽधमः स्मृतः ।। (र.र.स.3:12)

Though such is a case, still the texts chategorise the red sulphur as the best one, yellow sulphur as better and white sulphur as good variety. (Rasaratnasamuchchaya, 3:12)

In the market, the available varieties of sulphur are only white and yellow. For medicinal purpose, the yellow sulphur is mainly used.

• Purification

लोहपात्रे विनिक्षिप्य घृतमग्नौ प्रतापयेत् ।
तप्ते घृते समानं तु क्षिपेद् गन्धकजं रजः ।।
विद्रुतं गन्धकं ज्ञात्वा तनुवस्त्रे विनिक्षिपेत् ।
यथा वस्त्राद् विनिःसृत्य दुग्धमध्येऽखिलं पतेत् ।।
शीतो निष्कासितो धौतो जलं वस्त्रेण शोषयेत् ।
एवं नैर्मल्यमापन्नो गन्धकः शुद्ध उच्यते ।।
एवं वारत्रयं शोध्यो भिन्ने दुग्धे प्रयत्नतः ।
भक्षणार्थं हि भिषजां योगार्थं सकृदेव च ।।

(आयुर्वेदप्रकाश 2:21-24)

Equal quantity of impure sulphur and cow's ghee are taken. First the ghee is slowly heated till it is liquified. Then impure sulphur is poured in ghee and the mixture is stirred. Sulphur thus gets dissolved. Then this liquid is poured into milk through a cloth filter. We get a solid slab of sulphur. It is then washed with hot water, dried and powdered. This procedure is repeated twice and every time the milk and ghee should be changed. The purified sulphur is suitable to utilise for medicinal purpose and even for ingestion. (Ayurvedaprakash 2:21-24)

In this procedure, the sulphur gets dissolved in the ghee

and simultaneously ghee detoxifies the sulphur. The cow's ghee used, pacifies the *Pitta dosha*. The substances which are insoluble in ghee are filtered off from the sulphur. When transferred into milk, the temperature of sulphur drops down and it gets solidified again and the traces of ghee float on the surface of the milk. The unctuousness of sulphur, because of ghee, is washed out with hot water.

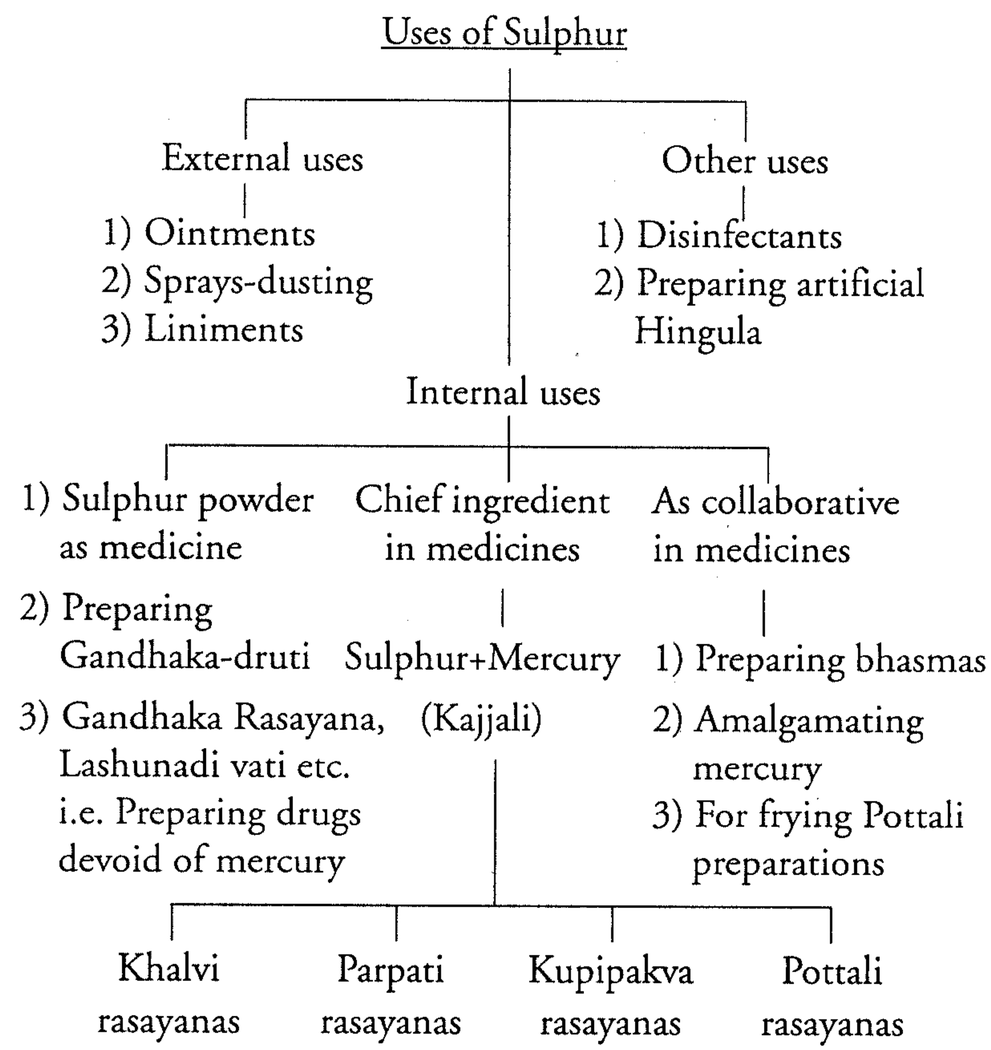
In all other texts, principally the same procedure is followed to purify the sulphur. Few texts have mentioned to liquify the sulphur; in such cases it is directly heated. Some other texts mention that sulphur is poured in the juice of *Bhringaraja* (Eclipta alba), which alleviates the *Pitta dosha*. The basic concept, to detoxify the sulphur and to process it with *Pitta* alleviating substances, remains the same.

There are very few other substances like cuttle bone (*Samudraphena*), ambergris (*vahnijara*), alum (*kankshi*), haematite (*gairika*) etc. which are only purified and directly used for medicinal purpose. These substances do not need any incineration (*marana*) or separation of an active element. Similarly sulphur does not require these procedures and is directly used in medicines after purification.

Various Uses of Sulphur

Sulphur is a yellow, non-metallic chemical element that is found in many parts of the world. It has been used for various purposes for hundreds of years. The ancient Greeks and Romans used sulphur as a cleanser, bleach and medicine. Ancient Indian scholars of Ayurveda had used sulphur for medicinal purpose to treat numerous diseases. They had an elaborated research on various properties of sulphur and used them for both *dehavada* as well as *dhatu-*

vada, i.e. to achieve longevity and to use sulphur for various processes in Rasashastra. Here we are going to study it through the perspective of *dehavada* i.e. various uses of sulphur for medicinal purpose only. Various uses of sulphur are simplified in a form of flow-chart.



• External Uses

(1) Ointments: Purified sulphur is mixed with *Shatadhauta ghrita* or vaseline, butter or resin of *Sarja* (Shorea robusta) as a base and is used topically, for wound dressing. Antimicrobial property of sulphur is used in skin diseases like scabies and various dermatoses.

(2) Sprays for dusting: In wounds with discharge, fine powder of purified sulphur is used for dusting.

(3) Liniments: Thin layer of sulphur is used in skin diseases and also in rheumatic joints and sciatica in the form of liniments.

• Internal Uses

Sulphur is highly esteemed like Mercury for its multiferous uses. Few important uses are briefed here:

(1) Sulphur powder, by itself, is used orally as a medicine. It is useful in diseases like skin diseases, tuberculosis, loss of appetite, asthma, cough, diseases of oral cavity and anorectal diseases, with proper vehicle.

(2) *Gandhaka druti*, a special dosage form, is also used orally, in various diseases. The purified sulphur powder mixed with other ingredients is spread on the cloth and wrapped. The pouch of cloth is dipped in the sesame oil and burnt on a flame. The liquified part of *gandhaka* dribbles down, which is collected and used for medicinal purpose. There are various other procedures to prepare *gandhaka druti*.

(3) There are few preparations, which are devoid of Mercury and pure sulphur is used, for example, *Lashunadi vati, Gandhaka rasayana*.

(4) In Rasashastra, there are numerous '*Khalvi rasayanas*' i.e. drugs prepared in mortar and pestles where *Kajjali* is used. For example *Sutashekhar*.

(5) The *Parpati rasayanas* are prepared from *Kajjali* itself. For example, *Rasa parpati, Panchamrita parpati* etc.

(6) The *Pottali rasayanas* are also prepared from *Kajjali*. For example, *Hemagarbhapottali rasa*.

(7) *Kupipakva rasayanas* also contain *Kajjali*. For example, *Rasasindura, Samirpannaga* etc.

(8) The *Pottali* preparations are cooked in smolten sulphur. For example *Hemagarbhapottali rasa*.

(9) Sulphur is also used in procedures of incineration (*bhasma*) of few metals. For example - *Tamra bhasma* (Calx of copper).

(10) *Kajjali* is the basic preparation, widely used in Rasashastra. (We have already seen about *Kajjali* in Chapter 10.)

• Dosage: Pure Sulphur is given 120 to 960 mg, with milk.

During the regimen of sulphur treatment, the patient should avoid sour substances and salt strictly. Also it is recommended to restrict alcohol, spicy and irritant food stuffs. Sulphur gets eliminated through urine, which may cause burning micturition and general burning sensation in the body. Hence, milk is the choicest medium of intake for drugs containing sulphur. Along with it, ample amount of water intake is also advised. In modern medicine, similar advise is given during usage of sulfa drugs, which keeps urine alkaline.

• Formulations

Gandhaka rasayana, Gandhaka druti, Rasa parpati, Panchamruta parpati, Suvarnarajavangeshwar, Samirapannaga etc.

(2) Gairika (Hematite)

• Synonyms: Haematite, i.e. *Gairika*, has few synonyms in Sanskrit, like *Gaireya, Girimrittika, Raktadhatu, Lohadhatu, Girimridbhava* etc.

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English Name: Haematite, Red lumbar or Red iron oxide.

• Occurrence

About 20% of iron produced in North America comes from hematite. Deposits of the ore lie near Lake Superior in Michigan, Minnesota and Wisconsin and in Alabama and Tennessee. Large amount of haematite also occur near the border of Labrodor and Quebec; and in Ontario. Other sources include Australia, Brazil and South Africa.

In India, Red Ocher, an earthy form of hematite occurs in Singbhoom (Bihar), Mayurbhanja, Sundargarh (Orissa), Bettari, Chikmanglore, Chitaldurga, Shimoga (Karnataka), and Kornul, Adilabad, Varangal (Andhra Pradesh).

• Characteristics/External Apperance

The word hematite means bloodlike. It is a mineral that supplies most of the world's iron. It is a ferric oxide (a compound of iron and oxygen) and in its pure form, hematite consists of about 70% iron. The mineral occurs in variety of forms, including shiny crystals, grainy rock and loose earthy material. Hematite is black, brownish-red or dark-red, but a fresh scratch on hematite rock is blood-red.

• Chemical Formula: Fe_2O_3.(Ferrous oxide)

• Physical Properties

1. *Gairika*, is supposed to be a subsidiary metal of iron, as it is a mineral of iron.
2. It is insoluble in water.
3. It is soft in touch and colours red.
4. Few varieties of haematite contain water of crystalization.
5. Specific gravity is 4.9-5.3.
6. Hardness is 5.5-6.5.

• Varieties

Suvarna-gairika and *Pashana-gairika* are the two varieties mentioned in texts. *Suvarna-gairika* is shiny, soft, unctuous looking and bright red in colour. *Pashana-gairika* is hard, dry and red in colour. Few texts of Ayurveda divide *Suvarna-gairika* into further two varieties viz. *Suvarna-gairika* which is bright and dark red, and *Samanya-gairika* which is described as red only. There is no difference in their properties. As per minerology, varieties of hematite are martite, turgite, reddle, kidney ore, micaceous hematite and specular iron ore.

• Approval

Suvarna-gairika is supposed to be the best variety, which is used for medicinal purpose. It is soft and unctuous looking. It is only purified and not required to undergo incineration process.

Chemical formula of *Suvarna-gairika* is $2Fe_2O_3$, $3H_2O$ or Fe_2O_3. It contains 30% oxygen and 70% iron. *Pashana-gairika* contains ferrous carbonate ($FeCO_3$)

• Purification

गव्याज्येन तु सम्भृष्टं यत्नतो मन्दवह्निना ।
सुवर्णगैरिकं शीघ्रं शुद्धिमाप्नोत्यसंशयम् ।।

(रसतरंगिणी 22:115)

Fine powder of *Suvarna-gairika* is mixed with 1/4 to 1/8 parts of cow's ghee and roasted on low flame. It gets purified without doubt. (Rasatarangini 22:115)

Another method of its purification is to process *Suvarna-gairika* with cow's milk. But it has to be used immediately, as it becomes rancid after few hours. Hence, *gairika* is purified and used immediately.

Like *Gandhaka, Gairika* is used directly after it is purified. There is no mention of incinerating of *Gairika* to prepare a *bhasma* of it.

• Properties

Gairika is sweet and astringent in taste, pungent in the post-digestive effect and has cold potency. As it contains iron, it increases the body strength . It alleviates *Pitta dosha* and detoxifies the toxins.

• Usage

Purified *Gairika* mitigates vomiting and hiccup. It is useful in anaemia, menorrhagia and bleeding diathesis. Externally, it is used as an ointment for promoting wound healing. It also relieves itching in urticaria, when its paste is applied topically.

• Dosage: 240 to 480 mg, with butter or milk with sugar.

• Extraction of Essense

गैरिकं सत्त्वरूपं हि नन्दिना परिकीर्तितम् ।
कैरप्युक्तं पतेत् सत्त्वं क्षाराम्लस्विन्नगैरिकात् ।। (र.र.स.3:50)

According to Nandi, a scholar of Rasashastra, *Gairika* itself is an extract, hence its extraction is not required. But it is quoted that when *Gairika* is steamed (*swedana*) in sour liquids, its extraction is prepared. But there is no any reference regarding which sour liquid or any information about the duration of steaming etc. In practice, extraction of *Gairika* is not done. (Rasaratnasamuchchaya 3:50)

• Formulations

Laghusutashekhar, Kamadudha, Padadari Malahara.

(3) Kasisa (Green Vitriol)

• Synonyms: Green Vitriol, i.e. *Kasisa*, has few synonyms

in Sanskrit, like *Kasisaka, Pushpakasisa, Pamshuka* and *Pamshukasisa* etc.

• English Name: Green Vitriol, Ferri Sulph, Melanterite.

• Chemical Formula: $FeSO_4$, $7H_2O$.

• Occurrence

Green Vitriol is a substance which occurs as light-green crystals. The crystals turn rusty brown when they react with oxygen in moist air. Ferrous sulphate is an iron salt of sulphuric acid. It can be made by combining iron with sulphuric acid or by oxidizing iron pyrites, a compound of iron and sulphur.

Green vitriol results from the decomposition of pyrites in the zone of oxidation. It is found in nature along with the minerals of iron. The chief source in India is Bihar and Orissa, which consists 40% ferrous sulphate and remaining as magnesium and iron. Green Vitriol is manufactured in Uttar Pradesh and Punjab from the mineral source - FeS_2.

• Characteristics

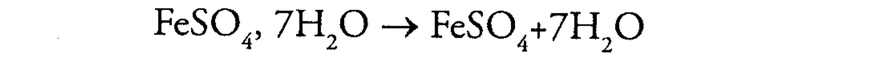
'Rasarnava', the Ayurvedic text mentions '*Kasisa*' as a greenish coloured mineral and '*Pushpakasisa*', a yellowish one. *Kasisa* i.e. ferrous sulphate when exposed to air for long duration, gets oxidized into ferric sulphate and turns into yellowish colour. Probably this is *Pushpakasisa.*

• Physical Properties

(1) Green Vitriol is easily soluble in water.

(2) When it is heated, the water contents get evaporated and it turns into white colour. When heated in anaerobic condition upto 140^0C, it breaks down into ferrous oxide, sulphurtrioxide and sulphurdioxide. Sulphuric acid is prepared by dissolving sulphur trioxide gas in water.

(3) It is efflorescent. In air it loses water of crystallisation and forms a white powder.



$$FeSO_4, 7H_2O \rightarrow FeSO_4 + 7H_2O$$

• Varieties

Ayurvedic texts have mentioned two varieties of *Kasisa*, viz. *Valukasisa* and *Pushpakasisa*. The former is green, whereas the latter is yellowish in colour. Both the varieties possess similar properties.

• Approval

Both varieties are used for medicinal purpose.

• Purification

कासीसं भृङ्गराजोत्थवारिणा घटिकात्रयम् ।
सकृत् स्विन्नं प्रयत्नेन शुद्धिमायात्यनुत्तमाम् ।। (रसतरंगिणी 21:230)

Kasisa is purified by boiling in the juice of *Bhringaraja* (Eclipta alba) for 72 minutes.

The prodcedure is done with the help of *Dola yantra*. When the pouch containing *Kasisa* is emersed into the juice of *Bhringaraja*, it starts getting dissolved. Still, for 72 minutes it is kept boiling till the juice gets thickened. Then it is kept in shadow, in a flat container. The crystals of Green Vitriol are formed. (Rasatarangini 21:230)

It is also mentioned that *Kasisa* can be purified by first processing it with lemon juice and then steaming is done in the sour gruel. It is mentioned that when *Kasisa* is processed with the bile (*pitta*) or the menstrual blood (*artava*) it gets purified.

• Incineration

स्नुहिपत्ररसैर्यद्वा मर्दितं पुटितं मुहुः ।
निरम्लीभावपर्यन्तं कासीसं भस्मतामियात् । (रसतरंगिणी 21:259)

Purified *Kasisa* is powdered and processed with the juice of leaves of *Snuhi* (Euphorbia nerifolia) for 7 times. Then the flat discs are prepared and dried and sealed into saucers and subjected for a *Laghu puta*. This procedure is continued till *Kasisa* loses its sourness or acidity. It can be tested with the help of litmus paper, by dissolving little quantity of *Kasisa bhasma* in water. Finally, a red coloured calx or incineration of *Kasisa* is formed. (Rasatarangini, 21:259)

• Usage

Ferrous sulphate is a mineral containing iron. Hence, *Kasisa bhasma* is also beneficial in treating anaemia. It is one of the important medicines to treat general debility. As it alleviates *Vata dosha*, it is benevolent in cough, as an expectorant. It also works well in splenomegaly, associated with anaemia. *Kasisa bhasma* is useful in dysuria and urinary calculi. It also promotes the menses. It is used as a coloring agent, for dying the hair. It alleviates the tinea versiculor (*shvitra*) and is also beneficial for eyes (*netrya*).

• Dosage: 60 to 240 mg; with honey or ghee.

A mild laxative should be given as an adjunct during the use of *Kasisa bhasma*.

• Formulations: *Rasapushpa*.

(4) Kankshi (Alum)

• Synonyms: Alum, i.e. *Kankshi*, has various synonyms in Sanskrit, like *Sphatika, Tuvari, Phatika, Shubhra, Rangada, Dridharanga, Sourashtri, Suramrittika, Khatika, Pitika* etc.

• English Name: Alum, Potash alum, Double sulphate of aluminium and potassium.

• Chemical Formula: K_2SO_4, $Al_2(SO_4)_3$, $24H_2O$.

• Occurrence

The main source of alum as a mineral is Sourashtra. Other sources are Punjab, Nepal, Bihar, Goa and Uttar Pradesh. Now a days, artificially prepared alum is used for medicinal purpose. Alum is found in shales (Alum shales) which contain pyrites. It also occurs in neighbourhood of volcanoes.

• Characteristics

Alum is a white crystalline solid having an astringent taste. It is readily soluble in water. Its solution in water is acidic. On heating, alum melts at 92°C. On further heating, water of crystallisation evaporates and it swells. The swollen mass is called 'burnt alum'. Specific gravity of alum is 1.75.

• Varieties

Two varieties of *Kankshi* have been mentioned in texts viz. *Phataki* and *Phullika*.

(1) ***Phataki Kankshi***: Yellowish, heavy, unctuous looking; also known as *Pitika*. It is found as a mineral.

(2) ***Phullika Kankshi***: Snow-white, slightly sour and astringent, unctuous looking. It is also known as *Phullatuvari* (Potash alum).

• Approval

Alum which is clean, white and heavy is the best. According to Ayurvedaprakash, it is not required to purify the alum.

• Purification

स्फटिका निर्मला श्वेता श्रेष्ठा स्याच्छोधनं क्वचित् ।
न दृष्टं शास्त्रतो, लोका वह्नावुत्फुल्लयन्ति हि ।। (आयुर्वेदप्रकाश 2:258)
वह्नौ च भर्जनात् उत्फुल्लिता एषा विशुद्ध्यति ।

Alum which is clean, white and crystalline, seldom required purification. In practice, it is burnt and then used.
(Ayurvedaprakash 2:258)

There are few other methods of purification of *Kankshi*. It is soaked in the sour gruel (*kanji*) for 3 days. The quantity of gruel should be very little, so as to dissolve just the impurities in *Kankshi*. Otherwise if gruel is taken in large quantity, all the alum will get dissolved.

Another method is to dissolve *Kankshi* in water and filter. The filtered water is slowly heated and evaporated. This is also rational method to purify the *Kankshi*.

• Incineration

Not done. The purified alum is directly used for medicinal purpose.

• Properties

It is predominently astringent, slightly sour and bitter in taste. Few texts mention it to posses 'hot' taste. It alleviates all three *doshas*. It is beneficial for the hair and also detoxifies the toxins.

• Uses

1. Purified alum is haemostatic, hence used to arrest the bleeding.
2. The paste is applied in tinea versiculor, a skin disease.
3. Eye drops of alum are useful in eye diseases.
4. Alum diluted in water is used as a vaginal douche.
5. Alum water is given orally in poisoning. Because of its potent astringent property, it delays the absorption of toxins from gastric mucosa. Meanwhile the toxins in the stomach are removed by gastric lavage.

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6. Alum promotes the wound healing.
7. It is beneficial in diarrhoea.
8. In stomatal ulcers, dental ill-hygiene and uvulitis, the gargles of alum water are recommended.
9. Alum water wash is helpful in eczema.

• Dosage: 240 to 480 mg; with sugar.

• Extraction

क्षाराम्लैर्मर्दिता ध्माता सत्त्वं मुञ्चति निश्चितम् । (र.र.स.3:65)

Kankshi is rubbed with *kshara*, like *Yavakshara* and sour gruel (*Kanji*) and a pulp formed, is subjected for heating in *Vrintaka musha* or *Andha musha*. The *Sattva* an active ingredient gets separated out in a form of aluminium metal.

(Rasaratnasamuchchaya 3:65)

Another procedure mentioned, is to process (*bhavana*) it with the bile of a cow for 100 times. This extract is useful in *Parada samskaras*. The medicinal uses of the extract are not mentioned.

(5) Haratala (Orpiment)

• Synonyms: Orpiment, i.e. *Haratala*, has various synonyms in Sanskrit, like *Tala, Talaka, Ala, Virala, Lomahrita, Shailushabhushana, Vamsapatraka, Chitragandhaka, Pitanaka, Mallandhaja* etc.

• English Name: Orpiment, Yellow Arsenic.

• Chemical Formula: As_2S_3 - Arsenic trisulphide.

• Occurrence

The chief source is Iran and it is also found in Burma and China. In India it is found in Uttar Pradesh. Artificially it is prepared by heating arsenic and sulphur together, in anaerobic condition. Orpiment occurs in the oxidized

portions of arsenic veins. It is associated with antimony ores in veins.

• Characteristics

1. Orpiment is yellow in colour.
2. Like Mica, one variety of orpiment has layers of thin sheets. It is golden-yellow in colour.
3. A typical shine is present on the yellow colour of orpiment.
4. As a mineral, its shape is variable.

• Physical Properties

1. Orpiment is insoluble in water.
2. It can be easily powdered, as it is fragile.
3. It is extremely toxic (even 125-250 mg of orpiment is lethal).
4. When heated in air, it burns out and sulphur dioxide and arsenic oxide are formed.

• Varieties

Ayurvedic texts have mentioned three varieties of *Haratala* viz. *Patra haratala, Pinda haratala* and *Tabaki haratala.*

(1) ***Patra haratala***: It is in the form of thin fine layers like mica. They are golden yellow and shiny. It is also called as *Vamsapatri haratala, Varki haratala* or *Bagdadi haratala. Patra haratala* is a scaly form.

(2) ***Pinda haratala***: It is in the form of small or large pieces. It has no layers. It contains soil and other impurities. *Pinda haratala* is solid form.

(3) ***Tabaki haratala***: It is prepared artificially. It contains arsenic and sulphur. It is chemically pure. It is not used for medicinal purpose, but is used to prepare colour paints. It is extremely toxic. It is known as 'Kings Yellow'.

(*Godanti haratala* - one variety mentioned by Ayurveda Prakash, is not mentioned here. Because though it is called as *Godanti haratala*, it does not contain arsenic at all. It is a misnomer. It is selenite i.e. crystalline form of calcium sulphate.)

• Approval

Patri haratala is the best one amongst all and is used in medicine. It should be in sheets of golden yellow colour, with lustre.

• Purification

स्विन्नं कूष्माण्डतोये वा तिलक्षारजलेऽपि वा ।
तोये वा चूर्णसंयुक्ते दोलायन्त्रेण शुद्ध्यति ।। (र.र.स. 3:70)

Coarse powder of *Haratala* is wrapped in a cloth pouch and steaming is performed with the help of *Dola yantra*, in the fruit juice of *Kushmanda* (Benincasa hispida) or lime water or *kshara* water of *Tila* (Sesamum indicum). The liquid used for steaming should be four times to that of *Haratala*. Coarse powder of *Haratala* is recommended so that it won't come out of the pouch. The steaming should be done for about 24 hours. (Rasaratnasamuchchaya 3:70)

In other procedures mentioned, *Haratala* is first advised to be washed with lemon water or sourgruel or little amount of borax (*tankana*) is added to it and washed. Then it is subjected to steaming.

The intention behind cleaning *Haratala* in sour juices is to make it free from impurities like dust, grit etc. and get more purified *Haratala* in shorter time.

• Incineration

मधुतुल्ये घनीभूते कषाये ब्रह्ममूलजे ।
त्रिवारं तालकं भाव्यं पिष्ट्वा मूत्रेऽथ माहिषे ।।

उपलैर्दशभिर्देयं पुटं रुद्ध्वाऽथ पेषयेत् ।
एवं द्वादशधा पाच्यं शुद्धं योगेषु योजयेत् ।।
(र.र.स. 3:73-74)

Purified *Haratala* is processed (*bhavana*) with the thick decoction of the roots of *Palasha* (Butea frondosa), for 3 times. Then it is rubbed with the urine of buffalo and thin discs are prepared. These discs are properly sealed in the saucers and heated with 10 cakes of cow dung. The procedure is repeated 12 times. Then it is used for medicinal purpose. It is only said that *Haratala* becomes pure, but nothing is mentioned about its incineration (*bhasma*).
(Rasaratnasamuchchaya, 3:74-75)

According to experienced Ayurvedists, after this procedure, a white coloured calx (*bhasma*) of *Haratala* is formed.

There are various procedures mentioned in texts, to incinerate *Haratala*. For example, purified orpiment is heated in the white ash or *kshara* of different plants; which contains plants like *Punarnava* (Boerhaavia diffusa), *Apamarga* (Achyranthes aspera), *Dhattura* (Datura metel) etc.

Purified *Haratala* is processed (*bhavana*) with the latex of *Snuhi* (Euphorbia nerifolia), juice of *Kumari* (Aloe vera), juice of *Tulasi* (Ocimum sanctum) and then heated. White coloured *bhasma* of *Haratala* is formed.

• Tests for Calx

Haratala bhasma is white in colour. Other routine tests like *varitara, rekhapurnatva* etc. should be performed. In addition, the text Ayurvedaprakash has mentioned that when *Haratala bhasma* is put on fire, smoke does not appear. If it smokes, the procedure of *bhasma* has lacked in heating and thus more heat is given again.

• Properties

Properties of *Haratala bhasma* are as follows:
Taste - Pungent, astringent.
Post-digestive effect - Pungent.
Potency - Hot.
Attributes - Unctuous.
Effects on *Doshas* - Alleviates *Vata* and *Kapha doshas.*

• Uses

Haratala bhasma is the choicest remedy for various skin diseases. It is also beneficial in treating gout, syphilis and gonorrhoea. It is aphrodisiac, improves the complexion and adds to the longevity.

• Dosage

15 to 60 mg; with rock candy or decoction of *Guduchi* (Tinospora cordifolia).

During *Haratala bhasma* regimen, one should avoid bitter, sour and salt tastes. The food predominent in sweet taste is preferred. Also one should avoid exposure to sunlight or heat.

• Extraction

कुलित्थक्वाथसौभाग्यमाहिषाज्यमधुप्लुतम् ।
स्थाल्यां क्षिप्त्वा निदध्याच्च मल्लेन च्छिद्रयोगिना ।।
सम्यङ् निरुध्य शिखिनं ज्वालयेत्क्रमवर्धितम् ।
एकप्रहरमात्रं हि रन्ध्रमाच्छाद्य गोमयैः ।
यामान्ते छिद्रमुद्घाट्य दृष्टे धूमे च पाण्डुरे ।
शीतां स्थालीं समुत्तार्य सत्त्वमुत्कृष्य चाहरेत् ।। (र.र.स. 3:76-78)

Orpiment powder is processed with the decoction of *Kulattha* (Dolichos biflorus), borax ghee and honey and the pulp is dried and kept in a pot. A saucer is kept on mouth of the pot, which has a small opening in the centre. The saucer and the pot are properly sealed with rags and mud. The small opening in the centre of saucer is also sealed with cow dung. Then the pot is gradually heated. After 3 hours, the saucer seal is taken out. When the white smoke starts coming out of that opening, heating should be stopped. After cooling on its own, the extract is taken out. Extract of orpiment may be chemically arsenic oxide and should be used accordingly.

(Rasaratnasamuchchaya 3:76-78)

In procedure of *Haratala bhasma* or *Haratala sattvapatana*, the optimum heat only should be used. Otherwise, more heating can cause loss of arsenic by sublimation.

• Formulations

Rasamanikya, Haratala mishrana, Samirapannaga, Bhutabhairava rasa, Ashwakanchuki, Chaturbhuja kalpa, Smritisagar, Sutikabharana etc.

(6) Manahshila (Realgar)

• Synonyms: Realgar, i.e. *Manahshila*, has various synonyms in Sanskrit, like *Naipalika, Manogupta, Kulati, Kunati, Nagamata, Kalyanika, Manohara, Rasanetrika, Nagajihvaka, Manojna* etc.

• English Name: Realgar or Red Arsenic Realgar.

• Chemical Formula: Arsenic disulphide (As_2S_2)

• Occurrence

Arsenic occasionally occurs in its pure form in nature. But it is most commonly found in chemical combination with sulphur or oxygen, or with such metals as cobalt, copper, iron, nickel, silver and tin. Compounds of arsenic have been used since ancient times for many purposes including medicines and poisons. The chief source is Iran, and

also in Burma and China. In India it is found in Uttar Pradesh.

Realgar occurs associated with orpiment. It occurs as a deposit in hot springs, and as a volcanic sublimate. It is common in veins, where it may occur as nests or nodules in clay, or associated with cinnabar.

• Characteristics

There is no much difference in *Haratala* and *Manahshila* chemically. It is mentioned in Ayurvedaprakash that *Manahshila* is a type of *Haratala. Haratala* is yellow in colour, whereas *Manahshila* is red.

It is red, shiny and heavy, and the pieces are of different shapes with red, yellow or black spots on its surface. But when powdered, it looks orange coloured.

• Physical Properties

1. *Manahshila* is insoluble in water, but soluble in hot and concentrated nitric acid.
2. It is a deadly poisonous substance.
3. It burns in air with a blue flame and sulphur dioxide and arsenic oxide are formed.
4. It is fragile and gets easily powdered.

• Varieties

Ayurvedic texts have mentioned three varieties of *Manahshila* viz. 1) *Shyamangi,* 2) *Kanaviraka* and 3) *Khandakhya.*

(1) ***Shyamangi***: It is blackish-red and slightly yellowish in colour. It is heavy.

(2) ***Kanaviraka***: This variety has copper-like reddish colour and is shiny. It has no yellow spots.

(3) ***Khandakhya***: It is bright red in colour, heavy and can be powdered easily.

There are few different names with the same description about the varieties of *Manahshila*, in texts like Rasakamadhenu, Ayurvedaprakash etc.

• Approval

Khandakhya variety of *Manahshila* is supposed to be the best one. Then *Kanaviraka* and *Shyamangi* are approved, respectively.

• Purification

अगस्त्यपत्रतोयेन भाविता सप्तवारकम् ।
शृङ्गवेररसैर्वाऽपि विशुध्यति मनःशिला ।। (र.र.स. 3:93)

Manahshila is purified by processing it with the juice of red flowered variety of *Agastya* (Sesbania grandiflora) or *Ardraka* (Zingiber officinale) juice, i.e. ginger juice for 7 times. (Rasaratnasamuchchaya 3:93)

Another procedure mentioned, is to process it with *Jayanti* (Sesbania egyptica), *Bhringaraja* (Eclipta alba) and the leaves of *Agastya* (Sesbania grandiflora) juices together steamed for 3 hours and then steamed in goat's urine for another 3 hours. Then *Manahshila* is washed with a sour gruel and used.

• Incineration

It is not done. After purification, it is used directly.

• Properties

Manahshila possesses following properties:

Taste - Bitter, pungent.
Post digestive effect - Pungent.
Potency - Hot.
Attributes - Heavy, unctuous.
Effects on *Doshas* - Alleviates *Kapha* and *Vata doshas.*

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Actions - Appetiser, reducing (*lekhana*), rejuvenating and improves complexion.

• Uses

Manahshila is used in diseases like bronchial asthma, tuberculosis, cough, fever and itching.

• Dosage: 5 to 8 mg; with honey.

• Extraction

अष्टमांशेन किट्टेन गुडगुग्गुलुसर्पिषा ।
कोष्ठ्यां रुद्ध्वा दृढं ध्माता सत्त्वमुञ्चेन्मनःशिला ।। (र.र.स.3:95)

Manahshila is mixed with 1/8 part of *Mandura,* jaggery, *Guggulu* and cow's ghee, and rubbed. Then it is heated in a sealed crucible, intensely. (Rasaratnasamuchchaya 3:95)

With this procedure it seems very difficult to get the extract of realgar. Because *Manahshila*, i.e. arsenic disulphide, when heated will lose both, arsenic as well as the sulphur. The remainder will be only a fraction of *Mandura*. The uses of *Manahshila sattva* are not mentioned in texts.

• Formulations

Formulations containing *Manahshila* are *Samirapannaga, Shwasakuthar, Smritisagar, Sutikabharana, Unmada-gajakeshari, Chandrodaya varti, Pachakendra rasa, Marichyadi taila* etc.

(7) Anjana

So far we have studied the substances like sulphur, hematite, green vitriol, alum, orpiment and realgar, under the category of '*Uparasa*'. We have seen also various varieties of these substances. For example, allotropes of sulphur or varieties of orpiment viz. *Patra haratala, Pinda haratala* and *Tabaki haratala*. The variety may have different properties, but the basic element was common. In case of allotropes, any variety contains basically sulphur. Similarly variety of any *haratala* contains basic element arsenic.

Anjana, whereas, has five varieties, but they are entirely different substances, still categorised under '*Anjana*' because they are used as a topical application for the eyes. There is not any similarity in their chemical composition or properties otherwise, except *Srotonjana* and *Souviranjana*, which are both chemically antimony sulphide.

• Varieties

Ayurvedic texts have mentioned 5 varieties of *Anjana* viz. 1) *Srotonjana,* 2) *Souviranjana* 3) *Rasanjana;* 4) *Pushpanjana* and 5) *Nilanjana.*

(1-2) *Srotonjana* (Stibnite) & *Souviranjana*

Both these substances contain sulphide of antimony. Moreover, *Souviranjana* contains some impurities of lead, silver and arsenic in addition.

Srotonjana is black, tapering and melts when heated. Its chemical formula is Sb_2S_3. The geological name of *Srotonjana* is 'Stibnite'. It contains 71.7% antimony. Stibnite easily fuses in the flame of a candle.

Both, *Srotonjana* and *Souviranjana* have a cold potency, astringent and sweet taste, are unctuous and useful to alleviate bleeding diathesis (*rakta-pitta*) and toxic metabolites and also promote wound healing and mitigate the hiccup. Though all these properties mentioned, they are used only for topical application in the diseases of eyes or for cosmetic purpose.

Srotonjana is found in Afganistan, Malasia, Indonesia and

main source in India is Jammu, Bihar, Punjab, Andhra Pradesh and Karnataka.

(3) *Rasanjana*

Synonyms: There are few synonyms to *Rasanjana* in Sanskrit like, *Rasagraja, Rasodbhava, Rasagarbha, Kataka, Tarkshyashaila, Darvikwathodbhava* etc.

About the nature of *Rasanjana*, there are two thoughts. According to one, it is yellow oxide of mercury. When mercury is heated in the air for long time, it forms a yellow coloured powder, which is known as *Rasanjana*. Its Sanskrit synonyms denote that it is made up from the mercury. The yellow oxide of mercury is also used in modern medicine in treating diseases of the eyes.

According to another thought, *Rasanjana* is prepared by procuring the solid extract from the she goat's milk and decoction of *Daruharidra* (Berberis aristata). Both these substances, individually, are also used in diseases of eyes. The combination, in solid extract form is yellow in colour. Probably, it may be replaced in place of yellow oxide of mercury.

Rasanjana alleviates *Vata* and *Pitta doshas*, mitigates hiccup, improves complexion and is useful in treating diseases of the mouth. Though these uses are mentioned, it is only used in diseases of eyes.

(4) *Pushpanjana*

Ayurvedic texts mention *Pushpanjana* to be useful in hiccup, fever and poison-induced diseases. It is also mentioned to be useful in treating ocular diseases. The description about it is very inadequate. There is a controversy about nature *Pushpanjana* and different schools of thought about it.

(1) The honey gathered from particular flowers in Kashmir is used to treat the diseases of eyes. As it is obtained from flowers, hence the name *Pushpanjana*.

(2) *Anjana* prepared from *Pushpakasisa*, hence the name. We have already seen that *Pushpakasisa* is beneficial for eyes.

(3) *Anjana* prepared from *Phullatuvari* i.e. burnt alum, is also called as *Pushpanjana*. As such alum is also used in diseases of eyes.

(4) *Jasada-pushpa* is prepared from *Jasada* (Zinc), which is white in colour and also beneficial in eye diseases. Thus it is also known as *Pushpanjana*.

From all above controversies, it is difficult to decide precisely what exactly *Pushpanjana* should be.

(5) *Nilanjana* (Galena, Blue lead)

It is heavy, alleviates all three *doshas* and has rejuvenating property. It is a substance used in incineration procedure of gold.

Nilanjana, chemically, is lead sulphide (PbS) and is known as galena. It is cubic, bluish-black in colour and shiny. When scratched on paper, produces a streak of black colour. When heated on charcoal, it emits sulphurous fumes, forms a yellow encrustation of lead oxide and fuses to a malleable metallic globule. It is sold in market under the name *Surma*.

- Purification

अञ्जनानि विशुद्ध्यन्ति भृङ्गराजनिजद्रवैः । (र.र.स. 3:105)

Any variety of *Anjana* is powdered and processed in the juice of *Bhringaraja* (Eclipta alba) for 5 times.

(Rasaratnasamuchchaya 3:105)

त्रिफलावारिणि स्वेद्यं तद्द्वयं शुद्धिमृच्छति ।
....
नीलाञ्जनं चूर्णयित्वा जम्बीररसभावितम् ।।
(आयुर्वेदप्रकाश 2:232; 238)

Another procedure to purify *Srotonjana* and *Souviranjana* is to process it in the decoction of *triphala. Nilanjana* is purified by processing it in the juice of *Jambira* (Citrus limonum). (Ayurvedaprakasha 2:232-238)

Rasanjana and *Pushpanjana* are used to treat the diseases of eyes, whereas *Nilanjana* is used for cosmetic purpose.

(8) Kankushtha

There are different references in Ayurvedic texts, indicating different substances under the same name-*Kankushtha*. Before concluding what exactly it should be, let us see different schools of thought mentioning about *Kankushtha*.

In Rasaratnasamuchchaya even different opinions of ancient scholars are mentioned. They are as follows:

(1) It is mentioned to be the faeces of newly born elephant. It is blackish-yellow in colour and has a strong purgative property.

(2) Another opinion about *Kankushtha* is that it is the umblical cord of a newly born horse. It is whitish-yellow in colour and has purgative as well as rejuvenating properties.

(3) According to Acharya Dalhana, *Kankushtha* is the herb - *Swarnakshiri* (Argemone mexicana), which has yellow flowers.

(4) According to some scholars, *Mriddarashringa* (Litharge), means *Kankushtha*. It is yellow in colour and heavy.

(5) Sushruta has mentioned about the roots of *Kankushtha* and categorised it under purgative herbs. Thus according to him it seems to be a plant.

(6) Dalhana, the critic of Sushruta mentions *Kankushtha* to be *Revandachini* (Rheum emodi) i.e. *Pitamula*.

(7) According to few scholars, *Kankushtha* is a resin obtained from the Mysore gambose tree, which occurs in Tamilnadu. The resin is yellow in colour and a strong purgative.

About *Kankushtha*, the reference from ancient texts mentioned, are as follows:

(1) *Kankushtha* is found in the peaks of Himalaya.

(2) It is yellow in colour, bitter and pungent in the taste, unctuous and heavy to digest.

(3) There are two varieties of *Kankushtha*, viz. *Nalika* and *Renuka*. *Nalika* is yellow, heavy and unctuous. It is used as medicine. *Renuka* is blackish-yellow, light.

(4) *Kankushtha* is a strong purgative, with very little dosage i.e. 50-60 mg, it causes catharsis.

(5) *Kankushtha* is purified by processing it with the decoction of dry ginger - *Shunthi* (Zingiber officinale) for 3 times. The astringent property of dry ginger reduces the purgative property of *Kankushtha.*

From the various thoughts about *Kankushtha*, mentioned above, it is difficult to derive the final decision about what precisely *Kankushtha* should be.

Though it is said that the faeces of a newly born elephant and umbilical cord of a newly born horse, both have a purgative property, it is not in practice to use these substances as a purgative and not also proved. So these two substances cannot be called as *Kankushtha*. Similarly, the two varie-

ties, viz. *Nalika* and *Renuka* are not purgatives, hence can be discarded.

The root of an herb *Swarnakshiri* (Argemone mexicana) is supposed to be as *Kankushtha*, but the latex and not the root, of this plant is purgative. Moreover, the latex is white in colour, and not yellow. Thus it also cannot be called as *Kankushtha*.

Mriddarashringa is categorised under *Sadharana rasa*, and is the *upadhatu* of lead. From its extraction, lead can be obtained. So it cannot be *Kankushtha*.

The plant *Pitamula* (Revandachini), (i.e. Rheum emodi) has the roots yellow in colour, but it has a mild laxative (not strong purgative) property. So it is not correct to call it as *Kankushtha*.

The resin collected from the bark of Mysore Gambose Tree, gets a rod-like shape (*nalika*) and when resin is in liquid state, it contains yellowish-black flakes (*renuka*). Hence, this resin consists of both the forms i.e. *Nalika* and *Renuka*, as mentioned in the texts. Moreover, it is a strong purgative. Only it is not found in Himalaya. thus it can be suitably called as *Kankushtha*.

Thus to derive at conclusion, it can be said that the resin of Mysore Gambos Tree, or at the most, the roots of *Pitamula* (Rheum emodi) can be said as *Kankushtha*. But the faeces of newly born elephant, umbilical cord of newly born horse, roots of *Swarnakshiri* and *Mriddarashringa* cannot be called as *Kankushtha*. There is no mention about purification, incineration or extraction of *Kankushtha* in the texts.

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Chapter 14

Sadharana Rasa

In this chapter, we are going to study about the substances categorised under the group - *Sadharana Rasa*. These are nomenclated in the following verse.

कम्पिल्लश्चापरो गौरीपाषाणो नवसादरः ।
कपर्दो वह्निजारश्च गिरिसिन्दूरहिङ्गुलौ ।।
मृद्दारशृङ्गमित्यष्टौ साधारणरसाः स्मृताः । (र.र.स.120-121)

Kampilla, Gouripashana, Navasagar, Kapardika, Vahnijara, Girisindura, Hingula and *Mriddarshringa* are the eight substances classified under '*Sadharana Rasa*'.

(Rasaratnasamuchchaya 3:120-121)

(1) Kampilla (Indian Kamala)

• Synonyms: Indian Kamala i.e. *Kampilla*, has few synonyms in Sanskrit, like *Kampillaka, Kapila, Raktanga, Rechanaka, Raktachurnaka, Lohitanga, Karkasha* and *Ranjana* etc.

• English Name: Indian Kamala

• Botanical Name: Mallotus philippinensis (Euphorbiaceae)

• General Characteristics

There are very few substances having plant origin, which are incorporated in Rasashastra. *Kampilla* tree grows upto height of 8-10 metres, with a trunk 1 metre round. The leaves are alternate, articulated, blade 4-10 cm long, ovate or rhombic-ovate, rusty-tomentose. The flowers dioecious, female flowers in lax spike-like terminal and axillary racemes and male flowers 3 together in the axils of small bracts.

The fruit-capsule is trigonous-globular, covered with a bright crimson layer of minute, readily detachable reddish granules. These granules collected together, are known as '*Kampilla*' which is used for medicinal purpose.

• Chemical Properties

1. *Kampilla* floats on water and is insoluble in water.
2. The finger tip moistened with water, dipped in *Kampilla*, colours orange or yellowish in colour on the paper.
3. *Kampilla* readily burns out, when put in the fire.
4. It is very soft, crimson coloured powder.

• Physical Properties

Taste - Pungent
Post-digestive effect - Pungent
Potency - Hot
Effects on *Doshas* - Alleviates *Kapha* and *Vata doshas.*
Special Potency - Purgative
Attributes - Light, Dry and Sharp
Main Properties - Purgative, vermicidal, wound-healer.
Diseases - Constipation, helminthiasis, wounds, tumours, ascites, glandular swelling and flatulence.

• Purification

To separate out adulterated brick-red substance, the powder is spread on the water. After sometime, the adulterated substance sinks at the bottom and *Kampilla,* floating on the surface is gently collected, dried and used.

• Incineration

Not required as it is of plant origin.

• Dosage

400 to 700 mg as anthelmintic in chindren.
3 to 6 gm in adults.

• Formulations

Krimighatini vati, Krimikuthar rasa.

(2) Gouripashaha (Arsenious Oxide)

• Synonyms: Arsenious oxide i.e. *Gouripashana*, has various synonyms in Sanskrit, like *Shankhavisha, Mushaka, Akhupashana, Somala, Phenashmabhasma, Malla, Pita, Vikata, Hatachurnaka* etc. It is commonly known as *Somala.*

• English Name: Arsenic oxide or Vitrious arsenic or Arsenolite.

• Chemical Formula: As_2O_3

• Characteristics

Somala is crystalline or amorphous substance, white in colour. Its powder resembles the flour of wheat but is much heavier. The surface of *Somala* has a peculiar shine and sometimes there occurs a yellowish tinge, which is due to impurities it contains. Sometimes, the articles made up of China clay or tiles are mixed with *Somala*, as an adulteratant material. But the shining surface of *Somala* distinguishes between them.

• Physical Properties

1. When heated, *Somala* becomes soft and emits the odour like garlic.
2. One crystalline variety of *Somala* is soluble in water, in very small quantity.
3. The crystals of arsenic oxide are octohedral or monoclinic, of which the later are unstable.
4. When heated with intense heat, it evaporates in the atmosphere, directly (sublimation), giving out garlic odour.

• Ayurvedic varieties

Three varieties of *Somala* are mentioned in Ayurvedic texts, viz. *Sphatikabha, Shankhabha* and *Pitabha.*

(1) ***Sphatikabha***: Resembles to rock crystal, is transparent and white.

(2) ***Shankhabha***: It is amorphous, white but opaque.

(3) ***Pitabha***: This is yellow in colour, because of the impurities - containing orpiment. It is also known as *Haridrabha*, meaning having a colour like turmeric.

• Modern Varieties

1) Amorphous; and 2) Crystalline.

The crystals are octohedral or monoclinic. Amorphous variety resembles to Ayurvedic varieties named *Shankhabha* and *Haridrabha.*

• Approval

Amongst all varieties, *Sphatikabha* is the best, *Shankhaba* better and *Haridrabha* is a good variety for medicinal uses.

• Purification

गौरीपाषाणकं श्रेष्ठं कारवल्लीफले क्षिपेत् ।
स्वेदयेद् हण्डिकामध्ये शुद्धो भवति मूषकः ।। (र.र.स.3:125)

The fruit of bitter gourd (*Karavella*), Momordica charantia, is made hollow by taking out the pulp and seeds within. The pieces of the best variety of *Somala* are placed inside the bitter gourd fruit, and the hollow portion is filled up. Then it is hanged in the big pot (*handi*), which is filled with water or juice of the fruit. Then bitter gourd is steamed in this pot.

With this procedure, *Somala* becomes purified.

(Rasaratnasamuchchaya 3:125)

In the above procedure, sometimes, the bitter gourd fruit filled with the pieces of *Somala* is wrapped in the cotton pouch and the pouch is subjected to steaming in *Dola yantra* for three hours. It is also mentioned that the juice of bitter gourd is to be kept in *dola yantra.*

There are few other procedures mentioned, wherein the steaming of bitter gourd (filled with pieces of *Somala*) is done in borax water (*tankana jala*) or cow's milk (*godugdha*), with the help of *dola yantra.* It can be also steamed in shegoat's milk or flesh juice in *dola yantra*, for one day. The cow's milk and borax water detoxify the *Somala.*

• Incineration

There is no any mention in texts, about the procedures to prepare incineration (*bhasma*) of *Somala* i.e. *Gouripashana.*

• Properties and Usage

1. *Somala* is useful for *bandhana* of mercury i.e. stability.
2. *Somala* augments the potency of mercury.
3. *Somala* is unctuous and alleviates all three *doshas.*
4. Purified *Somala* when consumed in optimum dosage for one month, cures asthma and skin diseases.
5. Purified *Somala* is an antidote for scorpion bite.
6. It also works well in joint disorders and syphilis.
7. Topically, it is used like *ksharakarma.*
8. It is excreted through urine, faeces, saliva, sweat, tears and breast milk.

• Dosage: 1 to 4 mg only. To adjust this tiny dose, excipients like black pepper powder and ginger juice are used along with it

• Formulations

Panchasuta, Mallasindura, Samirapannaga.

• Extraction

तालवद् ग्राह्येत् सत्त्वं शुद्धं शुभ्रं प्रयोजयेत् । (र.र.स. 3:126)

Extraction of *Somala* is done by a procedure, similar to that used for extracting *Haratala* (orpiment). The extract of *Somala* is snow-white in colour.

(Rasaratnasamuchchaya 3:126)

(3) Navasadara (Sal-Ammoniac)

• Synonyms: Sal-ammoniac i.e. *Navasadara*, has few synonyms in Sanskrit, like *Navyasara, Nrisara, Kittasara, Chullika lavana, Navasadara, Narasadara* etc.

• English Name: Sal-Ammoniac.

• Chemical Formulation: NH_4Cl. i.e. Ammonium chloride.

• Occurrence

The waste materials like faeces of animals, urine, damp leaves or other substances after putrification, get converted in ammonium salts which are irritant and pungent. In ancient time, it was prepared from waste products like faeces and urine like of man and animals, hence it is known as *Navyasara* and *Navasara*. It also is prepared by dissolving the ashes of few plants in water and then evaporating the water. It is formed in the brick furnaces also. It occurs as a white efflorescence in volcanic districts. Presnetly sal-ammoniac is an artificial product manufactured in chemical industries.

• Physical Properties

1. It is crystalline, light and white in colour.

2. It dissolves in water and during the process, it absorbs the heat from water and makes it cool.
3. When heted, it directly evaporates and releases ammonia gas and hydrochloric acid fumes.

$$NH_4Cl \rightarrow NH_3 \uparrow + HCl \uparrow$$

• Varieties

In Rasakamadhenu, two varieties viz. *Yogambari* and *Chullika* have been mentioned. There is no mention about their distinguishing characteristics etc. It seems the one, which is formed in brick furnaces is known as *Chullika* variety.

• Approval

Yogambari variety is the best one, as mentioned in Rasakamadhenu text. The solid cubes of *Navasadara* available in market, are commonly used.

• Purification

Impure *Navasadara* is first dissolved in water and the water is filtered and spread in a flat pan and kept in sunlight. After evaporation of water, white crystals are formed.

Another procedure to purify it, is with the help of *Damaru yantra, Navasadara* is slowly heated and the vapours collected are condensed with the help of *Toyadhara*. The solidified *Navasadara* is obtained again.

• Properties and Usage

1. *Navasadara* is classified as a salt.
2. It is used for purification of the gold.
3. In Dracunculiasis i.e. guinea worm infection (*snayuka*), it is used as a medicine, internally.
4. Also, it is used as an expectorant, to relieve the mucous. It is the common most ingredient in expectorant preparations.

• Formulations

It is used in preparations like *Rasasindura* and *Shankhadrava* etc.

(4) Kaparda (Cowrie)

• Synonyms: Cowrie i.e. *Kaparda*, has numerous synonyms in Sanskrit, like *Varata, Varataka, Varatika, Kapardika, Chora, Charachara, Balakridanaka* etc.

• English Name: Cowrie.

• Scientific Classification

Family : Cypraiedae
Genus : Cyprea
Species : Moneta

• Characteristics

Cowrie is a sea snail with a shiny, colourful shell. It lives in shallow waters of warm seas. Cowries may be from 0.5 to 6 inches long with a triangular base. It is hollow. The top of the shell looks like a colourful egg, and the underside has a long, narrow opening bordered by many small teeth. There are more than 150 kinds of cowries. Some kinds are extremely rare and are worth hundreds of Dollars to shell collectors. Cowries were once used as money in China, India and Africa.

• Chemical Composition

Cowries are mainly composed of calcium carbonate - $CaCO_3$. As it is an animal originate, it also contains few organic elements.

• Varieties

Grossly, cowries are classified into three varieties according to their colour, viz. white, yellow and smoky grey. Though

cowries occur in various colours, Ayurvedic texts have classified them basically, in three varieties.

• Approval

Amongst the three varieties mentioned above, the yellow cowrie is the best one, white is better and smoky grey is good. It is also mentioned that cowrie, which is yellow in colour, heavy and has elevated clusters or nodes on its top surface, is supposed tobe the best one. Cowries, which do not possess these properties are known as *Varata*, and are not used for medicinal purpose as they aggravate *Kapha* and *Pitta doshas* and are heavy (*guru*) to digest. These inferences have born out of experience of the ancient scholars. Hence, while selecting cowries for medicinal purpose, these standards are observed in practice.

• Purification

दोलायन्त्रे तु यामैकं काञ्जिकेन वराटिका ।
स्विन्ना प्रक्षालिता चोष्णवारिणा शुद्धिमाप्नुयात् ।।
(रसतरंगिणी 12:87)

Kaparda is purified by steaming it in sour gruel in *Dola yantra* for 3 hours. Then cowries are washed in hot water.
(Rasatarangini 12:87)

• Incineration

वराटकांस्तु विमलान् शरावे स्थापयेद्भिषक् ।
शरावेणापरेणाथ सम्यगाच्छादयेत् ततः ।।
सन्धिलेपं ततः कृत्वा शोषयेदातपे पुनः ।
करीषाग्नौ पचेत्कामं यत्नतस्तु भिषग्वरः ।।
स्वाङ्गशीतं समुधृत्य खल्वे सञ्चूर्णयेत् ततः ।
शरदिन्दुनिभं भस्म सर्वयोगेषु योजयेत् ।। (रसतरंगिणी 12:91-93)

Purified cowries are sealed in the saucers properly with rags and mud, and dried in the sunlight. Then it is subjected to

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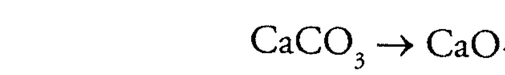
heating with the help of she goat's faeces, as a fuel. On cooling on its own, the cowries are taken out of saucers and ground into fine powder. A moonwhite incineration is formed. (Rasatarangini 12:91-93)

The mode of heat mentioned in this procedure is '*Karishagni*' i.e. the heat is obtained by burning dried faeces of the she goat. It indicates that the amount of heat required is for a short duration and of low intensity. With intense heat, calcium carbonate will get transformed into calcium oxide, which is very hot and irritant.



$$CaCO_3 \rightarrow CaO + CO_2$$

It seems that ancient scholars were aware of these changes on experimental background. Hence, only limited heating is suggested just to reduce the hardness of cowries, before preparing their incineration. In practice, the cowries are heated well and then powdered. The powder is processed with aloe juice. It eliminates the untoward effects of cowries.

• Tests for Kaparda Bhasma

Before using incinerated cowries for medicinal purpose, it should be tested as follows :

The taste of *bhasma* should not irritate the tongue and create any burning sensation on the tongue.

If it is so, then—

1. Incinerated cowries are again processed in aloe juice.
2. Otherwise, the *bhasma* is kept in water for some time and the sediment at the bottom is collected and dried and then used as *bhasma*
3. The *bhasma* can be filled in gelatine capsules and then used, to avoid its contact with the tongue.

• Properties and Usage

Kaparda bhasma is hot in potency and pungent in taste. It alleviates *Pitta* and *Vata doshas*. It is also astringent hence, is very effective in chronic colitis. It stimulates appetite and improves digestion and thus alleviates flatulence, indigestion, vomiting, abdominal dull pain etc. Externally it is used with great benefit in chronic suppurative otitis media. The *bhasma* is instilled into ears along with lemon juice. It cleanses the ears and also reduces the foul discharge from the ears. *Kaparda bhasma* is a valuable medicine for treating hyperacidity and peptic ulcer.

• Dosage

For internal use - 250 to 500 mg, 3 times a day; with lemon water or fresh buttermilk.

For external use - 250 mg to 1 gm; instilled into ears along with the lemon juice.

• Formulations

Pravala-panchamrita, Panchamrita vati, Lokanath rasa etc.

(5) Vahnijara (Ambergrees)

• Synonyms: Ambergrees i.e. *Vahnijara*, has few synonyms in Sanskrit, like *Ambar, Agnijara* etc.

• English Name: Ambergrees.

• Occurrence

Ancient scriptures of Ayurveda have mentioned that *Vahnijara* is the placental portion of a sea animal, known as *Agninakra*. When it reaches the shore, it gets dried.

According to modern concept, ambergrees is a waxy substance found in the intestines of some sperm whales. It has a musky smell when dried and is used in the expensive

perfumes. When ambergrees is added to perfume, it makes the odour of the perfume last longer. Whalers take some ambergrees from the bodies of dead sperm whales. The whale also passes ambergrees as a waste product. The substance is found in the water, or rarely on the shore. It is used as a base of expensive perfumes.

• Characteristics

It is opaque, grayish substance with black spots on its surface. It is fragrant and solid substance.

• Physical Properties

1. Ambergrees is a solid and opaque substance.
2. It is not soluble in water.
3. It gets easily burnt in fire.
4. When heated, it gets sublimated.
5. It possesses a typical fragrance.

• Purification

As it is found naturally, in sea water and hence it does not require any purification.

• Incineration

As it gets sublimated on heating, it is not incinerated.

• Properties and Usage

Being fragrant, it is stimulant and alleviates all the three *doshas*. It stimulates the appetite and mainly it is used in treating *vata* diseases like tetanus. Like musk it is used as an aphrodisiac. It is used along with or without musk, in various aphrodisiac preparations.

• Dosage

Like that of a musk.

(6) Girisindura (Red Mercuric Oxide)

• Synonyms: Red mercuric oxide i.e. *Girisindura*, has numerous synonyms in Sanskrit, like *Nagaja, Sindura, Mahila-bhala-bhushana, Ganesh-bhushana, Nagagarbha, Nagarenuka, Mangalya, Bhalasoubhagya* etc.

• English Name: Red Mercuric Oxide, Montroydite.

• Occurrence

The references *Girisindura* from Rasaratnasamuchchaya indicate that it is a mercury compound. It is quoted that *Girisindura* is found in mountains in a form red coloured dry mercury. In practice, another mineral called as *Nagasindura*, is used in place of *Girisindura*. It is lead oxide i.e. Pb_3O_4.

Girisindura, a mercury compound is not found in India. Massicot (PbO), a compound of lead is found in Kashmir, Punjab and Rajasthan, in a form of mineral. On heating it becomes *Sindura* (Pb_3O_4). There are no references about purification, incineration or extraction of an active element from *Girisindura*.

• Properties and Usage

In texts, it is mentioned as strong purgative (*bhedi*), strong body builder (*dehalohakar*) and helps in forming Mercurial compounds from Mercury (*Rasabandhanakaraka)*, but is not used for these properties in practice.

As a mercury compound, it is beneficial for the eyes (*netrya*). In a form of a lead compound, it is used topically for wound dressing and in diseases like eczema, pruritus in a form of an ointment.

• Formulations

Sindura malahara, Padadari malahara.

(7) Hingula (Cinnabar)

• Synonyms: Cinnabar i.e. *Hingula*, has various synonyms in Sanskrit, like *Darada, Mlechha, Suranga, Rakta, Singarapha, Churnaparada, Rasodbhava, Hansapada, Ingula and Chitranga* etc.

• English Name: Cinnabar.

• Chemical Composition: Mercuric sulphide - HgS.

• Characteristics

Hingula is a red coloured, heavy, mineral of the mercury. It can be powdered easily. Artificially, it is prepared by heating Mercury and sulphur in specific proportion, in a closed iron vessel. A dark red coloured *Hingula* gets accumulated on the inner surface of the lid. Hepatic cinnabar is a compact variety with a liver brown colour and a brownish streak.

• Physical Properties

1. *Hingula* is a red or whitish red coloured mineral.
2. It is heavy and its specific gravity is 8.09.
3. It is insoluble in water and acids, but dissolves in acquaragia (a mixture of hydrochloric and nitric acids), and forms Mercuric chloride.
4. On heating, the Mercury gets separated out and sulphurdioxide is released.

$$HgS + O_2 \xrightarrow{\text{Heat}} SO_2 + Hg \uparrow$$

5. The Mercury obtained by above method is the purest Mercury, which does not require any further processes of *Ashtaparadasamskara*.

• Varieties

Ayurvedic texts have mentioned two varieties of *Hingula*

viz. *Shukatunda* and *Hansapada. Shukatunda hingula* is bright red in colour like a parrot's beak, hence the name. Whereas *Hansapada hingula* resembles corals in its red colour, with white streaks on the surface.

• Approval

Hansapada hingula is supposed to be the best one.

• Purification

Hingula is processed for 7 times, with the ginger juice or juice of the *Lakucha* fruit. After drying, it becomes purified.

सप्तकृत्वाऽऽर्द्रकद्रावैर्लकुचस्याम्बुनाऽथ वा ।
शोषितो भावयित्वाऽथ निर्दोषो जायते खलु ।।
किमत्र चित्रं दरदः सुभावितः क्षीरेण मेष्या बहुशोऽम्लवर्गैः ।
एवं सुवर्णं बहुघर्मतापितं करोति साक्षाद्वरकुङ्कुमप्रभम् ।।

(रसरत्नसमुच्चय 3:142-43)

It can also be purified by processing it with the sour juices and she-goat's milk, for several times. It is then dried in intense sunlight. It becomes beautiful in colour like saffron.

After processing, *hingula* is washed neatly with water to remove the remnants of those juices. Then it is dried in sunlight and then used. The sour juices are used to remove the unctuousness of milk, which is used for processing. It is quoted in Rasatarangini.

(Rasaratnasamuchchaya 3:142-143)

• Incineration

Few texts have mentioned very complicated procedures of incineration of cinnabar. In these procedures, it is recommended that cinnabar is to be placed inside various fruits or rhizomes and subjected to heating by giving 100 *putas*.

In practice, those procedures are not done. Purified *Hingula* is directly used to prepare vairous formulation.

• Usage

Hingula is a rejuvenative, it augments the appetite, alleviates all three *doshas*, mitigates all diseases and aphrodisiac. It is used in diseases like diabetes, skin diseases, fever, hepatitis and splenomegaly etc.

• Dosage

60 to 240 mg, with betel leaf.

• Formulations

Tribhuvankirti, Suvarnamalinivasant, Anandabhairava-rasa, Siddhadaradamrita, Hinguleshwar rasa etc.

• Extraction

दरदः पातनायन्त्रे पतितश्च जलाशये ।
तत्सत्त्वं सूतसङ्काशं जायते नात्र संशयः ।। (र.र.स. 3:144)

Distillation of *Hingula* with the help of *Adhahpatana yantra* is done. The extract, which looks like Mercury gets collected in water. Though it is called as an extract of *Hingula*, in reality it is Mercury itself. The Mercury obtained from *Hingula* with this procedure is the purest form.

(8) Mriddarashringa (Litharge)

• Synonyms: Litharge i.e. *Mriddarashringa*, has few synonyms in Sanskrit, like *Mriddarashringaka, Murdashankhaka, Bodarashringaka* etc.

• English Name: Litharge, Lithory, Massicot.

• Chemical Formulation: Lead monoxide - PbO.

• Occurrence

Litharge is yellowish in colour and is found in Gujarat, especially in Mount Abu; according to references from ancient texts. But the geological survey indicates that litharge is not available in India. Litharge is used in making lead-glass, pottery glazes and rubber.

• Physical Properties

1. Litharge is a compound of lead and oxygen.
2. It is very heavy and insoluble in water.
3. It gets dissolved in mild but warm sulphuric acid.

$$PbO + H_2SO_4 \rightarrow PbSO_4 + H_2O.$$

4. If drawn over a paper, a black line is produced.

• Varieties

Ayurvedic texts mention three varieties of *Mriddarashringa* i.e. litharge viz. yellow, yellowish white and artificial; i.e. *Pita, Pitapandura* and *Kritrima*, respectively.

The third variety i.e. artificial one, can be prepared by two methods.

(1) Lead is heated intensely and the yellowish creamy layer which floats on the surface, is gathered. It is collected separately and again heated. It is artificially prepared *Mriddarashringa*.

(2) Lead and lead nitrate or lead and potassium nitrate are heated together, which forms this variety.

• Approval

Any variety amongst the three can be used for medicinal purpose.

• Purification

Though there is no specific mention about the purification of litharge, it is purified as recommended for purifying the *Sadharana Rasa* group.

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साधारणरसाः सर्वे मातुलुङ्गार्द्रकाम्बुना ।
त्रिरात्रं भाविताः शुष्का भवेयुर्दोषवर्जिताः ।। (र.र.स.3:147)

All the substances which are categorised under *Sadharana Rasa*, are purified by processing them with *Matulunga* (Citrus medica) fruit juice and ginger i.e. *Ardraka* (Zingiber officinale) juice, for 3 days, each. Then the substance is dried and used. Litharge is purified with the similar procedure. (Rasaratnasamuchchaya 3:147)

In the text - Rasatarangini, a different procedure is mentioned to purify *Mriddarashringa*. First of all, it is ground into fine powder and seived through a cloth. The seived fine powder is rubbed with water for 15 days and dried in sunlight. It should be noted that *Mriddarashringa* purified by this method can be used for external purpose only. It is used for dressing the wounds to promote their healing.

• Incineration

खण्डं मृद्दारशृङ्गस्य निक्षिपेत् निम्बुजेत्र्यहम् ।
शरावसम्पुटे यस्य पुटं दद्यात् प्रयत्नतः ।।
जायते शोभनं भस्म भावयेत् त्रिफलाम्बुभिः ।
कुमारीमूत्रजम्बीरैस्त्रेकैकं त्रिः क्रमेण वै ।। (रसयोगसागर)

The fine powder of litharge is soaked in the lemon juice for 3 days and then dried. It is then sealed properly in saucers and subjected to heating. With this one *puta*, the *bhasma* which is formed is processed with the decoction of *Triphala* for 3 times, aloe juice and cow's urine for one time each and with the fruit juice of *Jambira* (Citrus limonum) for 3 times. Finally, it is again subjected for heating by giving one *puta*. The *bhasma* or incineration of litharge gets prepared. (Rasayogasagar, Part 2)

Incineration of litharge is seldom used in any medicinal formulation. There is no mention of its separation of an active ingredient.

• Properties and Usage

1. *Mriddarashringa* is cold in potency and still pacified *Vata* and *Kapha doshas.*
2. *Mriddarashringa* ointment is beneficial in skin diseases, especially associated with itching.
3. *Mriddarashringa* powder is useful to heal up the syphilitic ulcers.
4. It is also beneficial as a hair-dye.

• Dosage: *Mriddarashringa* is commonly used for external purpose, hence should be taken in sufficient quantity, as per requirement.

Chapter 15

Metals

The Sanskrit word '*dhatu*' comes from a verb '*dha*' meaning 'to support'. There are seven basic tissues or *dhatus* which support and sustain the living body. In context with Rasashastra, the word *dhatu* denotes a metal. As the metals, which are formed as a solidified slag after cooling to form a continuous crust over the whole globe (about 50 km thick), hold the earth, hence called as *dhatus*. Another term '*loha*' was used to denote a metal, in ancient scriptures of Ayurveda.

स्वर्णतारारताम्राणि नागवङ्गौ च तीक्ष्णकम् ।
धातवः सप्त विज्ञेया अष्टमः क्वापि पारदः ।। (योगरत्नाकर)

In various ancient texts of Ayurveda, the mention has been made of 7 metals (*dhatus*) like gold (*suvarna*), silver (*rajata*), brass (*aara*), copper (*tamra*), tin (*vanga*), lead (*naga*) and steel (*tikshna*). (Yogaratnakar)

The Mercury (*parada*), though a metal, because of its liquid state, the very ancient texts had not categorised it as a metal. Few texts, like Yogaratnakar, have mentioned Mercury as a metal.

Moreover, there is a mention of few alloys like brass (*pittala*), bronze (*kasya*), *varta, vartaloha, chandrarka* and *shulbanaga* etc. in ancient Samhitas, along with the detailed account of the procedures to prepare them.

Almost all metals are derived from ores - which means concentrations of appropriate minerals accessibly situated at or near the earth's surface; except magnesium and plutonium. The Sanskrit word '*loha*' derived from a root '*luha*',

meaning to pull. Thus ores, from which the metals are extracted were known as *loha*.

The ancient texts of Ayurveda had mentioned the classification of metals as follows:

(1) ***Sara loha*** - includes gold and silver. (Rasakamadhenu)
(2) ***Shuddha loha*** -comprises gold, silver, copper and iron. (Rasaratnasamuchchaya)
(3) ***Sadharana loha*** - contains *tikshna loha* and copper. (Rasakamadhenu)
(4) ***Puti loha*** - Lead and tin are categorised by all texts. Moreover, zinc also is classified in this group.
(5) ***Mishra loha*** - The alloys like bronze, brass and *varta* are categorised in this group.

The criteria used for these different classes appear to be uniform for various texts.

The word '*Sara*' means essence or noble. Gold and Silver were acclaimed as noble metals since ancient times.

The word '*Shuddha*' means pure. Four metals named in this category are Gold, Silver, Copper and Iron. These were considered as purest of all the metals. Perhaps other metals could have been produced as byproducts.

The word '*Puti*' means bad, obnoxious or dirty. Three metals mentioned in this group are supposed to emit obnoxious smell, while they are melting. Presently we do not experience that has been mentioned in the past.

Mishra means mixed. This is so far a correct terminology for alloys of *Loha*.

Historical Background

The discovery of metal by early man depended on their being easily found, easily recognised as metals for easy dis-

covery were gold, silver, copper and Mercury. It is not known when gold was first discovered. But gold cups and jewellery made as early as 3500 B.C. have been dug up at Ur in Mesopotamia (now Iraq). Gold jewellery from about the same period has been taken from Egyptian tombs. The ancient Egyptians knew how to hammer gold into a *leaf* (thin sheet) so thin that it took 3,67,000 leaves to make a pile 1 inch (2.5 cm) high. During the Middle ages, a whole science called 'Alchemy' grew up around the effort to make gold by artificial means.

Silver is not so distinctive. It too occurs native, however, or as a readily decomposed sulphide and also in a native alloy with gold which was early recognized as being different and was called "electrum". Copper was probably first used about 8000 B.C. by people living along the Tigris and Euphrates rivers, where Iraq lies today. As early as 6000 B.C., the Egyptians knew how to hammer native copper into sheets to make tools and ornaments. Later on, copper was used by Chinese, Inca of Peru and American Indians.

At a rather later stage than gold and copper, iron came to be produced by primitive peoples. **Iron Age** is the period of history that began between 1500 and 1000 B.C. with the widespread use of iron for tools and weapons. By about 3500 B.C., some people in the Middle East had begun to smelt iron ore and use the iron for tools. True iron working began in Asia Minor (now part of Turkey) between 1500 and 1000 B.C. and spread over much of Asia, Africa and Europe.

The earliest known use of tin occurred about 3500 B.C. in the city of Ur in southern Mesopotamia (now Iraque). The people of Ur made articles from bronze, an alloy of tin and copper. Lead is one of the world's oldest known metals.

People have used lead for thousands of years as a building material and to make potteries and other objects.

By about 3500 B.C., people had discovered how to melt and alloy copper with tin to make bronze. **Bronze Age** was the period when people used bronze for tools and weapons. It followed the **Stone Age**, when stone was the chief material. When iron tools became widespread, the **Bronze Age** ended and the **Iron Age** began. The process of combining zinc with copper to make brass was probably between 100 B.C. and 600 B.C. No one knows who discovered Mercury, but the ancient Chinese, Egyptians, Greeks, Hindus and Romans knew about the metal.

In Indian history, Mercury was the first metal used for medicinal purpose. Numerous mentions have been made about various metals and minerals since Vedic period. In Rigveda(*Richa* 10:72:2), the mention of gold has been made denoting its usage for ornaments and the goldsmith was called as '*karmar*' in those days. There are many references of gold, copper, lead and iron in Yajurveda. In Atharvaveda, there are references of silver, copper, iron and lead. (Atharva 1:16:2-3). Various references about metals are found in ancient scriptures like Ramanaya, Mahabharata, Agnipurana, Koutiliya Arthashastra, Manusmriti and Vishnudharmottara Purana. References of gold, iron, orpiment, realgar etc. are in Charaka Samhita. Whereas, lead, copper, silver, iron, gold, black bitumen, blue vitriol etc. are mentioned in Sushruta Samhita. Later on, the concept of incineration of metals appeared in Ashtanga Sangraha (Sutra-sthana 12:12-26). In Brihatsamhita of Varahamihira , the use of mercury and iron as aphrodisiac, is quoted (587 A.D.). From 6th Century onwards, Rasashastra progressed very rapidly.

The history of metallurgy can be divided into two periods - The ancient period and the recent period, of about last two centuries. The recent period of development of extraction metallurgy begins perhaps about 1700 A.D. when zinc was recognized as a metal. An era was beginning in which chemists would isolate and classify all the elements that could be found on earth, and in which engineers and doctors would find uses for most of them. That era continues.

Though the usage of metals for medicinal purpose has started more from sixth century onwards in Ayurveda, the science of metallurgy was highly developed in India since Vedic period. During Nagarjuna era, Rasashastra and Dhatushastra developed further more. In this chapter, we are going to study the metals mentioned in Ayurvedic scriptures. We shall study each metal with its various aspects viz. occurrence, appearance, physical properties, varieties, purification, incineration, properties and medicinal uses, dosage, media of intake and its formulations etc.

Before that we will see first, how a metal is purified prior to any other treatment or process.

Purification
- General
- Special

General purification procedure is the same one for almost all metals, whereas special purification procedures vary with different metals. Sometimes, to achieve the desired properties, one metal is processed by another special purification procedure.

The basic procedures performed either in general purification or special purification are principally similar with respect to all metals. The metal is heated and immersed in

some liquid in order to remove its heat (*nirvapana*) or the molten metal is poured into some liquid (*dhalana*). In special purification procedures, the liquids or substances used may vary as per the metal. In general purification procedures, the liquids used are same for all metals. During the general purification, the main aim is to separate out other unwanted minerals or substances and to make the metal fragile. In special purification, the metal is made more fragile and is made suitable to undergo incineration (*bhasmikarana*) easily.

General Purification

तैले तक्रे गवां मूत्रे ह्यारनाले कुलत्थजे ।
क्रमान्निषेचयेत् तप्तं द्रावे द्रावे तु सप्तधा ।।
स्वर्णादिलोहपत्राणां शुद्धिरेषा प्रशस्यते ।। (र.र.स. 5:13)

Thin sheets of a metal, like gold etc; are heated red hot and are immersed in oil first. After quenching it is reheated and again dipped in different sample of sesame oil. The procedure is thus repeated for seven times. Then the same metal sheet is similarly treated i.e. heating and quenching in liquids, by using buttermilk, cows' urine, sour gruel and decoction of *Kulattha* (Dolichos biflorus). Thus total 35 times heating dipping in 5 different liquids (seven times in each) is performed. The oil used, is commonly sesame oil (*Tila taila*). (Rasaratnasamuchchaya 5:13)

Except sesame oil, all other liquids used in this procedure are acidic in nature. It may be helping in fragmentation of the metal, rendering it fragile. This procedure facilitates the *marana* i.e. incineration of a metal which is done later on.

Special Purification

Presently it is practised that any metal is first purified by general purification, then is processed by special purifica-

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tion and finally subjected to incineration. This concept of sequence of procedures is mentioned in 'Vijnana-bodhini Tika' of Rasaratnasamuchchaya. But there is no mention of *Samanya* and *Vishesha Shodhana* terminologies in ancient texts of Rasashastra. It seems that this concept was introduced by the critics on ancient Samhitas. On the contrary, it is mentioned except *Putiloha* i.e. tin, lead and zinc, first the thin sheets of metals are prepared by hammering and then they are subjected to purification. As per tradition, if the general purification procedures are first performed, then it will not be possible to hammer them into thin sheets, as the metals become fragile by heating process. Also, if the metals like tin, lead and zinc are processed by *samanya shodhana*, while heating, they will be converted into powder form because of oxygen and thus it will not be possible to perform *shodhana* procedures, described by texts.

Thus it seems that the tradition of general purification first, and then special purification has started in recent days, as per the recommendation of the critics on the ancient texts. It is also seen that this sequence of purification is seldom observed in practice.

The procedure of special purification infact, should have been transcripted as, precisely, specific purification. For example, for purification of gold, the juice of *Kanchanara* (Bauhinia variegata) leaves is the specific choice recommended. But if it is not available, then purification is suggested in oil, buttermilk, cow's urine, gruel and decoction of *Kulattha* (Dolichos biflorus) as a routine general procedure of purification. For the substances from the groups *Maharasa* and *Uparasa*, one general procedure of purification is recommended (Rasaratnasamuchchaya 3:118-19)

and for *Sadharana rasa*, one procedure is advocated (Rasaratnasamuchchaya, 3:147) for all substances in that group. Though mentioned in the texts, in practice, it is not observed to perform first this general purification and then special purification. It clearly indicates that specific special purification methods are sufficient. If the substances are not available, then one should go for common procedures.

Prelude to Extraction Metallurgy

Metal forms a large part of the earth on which we live. Normally 80 per cent of the known elements are metals. Most of the metals occure in nature in the combined state i.e. as compounds with other elements. The natural materials in which metals or their compounds occur in the earth are called **minerals**. Those minerals from which the metals may be extracted profitably are called **ores**. Thus, all ores are minerals, but not all minerals are ores. A **metal** is defined as an element which can form ions by the loss of electrons and a **non metal** is an element which ionises by gain of electrons to form a negative ion. Antimony and arsenic possess the properties of both, the metal and non metal, and hence known as **metalloids** or **semimetals**.

General properties of Metals

Metals have certain general properties which distinguish them from non metals, of which some of them are:

(1) Physical State: At ordinary conditions metals are solids, except Mercury and Gallium, which are liquids.

(2) Density: Metals usually have high density; we consider them heavy, except sodium and potassium.

(3) Melting & Boiling Point: They have high boiling and

melting points, and vaporise only at high temperatures; except Na and K.

(4) Lustre: Metals usually have high lustre, which is called as metallic lustre.

(5) Ductility: Metals are usually ductile i.e. they can be drawn into wire. For example, silver wires of 0.00008 mm in diameter have been drawn.

(6) Malleability: Metals are usually malleable, i.e. they can be hammered into thin sheets without cracking. Gold can be beaten into foil 0.00002 mm thickness.

(7) Conduction: Metals are good conductors of heat and electricity.

Metallurgy is the science of separating metals from their ores and preparing them for use. Extractive metallurgy deals with taking metals from their ores and refining them to a pure state. It includes a wide variety of specialized commercial processes as minerals dressing, roasting, sintering, smealting, leaching, electrolysis and amalgamation. Metallurgical processes mainly consists of three steps:

(i) Preliminary treatment,(ii) Reduction (iii) Refining.

The extraction metallurgist takes over the ore as it leaves the mine. In the general case the ore must be *concentrated* to free it from minerals of no value called *gangue*. This is done by operations known collectively as *ore dressing* which involves *communition* or fragmentation to small sizes to permit easy separation of the different kinds of minerals, followed by one or more *sorting* operations designed to distinguish and separate valuable mineral particles from the rest on the basis of some physical property such as density, magnetism or surface energy.

Concentration is followed by *extraction*, to produce the metal itself, and this may be carried out by *pyrometallurgy* or *hydrometallurgy*. Pyrometallurgy involves heating operations including *calcination* and *roasting* at temperatures below the melting point; *liquation* in which the metal melts and runs clear of other materials present; and full *smelting* in which the ore is all melted and separates out into two or more liquid layers one of which contains all the metal (either as metal or sulphide). Further *conversion* and *distillation* processes are carried out, whenever necessary. Hydrometallurgical extraction is effected by *leaching* the valuable mineral out of the ore with an aqueous solvent and finally precipitating the metal chemically or electrolytically; which is referred as *reduction*.

Extraction is followed by *refining* for the adjustment of the amount of impurities to low or controlled levels. It is achieved by pyrometallurgy or electrolytically. An alternative means of obtaining pure metal is by prerefinment. In this way, pyro, hydro, and electro-metallurgical methods are used one after another in the extraction of a particular metal.

(1) Suvarna (Gold)

• Synonyms: Gold i.e. *Suvarna* has various synonyms in Sanskrit, like *Hiranya, Svarna, Dravina, Kanchana, Hema, Kalyanaka, Agnivarna, Kanaka, Agnibija, Mangal-yaka, Champeyaka, Rukma* and *Hataka* etc.

• Name
English :Gold
Latin: Aurum
Chemical Symbol: 'Au'.

• Occurrence :

Gold is seldom found in an unalloyed, or pure, state. It is usually combined with silver in a natural alloy called as an *electrum*. But it is usually associated with quartz (*Reefgold*) and calcite, lead, tellurium, zinc or copper, and is usually mined as a by-product of these metals.

Scientists believe that gold is deposited from gases and liquids rising from beneath the earth's surface. These gases and liquids travel towards the surface through *faults* (cracks) in the crust. Gold is found in lode, or vein, deposits in placer deposits, as a minor element in prophyry copper, and in seawater. The *lode*, or *vein, deposits* are veins in the earth's crust.

Placer deposits are large particles, called *nuggets*, and grains of gold in the beds of streams. These particles have been washed and carried away from a lode, or vein, by surface water, usually floodwater. Some nuggets are very large. The "Welcome Nugget" found in Australia, weighed 2,217 troy ounces (69 Kilograms). Placer deposits are of two types, eluvial and alluvial. *Eluvial deposits* are found close to the vein of gold. *Alluvial deposits* are farther away, usually in stream beds.

Some gold is found in bulky copper deposits called porphyry copper deposits.

Gold in seawater is another source of gold. Seawater yields about 1 grain of gold per short tonne (72 mg per metric tonne).

Alluvial gold is found in river beds of Brahmaputra, Iravati and Suvarnarekha, in India. In India, the gold mines are at Kolar and Anantapur, near Madras.

The chief gold-producing countries of the world, in order of their importance are, South Africa, Soviet Union, U.S.A. and Canada. The richest gold field is located in the Transvall province of South Africa.

• Extraction of Gold

Three milling methods are generally used in separating gold from ores or from seawater. They are called as *floatation, cyanidation* and *carbon-in-pulp*.

Floatation: In the floatation process, particles of the finely ground ore are separated from each other according to the abilities of the different metals in the ore to attach themselves to an oily froth. Oils and chemicals, called *floatation reagents*, are mixed into water before the ground ore is mixed in. Three types of chemicals are used - a frothing agent, a collecting agent and a variety of inorganic chemicals. The *frothing agent* causes the water to foam. The *collecting agent* forms a film on the gold so that it will stick to air bubbles which go to the top. The *inorganic chemicals* keep other metals from filming along with the gold. After the ore is placed in the water, air is blown in. This is called *aeriation*. The gold particles are carried to the top in air bubbles and are skimmed off this frothy layer.

Cyanidation: It is a process in which the ground ore is placed in a tank containing a weak solution of cyanide. The gold in the solution is then separated, or precipitated, by contact with metallic zinc.

Carbon-in-pulp: Finely ground ore is first mixed with water to form a pulp. The gold in the pulp is then dissolved with a cyanide solution. Carbon particles are added to the pulp to collect and hold gold *ions* on their surface. Next, the carbon particles are removed from the pulp. The particles are then placed in a hot *caustic*

(corrosive) cyanide solution, which separates the gold from the carbon.

Gold is also extracted by amalgation with the Mercury.

• Appearance :

Gold has a lovely yellow colour and a soft metallic glow. Its softness makes it easy to work with. Throughout the world, it is available in market, in the form of chips, sheets or ornaments. In jewellery, gold is combined with another metal to render hardness, in the form of *alloy*. Gold alloys are measured by *karats* (sometimes spelled *carats*). A karat is equal to one twenty-fourth part. Thus, 24 karat (24K) gold is pure gold. Eighteen karat gold is 18 parts pure gold to 6 parts other metal. Gold is available in the market in the form of sheets, foil and chips.

• Physical Properties

(1) Pure gold melts at 1064.43^0 and boils at 2807^0 C.

(2) Gold has the highest malleability, ductility and sectility.

(3) Its density is 19.32 per cubic centimeter at 20^0C.

(4)It can be dissolved in a mixture of hydrochloric acid and nitric acids, called *aqua regia*.

(5) It may also be dissolved in alkaline cyanide solution, a hot solution of ferric chloride, thiosulphate solutions, mercury or nascent (free) chlorine.

(6) It is unaffected by air, water, alkalis and acids (except nitric acid and hydrochloric acid).

Though gold is unaffected by water, the water treated with gold by keeping it in a golden vessel or boilling with gold (called as *Suvarna-siddha jala*) is said to be beneficial for the health.

• Varieties

Five varieties of gold are mentioned in Rasaratnasamuchchaya viz. 1) *Prakrita* 2) *Sahaja* 3) *Agnisambhava* 4) *Khanija* and 5) *Rasaja*. Of which, the first three types are based on some Mythological conceptions, which need not be mentioed. Fourth i.e. *Khanija* can be further classified as reef gold - which is found in mines and alluvial gold - a free and pure form of gold in river waters. The fifth type viz. *rasaja* is supposed to be that gold which is obtained from nonprecious metals converted into gold with the help of Mercury.

According to minerology, two varieties of gold are mentioned. Forty-three percent of rhodium (Rh) has been reported in a variety called *rhodium gold* from Mexico and *maldonite*, a black Australian variety containing bismuth.(Au_2Bi).

• Approval

Gold which becomes reddish like the rising sun on heating and acquires saffron-like colour while rubbing on the grind-stone is acceptable.

• Purification

There are different schools of thoughts regarding the purification of gold. The treatise like Rasachananshu, Ayurveda-prakash, Rasaprakash Sudhakar emphasise that there is no need to perform any purificatory process on gold.

When the water or milk enhanced with treatment of gold (*suvarna-siddha jala and suvarna-siddha dugdha*, respectively) is given orally, it bestows all attributes of gold. Hence, there is no need to purify or incinerate the gold, is another thought. But incinerated gold (*Suvarna bhasma*) awards one more attribute of gold namely *rasayana* (reju-

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venative); which is not alloted by *suvarna-siddha jala* or *dugdha*. Thus the process of incineration (*bhasma*) of gold is essential. For that, first the purification (*shodhana*) of gold becomes mandatory, as to prepare the calx or *bhasma*, the metal has to be fragile. Therefore before preparing the incineration of any metal, it has to be purified, to make it fragile.

सुवर्णमुत्तमं वह्नौ विद्रुतं निक्षिपेत्त्रिशः ।
काञ्चनारद्रवैः शुद्धं काञ्चनं जायते भृशम् ।। (योगरत्नाकर)

The approved quality gold is smelted by heating (1064^{0}C) in a crucible and is poured into the decoction of the leaves of *Kanchanara* (Bauhinia variegata), for three times. The gold becomes pure. (Yogaratnakara)

• Incineration

Different methods have been mentioned in various texts of Rasashastra about the incineration of gold. The common procedure followed, is to first hammer the gold into thin sheets, which can be even pierced by a thorn (*kantakavedhi*). Then they are coated with the pastes of some mineral or animal originated substances and then subjected to heating by giving 10 *laghu putas* or *kukkuta putas*. The substances used to coat the gold sheets are 1) Pure mercury, 2) Incinerated mercury, 3) Cinnabar (*hingula*), 4) Red mercurial (*rasasindura*), 5) Black mercurial (*kajjali*), 6) Sulphur (*gandhaka*) and 7) Faeces of the pigeon.

Moreover, it is also mentioned to mix and amalgamate the metals like copper, tin, lead with gold and then subjected to heating. It is specified that the heating procedure should be gradual, for first few heatings. Otherwise there are chances of reduction of the converted form of gold in previous sittings into original gold.

One procedure to incinerate the gold mentioned in Rasamanjari, is as follows:

समसूतेन वै पिष्टीकृत्वग्नी ध्मापयेद् रसम् ।
स्वर्णं तत्समताप्येन पुटितं भस्म जायते ।। (रसमंजरी)

Thin sheets of purified gold are first prepared and mixed with equal quantity of pure Mercury and ground into a fine powder (*pishti*). It is then heated in an iron container, so that mercury gets evaporated and incinerated gold remains behind. (Rasamanjari)

Suvarnamakshika (chalcopyrite) powder is spread in the saucer (*sharava*) at the bottom and above it the gold is placed. Again, on the surface of gold, *suvarnamakshika* is spread. Then the saucer is sealed properly by rags and mud and subjected to *kukkuta puta*. The calx or incineration of gold gets ready.

Practically it is observed that with one *kukkuta puta* alone, the gold only becomes fragile and does not get properly incinerated. Hence this fragile gold is further processed with the decoction of the leaves of *Kanchanara* (Bauhinia variegata) for seven times and then subjected to heat. The cochineal-red coloured calx of gold is formed.

• Properties

Suvarna bhasma (gold calx) is sweet, slightly astringent and bitter in the taste, sweet in the post-digestive effect and has a cold potency. It is unctuous in attribute and the best rejuvenative. It augments the strength, memory, seminal fluids, intelligence and improves the complexion. It is anabolic, beneficial to the heart and voice also. It detoxifies the toxic metabolites and possesses a mild antituber-cular activity. It boosts up the *sattva* attribute of mind and reduces *rajas* and *tamasa gunas*. It alleviates *Vata* and *Pitta doshas*.

Suvarna bhasma is used to treat various diseases like tuberculosis, anaemia, cough, burning sensation, debility, sterility, cardiac debility, muscular debility, intoxication, diseases of *Vata* and as a rejuvenative to promote longevity and prevent ageing.

- Dosage: 30 mg to 120 mg., with proper *anupana.*
- Formulations

Suvarnasutashekhara,	*Suvarnamalinivasanta,*
Vasantakusumakara,	*Kasturibhairava rasa,*
Brihadvatachintamani,	*Suvarna parpati,*
Makaradhwaja vati,	*Hemagarbha matra,*
Chaturbhuja kalpa,	*Chaturmukha rasa,*
Suvarna samirapannaga,	*Sutikabharana rasa* etc.

(2) Rajata (Silver)

- Synonyms: Silver i.e. *Rajata* has few synonyms in Sanskrit, like *Roupya, Ruchira, Tara, Soudha, Chandrahasa, Chandrama and Shubhraka* etc.
- Names

English: Silver
Latin: Argentinum
Chemical symbol: 'Ag'.

- Occurrence

Silver occurs in nature in the free state, occasionally 99% pure, but generally containing copper, gold and other metals. There are two main classes of silver ores. The first is the dry or siliceous ores, which are used primarily for their silver content and the other is derived from the smelting of metalliferous ores, such as those of lead, copper and zinc, which contain a small percentage of silver.

Silver ores occur as veins, replacement deposits, contact metamorphic deposits or as alluvials. The most important primary ore is argentite, Ag_2S. The upper parts of silver deposits or lodes are weathered with the production of cerargyrite, AgCl, which is often accompanied by bromyrite, AgBr, and iodyrite, AgI. In several cases of such gossans, cerargyrite occurs above bromyrite, below which comes iodyrite.

Occurrence of silver is widesperead with 32 countries listed as producers. Production is heavily concentrated in America with one half of the world total Silver coming from Mexico, Peru, U.S.A. and Canada. The Russia and Poland produce another 20% and Australia a further 5% of the total. The remainder comes mainly from southern Africa and southern Europe.

- Extraction

The cyanide process is so similar to the process for gold, which is described previously. The amalgamation also follows a similar procedure to that process for gold.

The silver-zinc-lead crust from the Parkes process for desilvering lead, is retorted to distil off the zinc and the lead-silver alloy that is left is cupelled for silver. The silver may then be parted of its gold by an electrolytic process. For refining, Cathodic deposit is melted under charcoal and cast of ingots of very fine silver are prepared.

- Appearance

Silver is a soft, heavy and shining white metal. In its pure form, is called metallic, free or native silver. Pure silver is extremely soft. As a result, a small amount of another metal, usually copper, is generally added to increase its hardness and strength. For example, *sterling silver* is an alloy of 92.5% silver and 7.5% copper.

• Physical Properties

(1) Silver is a white and shining metal. It reflects 95% of the light that strikes it, making it the most *lustrous* (shiny) of the metals.
(2) It is good conductor of electricity and heat.
(3) It is second only to gold in *ductility* (the ability to be drawn out into fine wires) and *melleability* (the ability to be hammered into sheets).
(4) Silver melts at 961°C and boils at 2193°C.
(5) Its density is about 10.49 grammes per cubic centimeter, at 20°C.
(6) Silver, like gold, does not react chemically with most substances. However, the presence of sulphur compounds causes silver to develop a black or grey coating of silver sulphide called *tarnish*.
(7) Silver is soluble in nitric acid, and forms silver nitrate ($AgNO_3$).
(8) Silver remains unaffected with alkalis.

• Varieties

Ayurvedic texts mention three varieties of silver viz. *Sahaja*, *Khanija* and *Kritrim*. Of which, the *sahaja* and *kritrim* varieties are linked by mythological concepts. According to minerology, two varieties viz. free state (*sahaja*) and in the form of alloy, found in mines (*khanija*) are commonly met with.

• Purification

सूक्ष्मपत्रीकृतं रूप्यं प्रतप्तं जातवेदसि ।
निर्वापितमगस्त्यस्य रसे वारत्रयं शुचि ।। (आयुर्वेदप्रकाश 3:94)

Thin-leaved silver is heated on fire and dipped into the juice of *Agastya* (Sesbania grandiflora) leaves, three times consecutively.

Instead of *Agastya* leaves juice, it can be purified by dipping in the seed-oil of *Jyotishmati* (Celastrus paniculatus), three times consecutively. The leaves of *Agastya* possess the special potency (*prabhava*), by which it detoxifies, whereas, *Jyotishmati* seed-oil is the best nervine and helps to augment the memory. The silver possesses the similar properties, hence to boost up them *Jyotishmati* is recommended.

• Incineration

Like gold, the thin sheets of silver are coated with the pastes of substances like pure sulphur, incinerated Mercury, pure orpiment and pure chalcopyrite which are rubbed with various juices and then subjected to heating. Various methods have been quoted in different texts of Rasashastra about the preparation of *bhasma* (calx or incineration) of silver. One of these procedures mentioned in Rasaratnasamuchchaya is as follows:

भाव्यं तापयं स्नुहीक्षीरैस्तारपत्राणि लेपयेत् ।
मारयेत्पुटयोगेन निरुत्थं जायते ध्रुवम् ।। (र.र.स. 5:37)

Equal quantity of pure silver and pure chalcopyrite are taken. First, the chalcopyrite is processed for seven times with the latex of common milkhedge i.e. Euphorbia nerifolia, and its paste is coated on the sheets of pure silver. It is then properly sealed in saucers with rags and mud and subjected to heating in *gajaputa*. After cooling on its own, it is taken out and processed again with the latex of *Snuhi* and prepared in the form of thin discs and again subjected to heating. This procedure is repeated till the silver can not be recovered back from its calx . Instead of *Snuhi*, the use of *Matulunga* (Citrus medica) is mentioned.

• Properties

Rajata bhasma (incinerated silver) is sour, sweet and as-

tringent in the taste, sweet in post-digestive effect and has a cold potency. It alleviates *Vata* and *Pitta*. It is unctuous in attribute. It possess a special potency, with which it facilitates the action of *sadhaka-pitta* and helps as a nervine. It also stokes *agni* and improves the appetite, it is reducing and augments the strength. It is one of the best nervine and improves memory and intelligence.

• Uses

Rajata bhasma is used in treating various diseases. It is extremely useful in debility, especially in convalescence. Along with iron, copper and mica; it is also used to treat anaemia. As it is a nervine, it is beneficial in old age to improve memory, intelligence and as a whole, to improve mental faculties. It is also rewarding in *Vata* disorders like hemiplegia, neuritis, epilepsy, hysteria, puerperal fever etc. It works well in treating gangrene, impotence, diseases of the eyes, muscular weakness, intermittent claudication and depression.

• Dosage: 30 to 60 mg, three times a day, with honey.

• Formulatins

Rajata bhasma is one of the ingredients in the formulations like *Vasantakusumakar, Brihadvatachintamani, Kasturibhairava rasa, Laxmivilas rasa, Sutikabharana, Mahayogaraj guggulu, Chandrodaya rasa* etc.

(3) Tamra (Copper)

• Synonyms: Copper i.e. *Tamra* has various synonyms in Sanskrit, like *Shulba, Raktaka, Mlechhavastra, Nepaliya, Tryambaka, Suryaloha, Arka, Bhanu, Surya, Ravi, Ravipriya, Bhaskar, Lohitayasa,* etc.

• Names

English: Copper
Latin: Cuprum
Chemical Symbol: 'Cu'.

• Occurrence :

Almost pure copper, called native copper, rarely occurs in nature. Most copper comes from about 7 kinds of ores. These ores may also contain other metals such as lead, zinc, gold, cobalt, platinum and nickel. Copper ores usually contain less than 4% copper. Some ores may yield as little as 0.2% of copper.

The copper ores are *oxides* - cuprite, tenorite; *sulphides* - chalcopyrite, copper pyrites, chalcocite, copper glance, bornite, covelline, erubescite; *grey copper* - tetrahedrite, tennantite famatinite, enargite; *sulphate* - chalcanthite; *carbonates* - malachite, azurite; *silicates* - chrysocolla, dioptase and *chloride* - atacamite.

Much of the world's copper comes from the mountain ranges extending from Alaska to the tip of South America. About 1/7th of the world's copper is mined by U.S.A., Canada mines 1/10th of world's copper. Other sources include Chile, Russia, Zaire, Zambia, Australia, Peru, China and Mexico. In India, copper mines are at Sikkim, Bhutan, Singbhoom and Nellor.

• Extraction

Copper is obtained from its ores (usually sulphide) by an elaborate series of pyrometallurgical operations, commonly consisting of roasting, to expel part of the combined sulphur, then fusion in blast or reverberatory furnaces for the production of a concentrated double sulphide of cop-

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per and iron called *matte*. The copper matte next goes through a converter, where silica is added to combine with impurities, forming slag. The new mixture is called *blister copper*, which is 97 to 99.5% pure. In fire-refining furnace, it undergoes a process called *poling*; resulting copper nearly 97.9% pure. Copper to be used in electrical conductors undergoes *electrolytic refining* to achieve a purity of more than 99.9%.

• Appearance

Copper is reddish in colour, heavy, comparatively soft but extremely a tough metal.

• Physical Properties

Physical properties of copper make it valuable to industry. They include:

(1) It is best known for its ability to conduct electricity. Silver is the only better conductor, but silver is too expensive for common use.

(2) Copper is an excellent conductor of heat, which makes it useful in cooking utensils, radiators and refrigerators.

(3) Pure copper is highly malleable and can be rolled into sheets less than 0.05 mm thick.

(4) Copper possesses great *ductility* (ability to be drawn into thin wires without breaking). For example, a copper bar 4 inches square can be heated, rolled and drawn into a round wire that is thinner than a human hair. Such a wire would be more than 20 million times longer than the bar that was used to make it.

(5) Copper is quite resistant to corrosion. It will not rust. In damp air, it turns from reddish-orange to reddish-brown. After long exposure, copper becomes coated with a

green film called *patina*, which protects it against further corrosion.

(6) It melts at 1083.4°C and boils at 2567°C.

(7) Copper has a density of 8.96 grams per cubic centimeter at 20°C and it is about 14% heavier than iron.

(8) Various alloys of copper are prepared. They are - Brass (60-90% copper and 40-10% zinc), Bronze (81-90% copper and 19-10% tin), German silver (50% copper, 25% zinc and 25% nickel), Bell metal (78% copper and 22% tin), Gun metal (88% copper, 10% tin and 2% zinc.) Aluminium bronze - an alloy of copper and aluminium.

(9) Pure copper is unaffected by water or dilute hydrochloric acid, but it dissolves in nitric acid.

• Varieties

Ayurvedic texts have mentioned two varieties of copper viz. 1) *Nepaliya* and 2) *Mlechchha*.

Nepaliya variety of copper is found or obtained from Nepal. It is unctuous looking, soft, reddish in colour, easily malleable without breaking and does not corrode easily.

Mlechcha variety of copper possesses a blackish tinge and is less ductile. The utensils of this type of copper when used, cause ill effects like vomiting etc. and it stains the hands black.

• Approval

Nepaliya variety of copper is acceptable one. The copper, which is heavy, smooth, tolerating hard strokes and having colour like that of china rose is commendable.

• Purification

ताम्रनिर्मलपत्राणि लिप्त्वा निम्ब्वम्बुसिन्धुना ।
ध्मात्वा सौवीरकक्षेपाद्विशुद्धयत्यष्टवारतः ।। (र.र.स. 5:50)

The copper sheets are coated with the paste of lemon juice and rock salt and heated on fire and dipped into the sour gruel . This procedure is repeated for 8 times.

(Rasaratnasamuchchaya 5:50)

Moreover, it can be purified by dipping it in the juice of *Nirgundi* (Vitex negundo) or cows urine. In some procedures, the copper is melted in the crucible and the use of *yavakshara, sajjikshara* and *tankana* (borax) is recommended in that procedure for coating their paste.

In practice, as the improper purification of copper exerts untoward effects called as '*ashta dosha*' i.e. eight ill effects, like loss of consciousness, giddiness, burning sensation, sweating, nausea, vomiting, anorexia and restlessness. It is first purified by a procedure called - general purification, which is described earlier in this chapter. (By heating sheets of a metal and immersing them in *taila, takra, gavamutra, aranala* and decoction of *kulattha*, respectively for 7 times each). After that procedure, the above procedure is followed, as a special purification.

• Incineration

जम्बीररससम्पिष्टरसगन्धकलेपितम् ।
शुल्बपत्रं शरावस्थं त्रिपुटैर्याति पञ्चताम् ।। (र.र.स. 5:53)

Kajjali is prepared by rubbing pure mercury and pure sulphur, and the fruit juice of *Jambira* (Citrus limonum) is added to it. It is prepared in a form of paste and is coated on the thin sheets of copper. The sheets are then properly sealed in saucers (*sharava samputa*) and subjected to 3 *gajaputas*. The calx or incineration of copper gets ready.

(Rasaratnasamuchchaya 5:23)

During heating process, at the time of first *puta*, the proportion of mercury, sulphur and copper should be equal.

At the end of this first *puta*, copper gets transferred into a fine powder. At second *puta*, this copper powder is mixed with 1/4th quantity of, each, mercury and sulphur. Then the mixture is rubbed into the juice of *Jambira* and formed in the circular flat discs (*chakrika*) and subjected to heating for second *gajaputa*. For further heating, similar process is repeated.

Accoring to the experts' opinion, after first *puta*, if the mixture is poured into a bottle and subjected to heat with the help of *Valuka yantra*, at the neck of bottle *Rasadindura* will get collected and incineration of copper (*tamra bhasma*) at the bottom. By repeating this procedure for three times, calx of copper also can be obtained.

Moreover, there are various other methods of preparing incineration of copper, e.g. by coating the paste of sulphur alone, or by coating the paste of orpiment and realgar and then subjecting it to heating etc.

• Tests of Incinerated Copper

When the incineration of copper is not properly formed, it causes 8 types of untoward effects (*ashta dosha*), which are mentioned earlier.

The optimum quality of incinerated copper shows following properties.

वमनं च विरेकं च भ्रमं क्लममथारुचिम् ।
विदाहं स्वेदमुत्क्लेशं न करोति कदाचन ।।

(आयुर्वेदप्रकाश 3:128)

When *Tamra bhasma* ingested does not cause vomiting, loose motions, malaise, distaste, burning sensation, sweating and nausea; it is a good quality *tamra bhasma*.

(Ayurveda Prakash)

Following are the tests to varify the quality of calx of copper:

(1) The general tests used for all *bhasma*, like *varitaratva*, *rekhapurnatva*, *apunarbhavatva*, *nischandratva*, *nirdhumatva* should be positive.

(2)When tasted or ingested, *tamra bhasma* should not cause nausea. If it causes so, proper heating and processing should be done again.

(3) Sour curds or the lemon juice when mixed with little quantity of *tamra bhasma*, should not turn greenish in colour.

Amongst all the tests, the second test, i.e. symptoms like nausea, vomiting, burning sensation etc. is of clinical importance and the *bhasma* causing these symptoms should not be used.

The third test mentioned about the response of *tamra bhasma* to sour substances, is limited for a short time. If the sample of *tamra bhasma* contains non-transformed element of copper, with sours, it will get converted into cupric salts quickly and turn into green colour. It indicates that the quality of *bhasma* is not standard. It should be noted that *tamra bhasma* contains a little amount of copper oxide, which will get converted into cupric salts with sour substances and turn into green colour. But this action takes more than 24 hours. It will not be then considered as a fault in the quality of *tamra bhasma*.

Amritikarana

To achieve the best quality of *tamra bhasma* is not easy. Sometimes, even though it fulfils the above criteria, it manifests the symptoms like nausea, vomiting etc. Hence the additional process - *amritikarana* is followed to assure

the safty. There are various methods mentioned in different texts. The commonly followed procedures are mentioned here.

(1) *Tamra bhasma* and 1/2 quantity sulphur, are processed with *Panchamrita*. (a mixture of cow's milk, ghee, curds, honey and sugar, in equal quantity). Then the flat circular discs are prepared and sealed properly. It is then subjected to heating by giving 3 *gajaputas*. The flawless quality of *tamra bhasma* is achieved.

(2) In the procedure *tamra bhasma* is first rubbed with the lemon juice and the pulp formed is transferred into the hollow (purposefully made) of rhizome of *Surana* (Amorphophallus campanulatus) and subjected to heating by *putapaka* method.

(3) *Tamra bhasma* is processed with the juice of aloe and then subjected to heating by giving *varaha puta*. The procedure is repeated for 7 times to achieve *amritikarana*.

When *tamra bhasma* is to be used by itself, it is recommended to start with very low dosage (15 to 30 mg) and ensure that there are no untoward effects. Then gradually the dose can be increased as per requirement.

• Properties

Tamra bhasma (incinerated copper) is bitter and astringent in the taste, sweet in post-digestive effect and hot in potency. It alleviates *kapha dosha* and exerts a potent cholagogue activity.

• Uses

Tamra bhasma is useful in liver disorders like hepatitis, gall stones, cirrhosis and hepatosplenomegaly. It stimulates the appetite and helps digestion. It works well in anaemia, anasarca, abdominal pain, ascites, hyperacidity, colitis etc.

• Caution

Tamra bhasma should be used sparingly, as it may cause untoward effects. Many a times, it is used with other medicines as an adjunct. When used alone, it should be taken under medical supervision. *Mouktika bhasma* is used as an antidote of *tamra bhasma*.

• Contra-indications

Tamra bhasma should not be used in pregnancy, post-partum period, severe debility, tuberculosis, infants, old age and bleeding piles.

• Dosage: 60 to 120 mg. with honey or ghee.

• Formulations

Tamra bhasma is one of the ingredients in the preparations like *Arogyavardhini*, *Ekangavira rasa*, *Chandrakala rasa*, *Talisadi churna*, *Tamra parpati*, *Panchamrita parpati*, *Naracha rasa*, *Mahavatavidhvansa*, *Sutashekhar*, *Hemagarbha matra*, *Laxmivilasa* and *Sutikabharana*, etc.

Bhunaga sattva and Mayurapichchha sattva

Bhunaga means an earthworm and *Mayurapichchha* means the tail or feathers of a peacock. These two are supposed to contain copper, hence these preparations are mentioned here.

The earthworms are fed to the hens and their faeces are dried. It is then rubbed with the sours and salts, again rubbed and dried. It is then burnt into ash which is mixed with liquids and subjected to heating in a closed crucible. After cooling on its own, the *sattva* or extract accumulated at the bottom of the crucible, is collected. This extract is known as *Bhunaga sattva*.

Another procedure of *Bhunaga sattva* preparation is as follows:

ताम्रभूभवभूनागान् गृहित्वा यत्नतः पुमान् ।
गडगुग्गुलुलाक्षोर्णा मत्स्यपिण्याकटङ्कणैः ।।
दृढमेतांश्च संयोज्य मर्दयित्वा धमेत्सुखम् ।
मुञ्चति ताम्रवत् सत्त्वं तद्वत् पक्षोऽपि बर्हिणाम् ।।

(रसराजसुन्दर, पृष्ठ 64)

Earthworms are collected, preferably found in the vicinity of copper mines. They are rubbed with the jaggery, *Guggulu* (Commiphora mukul), *Laksha* (Coccus lacca), ash of the wool, *pinyaka* and *tankana* (borax). The pulp formed, is dried and subjected to heating in *sattvapatana musha*. From *bhunaga* (earthworm) and *mayurapichchha* (peakcock feathers), copper like extract is acquired. It is cold in potency and useful in skin diseases. (Rasarajasundara, p.64)

(4) Loha (Iron)

• Synonyms: As per Ayurvedic texts Iron i.e. *Loha* is obtained in three varieties called as *Munda loha*, *Tikshna loha* and *Kanta loha*. Every variety has many synonymes as mentioned below:

Munda loha: *Munda*, *Kritiloha*, *Shilatmaja*, *Krishnayasa*, *Drishtasara* and *Ayas*.

Tikshna loha: *Lauha*, *Loha*, *Lohaka*, *Shastraloha*, *Tikshnaka*, *Aya*, *Saraloha*, *Kalaloha*.

Kanta loha: *Kanta*, *Kantayasa*, *Ayaskanta* and *Mahaloha*.

• Names

English: Iron
Latin: Ferrum
Chemical symbol: 'Fe'.

• Occurrence

Next to aluminium, iron is the most widely distributed and abundant metal, consisting about 4.6% of the Earth's

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crust. It is found native in meteoritic masses and in eruptive rocks, mostly associated with allied metals such as nickel and cobalt. In addition to the essentially iron minerals, iron enters into the composition of a great number of rock-forming silicates.

The main ores of iron are : the Oxides - Magnetite, Fe_3O_4, containing 72.4% iron, Hematite, Fe_2O_3, containing 70% iron, Hydrated oxides - Goethite, FeO(OH), containing 68.5% iron, Limonite; and the Carbonate, Siderite, Chalybite or spathic iron ore, containing 48.3% iron.

The most important iron ore deposits in the United States lie near Lake Superior in Minnesota and Michigan. Other countries that have large deposits of iron ore include Soviet Union, Australia and Brazil. One of the world's richest deposits is Cerro Bolivar, a mountain of iron ore in Venezuela.

• Extraction

Iron is extracted chiefly from its oxide ores in the blast furnace by the reduction method. First, the ore is crushed into small pieces and washed with water to remove the impurities like sand and clay. The washed ore is heated in shallow kilns in excess of air. The impurities like carbon dioxide, moisture, sulphur and arsenic are removed. Thus the ore is *concentrated.*

It is then mixed with limestone and coke and smelted in the blast furnace. The blast of hot air (about 800°C) is passed through the tuyeres. The temperature inside the furnace is not the same throughout. It is lowest at the top and highest at the bottom of the furnace. The reactions taking place at different temperatures and parts of the furnace are simplified in the table below:

Reactions	*Part of Furnace*	*Temperature*	*Inference*
$C+O_2 \rightarrow CO_2\uparrow$ + heat $CO_2+C \rightarrow 2CO$ + heat	Lower part	1500°C	Coke and Oxygen combine heat is liberated.
$CaCO_3 \rightarrow CaO + CO_2\uparrow$ $CaO + SiO_2 \rightarrow CaSiO_3$	Middle part	900°C	Limestone is decomposed to calcium oxide which combines with silica and forms calcium silicate (slag).
$Fe_2O+3CO \rightarrow 2Fe+3CO_2\uparrow$ $Fe_2O_3+3C \rightarrow 2Fe+3CO\uparrow$	Upper part	600°C	The iron ore is reduced to iron.

Being lighter than molten iron, slag floats on the surface. At the bottom of the furnace slag is removed from the upper outlet and molten iron is withdrawn from the lower outlet and is then run into moulds. Molten iron obtained from the lower outlet of the blast furnace is impure iron, called *Cast iron* or *Pig iron*. It contains 0.5 to 4.2% carbon with other impurities like phosphorus, silicon and sulphur. When these impurities are removed, the purest variety of iron is known as *Soft iron* or *Wrought iron*. In India, iron is extracted from the ores at Bhilai, Durgapur, Rourkela, Jamshedpur and Bhadravati.

• Appearance

Iron is a silvery-white metal in its pure state. It seldom occures in pure state. It is obtained from ores.

• Physical properties

(1) Iron possesses all common properties of metal like hardness, ductility, malleability, etc.

(2) It is easily magnetized.

(3) Iron unites easily with non-metals, such as sulphur, oxygen and carbon.
(4) It unites easily with oxygen to form iron oxide (Fe_2O_3) i.e. iron rust.
(5) Iron has a density of 7.874 grams per cubic centimeter at 20°C.
(6) Iron melts at 1535°C and boils at 3000°C.
(7) With acids, iron turns into iron salts.
(8) It is unaffected by alkalis.
(9) It dissolves in water, but the process takes a long time.

• Ayurvedic Varieties of Iron

Ayurveda classifies varieties of iron basically into 3 types, viz. *Munda loha, Tikshna loha* and *Kanta loha*. Their further subtypes are given in the flowchart below:

Loha

Munda Loha	Tikshna Loha	Kanta Loha
1. Mridu munda	1. Khara tikshna	1. Bhramaka kanta
2. Kuntha munda	2. Sara tikshna	2. Chumbaka kanta
3. Kadara munda	3. Hrinnala tikshna	3. Karshaka kanta
	4. Taravatta tikshna	4. Dravaka kanta
	5. Vajira tikshna	5. Romakanta
	6. Kalayasa	

Thus there are 14 varieties of *loha*, in total.

• ***Mundaloha***

It is similar to *Pig iron*. It is fragile as it contains 2.5% carbon. The subtypes of *mundaloha* show following characteristics:

(1) The one which is not broken easily by stroking and quickly melts when put on fire, is called as '*Mridu mundaloha*'.

(2) The variety which expands after heavy stroking is known as *Kuntha mundaloha*.

(3) The one which is easily broken by stroking and whose cut surface turns black, is called as '*Kadara mundaloha*'.

The cut surface of the metal is examined for its appearance, shine and lines. These three criteria together are known as '*Pogar*'.

• ***Tikshnaloha***

The subtypes of *tikshnaloha* are described in brief as under:

(1) *Khara tikshnaloha* : It is very hard and when bent, it is broken. The cut surface is shiny like Mercury.

(2) *Sara tikshnaloha* : Weapon made up of this variety loses its sharpness when struck against hard surface.

(3) *Hrinnala tikshnaloha* : It is very hard, difficult to cut and is blackish-white in colour.

(4) *Taravatta tikshnaloha* : No specific description mentioned in texts.

(5) *Vajira tikshnaloha* : It is black in colour and its cut surface is hard and brilliant like a diamond.

(6) *Kalayasa* : It is bluish-black in colour and shiny. Weapon made up of this variety does not lose its sharpness even though struck against the hard surface.

Six varieties mentioned above are more potent in their properties, with respect to their sequence. The text Rasarnava has mentioned only three subtypes of *tikshnaloha*, viz. *Rohana*, *Vajar* and *Chapalalaya*.

• ***Kantaloha***

Iron ores like magnetite, which naturally possess magnetic properties are called *Kantaloha*. The magnetic properties

are more prominent at certain points, called as magnetic poles. The subtyping of *kantaloha* is based on the magnetic power of each variety.

(1) *Bhramaka kantaloha* : This type of *kantaloha* attracts the iron flakes, when brought in the vicinity.

(2-3) *Chumbaka kantaloha* : It attracts the iron flakes from a distance. It is also known as *Karshaka kantaloha.*

(4) *Dravaka kantaloha* : One which attracts the iron flakes from a very long distance. When heated, alongwith other metals, it facilitates the their melting.

(5) *Romakanta* : On the cut surfaces of which hairline like pattern is seen. When cut into pieces, the tiny flakes stand erect like hair. On putting it in iron flakes, the flakes get glued on all sides and looks like hair. This variety is supposed to be the best one.

From the number of poles it contains, it is also known as *ekamukha, dvimukha, trimukha, chaturmukha, panchamukha* and *sarvatomukha. Kantaloha* is also classified into three varieties according to its colour, viz. yellow, red and black.

• Approval

The following varieties of iron are acceptable:

1. *Mridu* (*Mundaloha*)
2. *Kalaloha* (*Tikshnaloha*)
3. *Romakanta* (*Kantaloha*) and
4. *Sarvatomukha* (*Kantaloha*)

The best quality of *Kantaloha* shows following properties:

(1) The container made of *Kantaloha* is filled with water. If a drop of oil is put in water, it does not get spread.

(2) The container of *Kantaloha* when coated with the paste of asafoetida, it loses its odour very quickly.

(3) The container when coated with the paste of *Nimba*, it loses its bitter taste.

(4) When milk is heated in this container, it rises in its level but doesn't get spilt.

Now a days, the vessels or containers made up of *Kantaloha* are very scarce.

• Purification

क्वाथ्यमष्टगुणे तोये त्रिफलाषोडशं पलम् ।
तत्क्वाथे पादशेषे तु लोहस्य पलपञ्चकम् ।।
कृत्वा पत्राणि तप्तानि सप्तवारं निषेचयेत् ।
एवं प्रलीयते दोषो गिरिजो लोहसम्भवः ।। (र.र.स. 5:102-3)

A speical type of decoction of *Triphala* is prepared in which *triphala* and water are taken in 1:2 proportion and heated till 1/4th of the decoction remains. Thin sheets of iron are heated and dipped into this decoction of *triphala,* for 7 times. (Rasaratnasamuchchaya 5:102-103)

Similarly thin sheets of iron are coated with rock salt and heated and dipped into decoction of *triphala* or heated sheets are dipped into the juice of rhizomes of *kadali* i.e. banana (Musa sapientum). The procedure of purification makes the iron sheets fragile and thus can be easily ground into fine powder afterwards.

In old days purified iron in the form of a fine powder was directly used as a medicine. The Samhitas like Charaka, Sushruta, Sharngadhara and also Bhaishajya Ratnavali had mentioned the uses of purified iron fine-powder in the diseases like anaemia, ascites, jaundice and anasarca, and also as a rejuvenative (*rasayana*). The procedure called '*ayaskriti*' also indicates the use of various decoctions, in

which the heated sheets of iron are dipped, for medicinal purpose.

• Incineration

Munda loha is not used to prepare its *bhasma* and *Kanta loha* being scarce, *Tikshna loha* is commonly used for preparing *loha bhasma*. More than 25 different methods of preparing *loha bhasma* have been mentioned in various texts of Rasashastra. All of them include principally three stages like (a) To prepare the thin sheets or iron, (b) To heat them and dip in the liquids to make iron fragile and to grind it in a fine powder form and (c) To mix various minerals or herbs into powder and subject it to heating repeatedly.

Today, thin sheets or iron filings are available in the industries which is an easy source of *tikshna loha*. They are used to prepare *loha bhasma*.

Few procedures of preparing *loha bhasma* are briefed here:

(1) *Tikshna Lohabhasma*

तच्चूर्णं सूतगन्धाभ्यां पुटेद् विंशतिवारकम् ।
पुटे पुटे विधातव्यं पेषणं दृढवत्तरम् ।।
एवं भस्मीकृतं लौहं तत्तद्रोगेषु योजयेत् ।। (र.र.स. 5:113-14)

To purified fine powder of iron, equal amount of pure Mercury and sulphur are added and *kajjali* is prepared. It is properly sealed in saucers and then subjected to heating with *gajaputa*. After cooling on its own, the powder is taken out and of it's 1/4th part *kajjali* is mixed and rubbed together for sufficient time and again subjected to heating. This procedure is repeated for 20 times to get *loha bhasma* ready. (Rasaratnasamuchchaya 5:112).

The exact proportion of *kajjali* is not mentioned in the text. With experience, before first *gajaputa* it is added in

equal quantity and afterwards 1/4 quantity is added. Though there is no mention about the type of *puta*, commonly *gajaputa* is given.

(2) *Kanta lohabhasma*

The fine powder of iron is processed for 21 times, with the decoction of *triphala* which is prepared in cow's urine. Then flat circular discs are prepared of that mixture and subjected to *gajaputa*, with due precaution for 21 times, to get incineration of any type of (*Munda*, *Tikshna* and *Kanta loha*) iron.

(3) *Trividha Lauha Paka*

(Three Heating Procedures)

Lohabhasma prepared by the procedure, called as '*Trividha lauha paka*', is mentioned in the text - Rasendrasara Sangraha. It is prepared in 3 stages, named:1. *Loha bhanupaka*, 2. *Loha sthalipaka* and 3. *Loha putapaka*.

They are briefed below:

(1) ***Loha bhanupaka***: The purified iron is washed well frequently with *triphala* decoction and then kept in a mortar along with *triphala* decoction and dried in the stark sunlight. This is repeated for 3 to 7 days.

(2) ***Loha sthalipaka***: The above iron is washed and then put in earthen vessel containing decoction of *triphala* and heated till it is dehydrated.

Instead of *triphala* decoction, the juice of roots of *Palasha* (Butea frondosa), *Shatavari* (Asparagus racemosus) or *Bhringaraja* (Eclipta alba) or their decoction can also be used. It is designed as per the constitution (*prakriti*) of the patient and the aggravated *doshas*, for which it is to be used.

(3) ***Loha putapaka***: The iron undergone the vessel-heating

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is rubbed with the juice of certain herbs and then heated in *gajaputa* hundred or thousand times consecutively. It becomes gradually more potent.

• De-reviving of *Lohabhasma*

Lohabhasma, cow's ghee and pure sulphur are rubbed together with the juice of *Kumari* (Aloe vera) and then subjected to heating in *gajaputa*. Thus the incinerated iron becomes *niruttha*.

• Properties

Incinerated iron is predominantly astringent in taste, sweet in the post-digestive effect and cold in potency. It alleviates *Kapha* and *Pitta doshas*. It possess dry, heavy and cold attributes and is the choicest remedy for anaemia. It also possessed a rejuvenating properly.

• Uses

Lohabhasma is recommended in various diseases like anaemia (especially of iron deficiency), anaemia associated with the aggravated signs of *Pitta dosha*, hepatosplenomegaly, jaundice, oedema, obesity, bleeding piles, leucorrhoea, menorrhagia, skin diseases of *Pitta* origin, to improve the eyesight and memory, as a general tonic and as rejuvenative.

• Dosage: 30 to 240 mg, with ghee or honey.

• Formulations

Loha bhasma is one of the ingredients in the formulations like *Panchamrita parpati*, *Saptamrita loha*, *Kasturibhairava rasa*, *Chandrakala rasa*, *Vasantkusumakar*, *Mahalakshmivilas rasa*, *Putapakva-vishamajvarantaka loha* etc.

(5) Mandura (Red Iron Oxide)

• Synonyms: Red iron oxide i.e. *Mandura* has various synonyms in Sanskrit, like *Ayoraja*, *Lohamala*, *Ayomala*, *Lohchhishta*, *Lohakitta*, *Singhana*, *Singhanaka*, *Sinhanam*, *Ayakitta*, *Kitta*, *Lohottha*, *Lohavit*, etc.

• Names

English: Red Iron Oxide.
Latin: Rubrum.
Chemical formula: Fe_2O_3 (Ferric oxide)

• Appearance

Mandura means the iron rust.It is formed because of the effect of moisture on iron. It is formed becase of the effect of moisture on iron. It is found with iron ores in igneous and metamorphic rocks. Morever, the iron when exposed to atmosphere turns into *Mandura*, because of heat and moisture. When a blacksmith prepares Iron objects, they are made redhot and then hammered over an anvil to shape it. Small pieces of iron are scattered during the process. These are also termed as *Mandura*. In texts, another way of formation of *Mandura* has been described. It seems that excavation of earth for various purposes was common in that period also. It was also a common fact to unearth various instruments and other objects madeup of iron which had been burried many years back. Such iron was also termed as *Mandura*. But it is blackish in colour. Few texts mention it as *lohakitta* than *Mandura*. When *lohakitta* is heated by using *Bibhitaka* (Terminalia belerica) coal as a fuel and dipped into cow's urine for 7 times, it gets transformed into *Mandura*. Sometimes instead of cow's urine *triphala* decoction prepared in cow's urine is also used.

• Varieties

Three varieties of *Mandura* are mentioned in the texts, e.g. *Tikshna mandura*, *Munda mandura* and *Kanta mandura*. It

is also categorised as per the time or how old is the sample of *Mandura*. For example, a hundred years old, eighty years and sixty year old *Mandura* are the three varieties mentioned.

• Approval

Kanta mandura is esteemed as the best variety, whereas *Tikshna mandura* and *Munda mandura* as better and good variety, respectively.

One hundred years old *mandura* is supposed to be the best one, whereas eighty years and sixty years old varieties are better and good, respectively.

• Purification

Mandura is heated on fire and dipped into cow's urine seven times consecutively.

• Incineration

The powdered *Mandura* is processed with cow's urine and *triphala* decoction for seven times and flat discs are prepared. They are properly sealed and subjected to heating by giving one *gajaputa*. The *Mandura bhasma* formed is chemically ferric oxide, which is easily absorbed in the gut.

• Tests

Mandura bhasma should contain iron particles. The routine tests like *varitaratva*, *rekhapurnatva*, *apunarbhavatva* etc. also should be fulfilled.

• Propeties

It is predominantly astringent in taste, sweet in post-digestive effect and has cold potency. It alleviates *Kapha* and *Pitta doshas*. It is comparatively easy to digest and causes less constipation than *loha bhasma*.

• Uses

Mandura bhasma is the choicest remedy for anaemia in children, especially associated with worm infestations. It is used in treating jaundice, anasarca, hepatosplenomegaly, skin diseases, diabetes mellitus, bleeding piles, menorrhagia etc.

• Dosage: 30 to 240 mg., with ghee.

• Formulations

Mandura bhasma is one of the ingredients in formulations like *Navayasa loha, Tapyadi loha, Punarnava mandura, Saptamrita loha, Mandurarishta* etc.

(6) Vanga (Tin)

• Synonyms: Tin i.e. *Vanga* has few synonyms in Sanskrit, like *Vangaka, Ranga, Rangaka, Kurupya, Shukraloha, Trapu, Trapusa*, etc. The word *Vanga* means Bengal. Since ancient times the required Tin in Indian subcontinent was imported from Sout East Asian countries, through the ports of Kolkata and hence the name.

• Names

English: Tin
Latin: Stannum
Chemical symbol: 'Sn.'

• Occurrence

Tin makes up only about 0.001% of the Earth's crust. The principal tin ore is a compound of tin and oxygen called *Cassiterite* (SnO_2). Some tin ores contain sulphur and small amounts of such other metals as copper, iron and lead. *Stannite* (SnS_2 with Cu_2S and FeS) is occasionally attracting some attention. Tin is found very rarely in the native form. Tin deposits sometimes occur as narrow veins

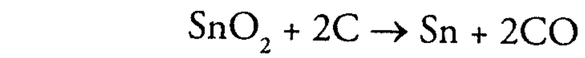
that run though granite. Most tin ore, however, is found in plains, where flowing water has deposited bits of eroded granite and ore.

Most known deposits of tin are in the Southern Hemisphere. Malaysia is the world's leading producer of tin. Other important tin-producing countries include Australia, Bolivia, Brazil, Indonesia, Sovient Union, Thiland, Great Britain and China.

• Extraction

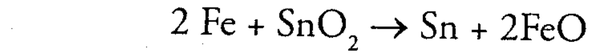
First, in ore dressing gravels are screened, all the tin residing in the fine fraction. Further classifications and jigging or tabling for the denser part of the fines easily produce 50% concentrate. Treatment for deep mined ore is more complex, it consists of separate steps like magnetic seperation, floatation and leaching. Cassiterite (SnO_2) is very friable and must not be over-ground.

Extraction is done by smelting tin with coal in a reverberatory furnace.



$$SnO_2 + 2C \rightarrow Sn + 2CO$$

At 1250^{0}C, tin is reduced from the slag. The slag is resmelted with coal and limestone to produce "*Hardhead*" - 95% tin, 5% iron and a lean slag. Hardhead is smelted with fresh concentrate and siliceous flux for reaction



$$2\,Fe + SnO_2 \rightarrow Sn + 2FeO$$

Finally the processors refine the tin - usually to a purity of 99.8%. Most pure tin is cast into *ingots* (bars) that weigh about 45 kilograms.

• Physical Properties

(1) Tin is a shiny white metallic element.

(2) The difference between its melting point, 231.9^{0}C, and its boiling point, 2270^{0}C, is one of the widest of any metal.

(3) Tin is very malleable and thus can easily be formed into complex shapes. For example, tin plates and tin cans.

(4) It is unaffected by dry air.

(5) Tin is very soft and can easily be bent.

(6) Density of tin is 7.3 grams per cubic centimeter at 20^{0}C.

• Varieties

Ayurvedic texts have mentioned two varieties of *Vanga* (tin), viz. *Khuraka vanga* and *Mishraka vanga.*

Khuraka vanga is white like silver, heavy and melts earlier. *Mishraka vanga* is blackish in colour, hard and does not melt easily.

• Approval

Khuraka vanga is accepted for medicinal purpose.

• Purification

द्रावयित्वा निशायुक्ते क्षिप्तं निर्गुण्डिकारसे ।।
विशुद्ध्यति त्रिवारेण खुरवङ्गं न संशयः ।।

(र.र.स. 5:156)

Impure *Khuraka vanga* is melted and poured into the juice of *Nigundi* (Vitex negundo), which contain turmeric powder i.e. *Haridra* (Curcuma longa). This procedure is repeated for three times, to purify the tin.

(Rasaratnasamuchchaya, 5:156)

• Incineration

Various methods of incinerating tin are mentioned in different texts. Principally, first the tin is melted and then

mixed with different minerals or herbs and heated. We will see here the commonly followed procedure.

प्रद्राव्य खर्परे वङ्गं षोडषांशं रसं क्षिपेत् ।
स्वल्पस्वल्पाऽऽलकं दत्त्वा भारद्वाजस्य काष्ठतः ।।
मर्दयित्वा चरेद् भस्म तद्रसादिषु शस्यते ।

(र.र.स. 5:160)

Purified tin is melted and equal quantity of orpiment with 1/6 part (of tin) pure Mercury are added. This mixture is then kept on stirring with fresh stick of *Vanakarpasa* (*Bharadwaja*) plant. After sometime, the mixture in a form of powder, itself is the *Vanga bhasma*.

(Rasaratnasamuchchaya 5:160)

• Tests

Vanga bhasma should be tested with routine tests like *varitara*, *rekhapurnatva*, *apunarbhavata*, etc. The bhasma is white or yellowish-white in colour.

• Properties

Vanga bhasma is predominant in astringent taste, has a pungent post-digestive effect and is hot in potency. It possesses light, dry and hot attributes and alleviates *Kapha* and *Vata doshas*. It is rejuvenating, digestant, appetiser, aphrodisiac, immuno-stimulant in properties and also promotes intelligence.

• Uses

Vanga bhasma is used to treat various diseases like diabetes mellitus, anaemia, skin diseases like oozing eczema, leucorrhoea, tuberculosis. It is a highly esteemed remedy for sexual debility and oligospermia. As it boosts up *dhatu-agnis*, it facilitates the nourishment of all the body tissues and thus augments *ojas*, the quintessence. As it stokes

agni, it is used as an appetiser, and is also a digestant, hence is used as a general tonic.

• Dosage: 60 to 240 mg with honey or milk.

• Formulations

Vanga bhasma is one of the ingredients in the formulations like *Trivanga bhasma*, *Vasantakusumakar*, *Kasturibhairava*, *Suvarnarajavangeshwar*, *Vatavidhwansa*, *Ekangavira rasa*, *Lakshmivilasa rasa*, *Mahayogaraj guggulu*, etc.

(7) Naga (Lead)

• Synonyms: Lead i.e. *Naga* has various synonyms in Sanskrit, like *Sisaka*, *Sisa*, *Nagaka*, *Bhujanga*, *Ashivisha*, *Kuvaduka*, *Kuranga* and *Sindurakarana* etc.

• Name

English: Lead
Latin: Plumbum
Chemical symbol: 'Pb.'

• Occurrence

Nearly all lead ores are produced from mines. Many minerals contain lead, but the principal source of the element is *Galena* (PbS), a grey metallic ore. In its pure form, galena consists of only lead and sulphur. However, it rarely occurs in such a form in nature. Instead, most deposits of galena contain some copper, gold, silver and zinc. The other ores of lead include *Anglesite* ($PbSO_4$) and *Cerussite* ($PbCO_3$).

The occurrence of lead is widespread. It is found in Soviet Union, Australia, America, Canada, Mixcico and Peru. In India the lead mines are at Madras, Uttar Pradesh and Rajasthan.

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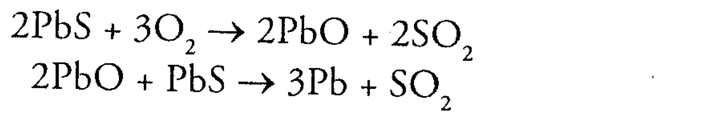
• Extraction

A good quality galena when heated with controlled heat, first forms lead oxide. It is called the method of 'air reduction'.



$$2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$$
$$2PbO + PbS \rightarrow 3Pb + SO_2$$

Most lead ores contain silver, and this metal is obtained from the lead by cupellation, repeated melting and crystallization, alloying with Zinc, or by electrolytic process. Sphalerite or blende is frequently associated with galena, and the presence of zinc causes difficulties in smelting, where mechanical separation is called for.

• Appearance

Lead is a bluish-grey, heavy metal, the freshly cut surface of which shows a bright metallic lustre, which is however, quickly lost on exposure to air. Due to oxidisation it is soft, may be scratched with the finger-nail, and makes a black streak on paper. When heated, it emits a foul odour.

(Rasaratnasamuchchaya 5:170)

• Physical Properties

(1) Lead is highly malleable, that is, it can be hammered or pressed into thin sheets.
(2) It has less ductility i.e. cannot be easily drawn into wire.
(3) When scratched, it makes a black streak on paper.
(4) Lead is a poor conductor of electricity.
(5) It resists corrosion by water and by sulphuric acid and by other powerful chemicals.
(6) Lead melts at 327.5°C and boils at 1740°C.
(7) Its density is 11.35 grams per cubic centimeter at 20°C.

• Varieties

Ayurvedic texts have mentioned two varieties of lead as

Kumara and *Shabala* or *Shamala*. No description about their individual properties or differences is available. It is not mentioned which variety is superior or inferior and hence, both of them are used.

• Purification

फलत्रिकजकषाये वा कुमारी रसे वा
करवीरसलिले वा गालयेत्सप्तवारम् ।
खरिददहनतप्तं लोहपात्रे स्थितं सत्
तदनु सपदि नागो जायते शुद्धभावः ।। (रसचण्डांशु p. 118:562)

Lead is heated in an iron vessel with the fuel of *Khadira* (Acacia catechu) wood. On melting it is quickly poured into the decoction of *triphala* or juice of *Kumari* (Aloe vera) or juice of *Karavira* (Nerium indicum) roots. The lead gets purified. (Rasachandanshu, pg. 118/562)

According to few texts, it can also be purified by pouring the molten lead into the latex of *Arka* (Calotropis procera) or juice of leaves of *Nirgundi* (Vitex negundo) or turmeric powder - *Haridra churna* (Curcuma longa).

• Incineration

अश्वत्थचिञ्चात्वग्भस्म नागस्य चतुरंशतः ।
क्षिपेन्नागं पचेत्पात्रे चालयेल्लोहचाटुना ।।
यावद्भस्म तदुद्धृत्य भस्मतुल्या मनःशिला ।
जम्बीरैरारनालैर्वा पिष्ट्वा रुद्ध्वा पुटे पचेत् ।।
स्वाङ्गशीतं पुनः पिष्ट्वा विंशत्यंशशिलायुतम् ।
अम्लेनैव तु यामैकं पूर्ववत् पाचयेत् पुटे ।।
एवं षष्टिपुटैः पक्वो नागः स्यात् सुनिरुत्थकः । (र.र.स. 5:181-83)

First of all the purified lead is melted over firein an iron vessel. To it, 1/4th quantity of each, the ash of the bark and skin of *Ashwattha* (Ficus religiosa) and *Amlika* (Tamarindus indica) is added repeatedly in small amount and the mixture is stirred well with an iron rod. When the whole

lead turns into a solid, powder form, it is transferred into a mortar. Equal quantity of pure realgar is added to it and the mixture is processed with the *Jambira* juice or a sour gruel and subjected to heating, by giving a *laghu puta*. On cooling on its own, the mixture from the sealed saucers is taken out and 1/20th of its part pure realgar is added into it, processed with *Jambira* (Citrus limonum) and subjected to *laghu puta*. This procedure is repeated till 60 *laghuputas* are given. The incineration of lead thus formed is de-revived (*niruttha*) one. (Rasaratnasamuchchaya 5:181-183)

It is also mentioned in the text that when the lead melted in an iron vessel is stirred with the root of *Palasha* (Butea frondosa) for 12 hours, the red coloured powder formed, is itself the lead calx. In practice, it is further processed with the decoction of the sticks of *Palasha* and the juice of *Kumari* (Aloe vera) to de-revive it.

• Tests

Routine tests are performed to assess the quality of *Naga-bhasma*. It is also tested for its de-revival (*nirutthatva*). For that *Naga bhasma* is heated in an iron vessel. If it forms into a lead pill, the *bhasma* is not of good quality and vice-versa. *Naga bhasma* is yellowish-scarlet in colour.

• Properties

Naga bhasma is bitter in taste, pungent in the post-digestive effect and very hot in potency. It alleviates *Vata* and *Kapha doshas*. It is unctuous in attribute and mitigates the *kleda* in the body.

• Uses

Naga bhasma is used to treat various diseases. It is a highly esteemed remedy for urinary disorders like dysuria, oliguria and diabetes mellitus. It also works well on genital

system and skin diseases associated with oozing and itching. It is used in treating colitis, leucorrhoea, *Vata* diseases, tumours, anaemia, sexual debility and diabetes, especially, associated with obesity.

• Dosage: 30 to 120 mg, with proper *anupana* as per disease.

• Formulations

Naga bhasma is one of the ingredients in preparations as *Vasantakusumakar, Trivanga bhasma, Nagasindura, Chandreshwara rasa, Dipika rasa, Nagendra rasa, Lakshmivilas, Ekangavira rasa, Mahavatavidhwansa* etc.

(8) Jashada (Zinc)

• Synonyms: Zinc i.e. *Jasada* has few synonyms in Sanskrit, like *Yasada, Yashada, Ritihetu* and *Kharparaj* etc.

• Name

English: Zinc.
Latin: Zinc.
Chemical symbol: 'Zn.'

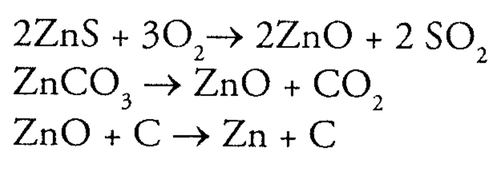
• Occurrence

Principal primary minerals of zinc being mined today are sulphide - Sphalerite or zinc blende (ZnS); oxide - Zincite (ZnO) and carbonate - Smithsonite or calamine ($ZnCO_3$). Secondary silicates like willemite, hemimorphite, sulphate like goslarite, basic carbonate as hydrozincite and oxide like franklinite are of diminishing importance.

The major producers of zinc are Canada, Russia, Australia and Peru, which currently are mining half of the worlds total. The rest comes from U.S.A., Mexico, China, Japan, Poland, Spain and Sweden.

• Extraction

Extensive communition followed by floatation is directed at separating zinc from lead, copper and as far as possible from iron. Roasting to ZnO is essential for all purpose. Further, the heating at high temperature with coal convert them into zinc. The chemical reactions in the process are as under :



$$2ZnS + 3O_2 \rightarrow 2ZnO + 2\,SO_2$$
$$ZnCO_3 \rightarrow ZnO + CO_2$$
$$ZnO + C \rightarrow Zn + C$$

• Appearance

Zinc is a shiny, bluish-white brittle metal, commonly found with other metals like iron, cadmium, arsenic and aluminium. Zinc is never found pure in nature.

• Physical Properties

(1) Zinc possesses a crystalline structure.

(2) Zinc melts at 419.58^{0}C and boils at 907^{0}C.

(3) It has specific gravity of about 7.15 grams per cubic centimeter at 20^{0}C.

(4) Zinc may be rolled out into sheets or drawn into wire between 100^{0}C and 150^{0}C, but it reverts to a brittle condition and may be readily powdered under the hammer.

(5) It is unaffected by dry air, but becomes superficially tarnished in moist air.

(6) It is soluble in dilute acids.

(7) At high temperature it burns in air producing a greenish-white flame.

• Varieties

Ayurvedic texts have mentioned two varieties of zinc, viz. *Jasada* and *Shavaka*.

• Approval

Out of two varieties, *Jasada* variety which is white, smooth, soft, heavy and melts quickly is acceptable. The other variety, *Shavaka* which is black as it contains iron, is not acceptable.

• Purification

जसदं गालयेत्पूर्वं दुग्धमध्ये तु ढालयेत् ।
एकविंशति वारांश्च खर्परः शुद्धिमाप्नुयात् ।। (रसचण्डांशु पृ. 121:574)

Melted zinc is poured into cow's milk. After repeating this procedure for 21 times, it gets purified.

(Rasachandanshu, pg. 121:574)

When heated in open air, it forms oxide like lead and tin and floats on the surface like a cream. Thus if it is heated for 21 times, major part of zinc will get burnt and lost. So it is recommended that during heating, it should be closed with a lid. In some texts it is mentioned that zinc is heated and dipped into slime water or in the root juice of *Nirgundi* (Vitex negundo) for 7 times, for its purification.

• Incineration

जसदस्य चतुर्थांशं पारदं गन्धकं तथा ।
मर्दयेत् खल्वके सम्यक् कन्या निम्बुरसैः पृथक् ।।
लेपयेत् तेन पत्राणि गजाह्वे पाचयेत् पुटे ।
एके नैव पुटे नैव भस्मसात् जसदं भवेत् ।।

(रसचण्डांशु पृ. 121:575-76)

Pure Mercury and sulphur are rubbed together and *Kajjali* is prepared. It is processed with aloe juice and lemon juice, once each. The paste of this mixture is coated on the sheets of zinc and subjected to heating by giving one *gajaputa*. The incineration of zinc gets ready.

(Rasachandanshu, pg.121/575-76)

Otherwise like lead and tin, zinc is melted in an iron vessel

and various minerals or herbs are mixed and stirred with it to prepare the *jasada bhasma*. The substances to be used have been mentioned as opium, leaves of *Bhanga* (Cannabis sativa), leaves of *Nimba* (Azadirachta indica), sugar and orpiment (*haratala*) etc.

• Tests

Routine tests like *varitaratva, rekhapurnatva, apunarbhavatva* etc. are carried out. The calx (*bhasma*) of zinc is yellowish-white in colour.

• Properties

Jasada bhasma is astringent and bitter in the taste, sweet in post-digestive effect and has cold potency. It alleviates *Kapha* and *Pitta doshas*.

• Uses

It is the choicest remedy for diabetes mellitus, anaemia and asthma. Because of its astringent property, it prevents the formation of *kleda* in body and hence is useful in diabetes mellitus as well as skin diseases associated with oozing and itching. It also helps preventing diabetic skin afflictions. It is one of the best panacea for diseases of the eyes. It works well in colitis, chronic infections of throat, tonsils, chronic wounds, and fistula and stomatitis. Externally, it is used in the form of ointments in wounds and tonsilitis.

• Dosage

60 to 240 mg, with proper *anupana*.
For external use, sufficient quantity required.

• Formulations

Jasada pushpa and *Trivanga bhasma*.

(9) Kansya (Bronze)

• Synonyms: Bronze i.e. *Kansya* has a few synonyms in Sanskrit as *Kansiya, Kansyaka, Ghoshaka, Ghoshapushpa* and *Vahniloha*.

• Names

English: Bell metal or white metal
Latin: Branz

• Bronze - An alloy

Bronze is an alloy made primarily of Copper and Tin, approximately in 8:2 proportion. The copper and tin are first melted and then mixed in a porportion desired and after cooling, bronze is formed.

• Appearance

Bronze is very hard and strong and blackish-red in colour. It may contain as much as 25% tin. Phosphorus, lead, zinc and other metals may be added for special purposes. For example, phosphorus hardens and strengthens bronze.

• Physical Properties

(1) Bronze is unaffected by dry or moist air.

(2) The hardest and strongest bronze contains much tin and little lead. As per requirement, different combinations are used to prepare bronze.
(3) Most bronze alloys resist corrosion, hence the statues made of bronze last hundreds of years.
(4) Because it is easily cast in large shapes, bronze is often used in making bells and cymbals. It also has special sound-damping characteristics that give these bells a rich tone.
(5) Bronze is malleable and thus can be drawn into sheets.
(6) It is little affected by acids.

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• Varieties

Two varieties of *Kansya* (bronze) have been mentioned in Ayurvedic texts, *Pushpaka* and *Tailika kansya.*

Pushpaka kansya: It is more whitish in colour than the other. It contains more percentage of tin. It creates high-pitched notes of sound, when struck.

Tailika kansya: This variety is blackish-yellow in colour and contains less percentage of tin.

The proportion of copper to tin ranges from 75:25 to 90: 10 in different preparations of bronze, as per requirement.

• Approval

Pushpaka kansya is used for medicinal prupose. It is blackish-white in colour, ductile, turns red when heated and creates high pitched notes of sound, when struck. It is soft and smooth.

• Purification

गोमूत्रे च कुलत्थानां कषाये च त्रिधा त्रिधा ।
एवं कांसस्य रीतेश्चः विशुद्धिः सम्प्रजायते ।।

Bronze is heated and dipped into cow's urine and decoction of *Kulattha* (Dolichos biforus) for 3 times each.

• Incineration

म्रियते गन्धातालाभ्यां निरुत्थं पञ्चभिः पुटैः ।
त्रिक्षारं पञ्चलवणं सप्तधाऽम्लेन भावयेत् ।।
कांस्याऽऽरकूटपत्रं च तेन कल्केन लेपयेत् ।।
रुद्ध्वा गजपुटे पक्वं भस्मी भवति निश्चितम् ।।

(र.र.स. 5:210-11)

The paste of sulphur and orpiment as well as *Trikshar* and *Panchalavana* is prepared by rubbing it in the lemon juice for 7 times. This paste, in equal quantity, is coated on the thin sheets of bronze and dried. Then it is properly sealed and subjected to one *gajaputa*. The mixture is then taken out and 1/20 part of it, the above mixture is mixed to it and processed with lemon juice. It is again subjected to one *gajaputa*. This procedure is repeated totally for 5 times. The incineration of bronze prepared is completely de-revived (*niruttha*).

(Rasaratnasamuchchaya, 5:210-211)

• Tests

Routine tests of *bhasma* like *varitaratva*, *rekhapurnatva*, *apunarbhavatva* etc. should be taken before use.

• Properties

Kasya bhasma is bitter, pungent in the post digestive effect and hot in potency . It alleviates *Vata* and *Pitta doshas*. It is light in attribute and is of *lekhana* property.

• Uses

Kasya bhasma i.e. incineration or calx of bronze is used in treating various skin diseases and worms. It improves the appetite and is beneficial to the eyes (*netrya*).

• Dosage: 60 to 120 mg, with honey.

(10) Pittala (Brass)

• Synonyms: Brass i.e. *Pittala* has few synonyms in Sanskrit, as *Pittalasa, Pitaloha, Ritika, Aar, Aarakuta, Kapiloha*, etc.

• English Name: Brass

• Brass - an alloy:

Brass is an alloy made primarily of Copper and Zinc. Other elements may be added to the alloy for special uses. The proportion of copper to zinc is normally 2:1 in brass.

Ayurvedic texts mention to take pure copper and pure

zinc together and to subject them for intense heating in a *garamusha* (crucible, prepared of roasted old clay 6 parts and *mandura*, black soil, coal and Bengal hemp, mixture). The intense heat melts both the metals and form homogeneous alloy, which gets solidified after pouring in liquids.

Modern Method of Making Brass

The first step in making brass is to melt copper in an electric furnace. Solid pieces of zic are then added to the melted copper. The zinc melts rapdily. A covering of charcoal is often placed over the liquid metals to reduce the loss of heat and to prevent an excessive loss of zinc by vaporization. After the copper and zinc have been melted and thoroughly mixed, the brass is ready for pouring. It can be poured directly into forms to cast the wanted articles, or it can be made into bars called *billets*. Such bars make it easier to work with the brass or to store it.

Workers may cut off the top of the brass bar. This portion, which became solid last, contains impurities and is porous. The billet is then placed in another furnace and reheated until it reaches the proper temperature for working.

• Appearance

Commonly brass is a yellow coloured, shiny alloy. Its cut surface is more shining. It becomes harder than individual copper and zinc.

The amount of copper used in brass ranges from 55% to more than 95%. The colour and properties of brass vary with its compositon.

When the alloy contains about 70% copper, it has a golden yellow colour and is known as *yellow* brass, *high* brass or *cartridge* brass. When it contains 80%, or more copper, it

has a reddish copper colour and is known as *red* brass or *low* brass. *Muntz metal* contains 60% copper and 40% zinc. Alloys that have a high copper content are almost as soft as pure copper. But as zinc is added, they become stronger and tougher. Compositions of 55% copper and 45% zinc are hard and somewhat brittle.

• Physical Properties

(1) The brass is hard and possesses ductility and malleability.
(2) It is unaffected by dry weather, but moisture causes the loss of its yellowishness and shine and it turns blackish.
(3) Brass is unaffected by pure water.
(4) The substances of acidic nature act with the copper contents of the brass and turn it into greenish colour because of salts formed.
(5) Alloys containing upto 30% zinc are ductile and formable.
(6) Alloy containing 40% zinc is stronger and can be worked at higher temperature.
(7) The alloys are resistant to atmospheric and marine corrosion.

• Varieties

Two varieties viz. *Ritika* and *Kakatundi* are mentioned in Ayurvedic texts.

Brass is intensely heated and dipped into sour gruel. When it turns into reddish colour like copper, it is known as *Ritika* and when blackish, it is called as *Kakatundi.*

• Approval

Brass, which is soft, heavy, yellow, unctuous looking, smooth and can withstand stroking is acceptable. *Ritika* variety is acceptable, as it is made up of pure copper and

pure zinc. Whereas, *Kakatundi* is not acceptable as it contains impurities.

• Purification of Brass

तप्त्वा क्षिप्त्वा च निर्गुण्डीरसे श्यामारजोऽन्विते ।
पञ्चवारेण संशुद्धिं रीतिरायातिनिश्चितम् ।।

(र.र.स. 5:197)

Ritika Pittala is heated intensely and dipped into the juice of *Nigundi* (Vitex negundo) which is mixed with turmeric powder. This procedure is repeated for 5 times to purify the brass. (Rasaratnasamuchchaya 5:197)

Instead of *Nigundi*, various other liquid substances like cow's urine, a mixture of horse's and cow's urine, seasame oil, buttermilk or decoction of *Kulattha* (Dolichos biflorus) are used for dipping the heated brass.

• Incineration

निम्बूरसशिलागन्धवेष्टिता पुटिताऽष्टधा ।
रीतिरायाति भस्मत्वं ततो योज्यो यथायथम् ।
ताम्रवन्मारणं तस्याः कृत्वा सर्वत्र योजयेत् ।।

(र.र.स. 5:198-99)

The paste of pure sulphur and pure realgar (*manahshila*), rubbed in lemon juice is prepared. It is coated on the purified sheets of brass and subjected to *putapaka*. After repeating the procedure for 8 times, the incineration (*bhasma*) of brass gets ready. (Rasaratnasamuchchaya 5:198-99)

(Incineration of brass can be done by the procedures similar to those, used to prepare incineration of copper).

While preparing calx of brass, the proportion of pure sulphur and pure realgar should be equal to that of brass during first *puta*. Then onwards, for remaining seven *putas* it should be 1/20th of the brass.

• Tests

Routine tests for *bhasma* like *varitaratva*, *rekhapurnatva*, *apunarbhavatva* etc. should be carried out to assess the quality of *Pittala bhasma*. Moreover, the test '*nishkalanka*' should also be performed, which is done for *tamra bhasma*. *Pittala bhasma* is blackish in colour.

• Properties and Uses

Pittala bhasma is cold in potency, dry in attribute and *yogavahi*. It alleviates *Kapha* and *Pitta doshas*.

It is useful in diseases like bleeding disorders, ascites, worms, skin diseases and hepatosplenomegaly. In practice, *Pittala bhasma* is seldom used.

• Dosage: 60 to 120 mg, with proper *anupana*.

Table showing particulars of the metals

No.	*Metal*	*Symbol*	*Atomic No.*	*Atomic Wt.*	*Melting Point (°C)*	*Boiling Point (°C)*	*Density ($Kgx10^3/m^3$)*
1	Gold	Au	79	196.967	1064.43	2807	19.32
2	Silver	Ag	47	107.870	961.0	2193	10.49
3	Copper	Cu	29	63.54	1083.4	2567	8.96
4	Iron	Fe	26	55.847	1535.0	3000	7.874
5	Tin	Sn	50	118.69	231.9	2270	7.3
6	Lead	Pb	82	207.19	327.5	1740	11.35
7	Zinc	Zn	30	65.37	419.58	907	7.15
8	Bronze	(Alloy)	-	-	-	-	-
9	Brass	(Alloy)	-	-	-	-	-

Particulars of Bhasmas of Metals

No.	Name	Taste	P.D.E.	Potency	Attributes	Doshas Alleviated	Therapeutic Uses	Dose
1.	Gold (*Suvarna*)	Sweet Astringent Bitter	Sweet	Cold	Unctuous Rejuve-native	Vata, Pitta	Rejuvenating, Augments memory, semen, intelligence, strength. Detoxifier, Strengthens Heart, Vessels.	30 to 120 mg
2.	Silver (*Roupya*)	Sour Sweet Astringent	Sweet	Cold	Unctuous, Nervine	Vata, Pitta	Nervine, tonic Works well in paralysis, diseases of eyes and muscles	30 to 60 mg
3.	Copper (*Tamra*)	Bitter Astringent	Sweet	Hot	Sharp, Cholego-gue	Kapha, Kapha-Vata	Enlargement of Liver and Spleen, Anaemia, Colitis, Anasarca, Ascites	60 to 120 mg
4.	Iron (*Loha*)	Astringent	Sweet	Cold	-	Kapha, Pitta	Rejuvenator, Anaemia, Piles, Dermatoses, Lever and Spleen diseases.	125 to 250 mg

No.	Name	Taste	P.D.E.	Potency	Attributes	Doshas Alleviated	Therapeutic Uses	Dose
5.	Tin (*Vanga*)	Astringent	Pungent	Hot	Hot, Dry Sharp	Kapha, Vata	Diabetes, Sexual debility Dysmenorrhoea, Dermatoses.	60 to 240 mg
6.	Lead (*Naga*)	Bitter	Pungent	Hot	Unctuous	Vata, Kapha	Urinary and Skin diseases. Diabetes, Tumours.	60 to 120 mg
7.	Zinc (*Jasada*)	Astringent, Bitter	Sweet	Cold	Dry	Kapha, Pitta	Diseases of eyes, Diabetes, Tonsillitis, Colitis	60 to 240 mg
8.	Trivanga (No 5+6+7) Combination of Vanga, Naga and Jasada.	-	-	-	-	-	Secondary. Sterility in males and females, Abortion, Sexual debility, Diabetes.	120 to 240 mg

P.D.E. = Post Digestive Effect (*Vipaka*).

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Chapter 16
Gemstones & Semiprecious Stones

GEMSTONES

Throughout the ages, gemstones have been a symbol of wealth and power. Symbols of supremacy, from crown to richly decorated robes, ornaments, vessels and even weapons have traditionally been adorned with jewels. The mysterious appeal of gemstones, their exquisite colours, and the play of light within them, would alone have made them precious to many, but their rarity, hardness and durability have made them doubly valuable. There are over 3,000 different minerals, but only about 50 are commonly used as gemstones.

Ancient Ayurvedic texts of Rasashastra had mentioned the use of gemstones for medicinal purpose. Detailed study of gemstones is mentioned for their use to make Mercury stable, to alleviate the diseases and enhance the longevity, to avert the ill effects of planets and to use them in medicinal preparations as their ingredients. Hence the study of gemstones is incorporated in Rasashastra.

Definition of Gemstones

धनार्थिनो जनाः सर्वे रमन्तेऽस्मिन्नतीव यत् ।
अतो रत्नमिति प्रोक्तं शब्दशास्त्रविशारदैः ।। (आयुर्वेदप्रकाश 5:2)

The substance, which attracts the individuals who wish to become rich and prosperous, is called as *Ratna* (gemstone). It simply conveys the meaning that the gemstones are beautiful and they attract the people.

(Ayurveda Prakash 5:2)

जातौ जातौ यदुत्कृष्टं तद्धि रत्नं प्रचक्षते ।
रत्नं च वरपाषाणं रमनो यत्र मानवाः ।। (रघुवंश सर्ग 16)

The substance which is the best in qualities amongst the class is said to be a *ratna* (gemstone). (Raghuvamsha 16)

Both the definitions mentioned above are inadequate to really define the gemstone.

To be regarded as a gemstone, a mineral (or occasionally an organic material) must be beautiful, most importantly in its colour. A gemstone must also be durable - hard enough to survive constant use or handling without becoming scratched or damaged. Finally, it must be rare, because its very scarcity endows it with a greater market value. Gems are scientifically fascinating too. The science of gems is known as 'Gemmology'. Gemmologists make a complete study of each stone, both as it is found in rocks and after it has been cut and polished. A micro-photograph of a gem reveals the internal structure of the stone by magnifying it many times. A gemmologist may turn detective, being able to distinguish between two outwardly similar stones, or between a natural stone and a fake one.

Salient Properties of Gemstones

(1) The gemstones are commonly mineral in origin. A few gems, like amber, pearl and coral, come from plants or animals, and are known as organics.
(2) Majority of the gemstones are crystals and have peculiar constant shapes. They are found in rocks, or in gem gravels derived from these rocks. They are formed during the crust formation of the earth, when it cooled gradually.
(3) They are either transparent or opaque and possess characteristic colours.
(4) Commonly the gemstones are hard, especially, those who have a mineral origin.

A substance in which properties mentioned above are present in definite proportion are called as a gemstone (*Ratna*). Hence a gemstone which is (mineral or organic), beautiful, colourful, durable and rare becomes the most valuable entity.

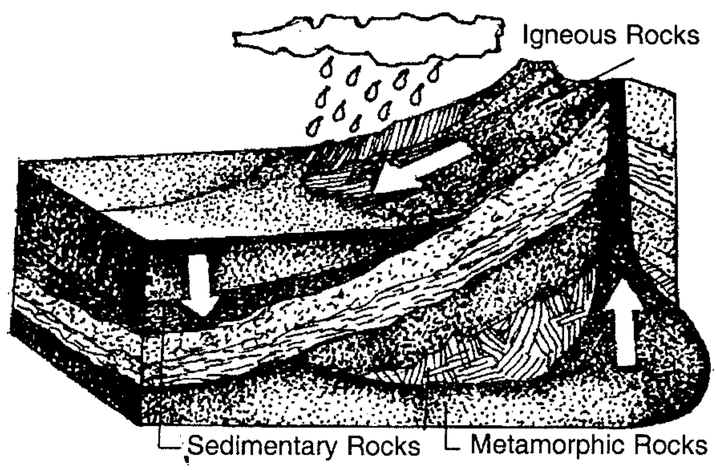
The Five Gemstones

The following five gemstones are reckoned to be gems of superior quality and are most highly prized. The group is collectively known as *Pancha ratna*.

1. Ruby (*Padmaraga* or *Manikya*)
2. Blue Sapphire (*Indranila*)
3. Emerald (*Tarkshya*)
4. Yellow Sapphire (*Pushparaga*)
5. Diamond (*Vajra* or *Hiraka*).

How Gemstones Are Formed

The gemstones of mineral origin are found in rocks. Rocks themselves are made up of one or more minerals, and may be divided into three main types.



Metamorphic rocks are formed by heat and pressure within the Earth. Gemstones grow within them. Garnet for example, form in rocks called mica schists, which were once mudstones and clays. Marble, formed from limestone that has been subjected to intense pressure and high temperatures, may contain rubies.

Sedimentary rocks are formed by accumulation of the rock fragments produced by weathering. In time, these fragments settle down and harden into rock, in layers. Australian opal, halite and gypsum are the examples. Also turquoise (*Peroja*) occurs mainly as veins in sedimentary rocks such as shale.

Igneous rocks have solidified from molten rock, which comes from deep beneath the Earth's surface. The slower a rock cools and solidifies, the larger the crystals, and therefore the gemstones, are formed within it.

Classification of Gemstones

There are various means and methods to categorise the gemstones. Mainly, by considering four aspects, we can classify the gemstones, in general as follows:

(A) Structure of the gemstones (crystal systems)
(B) Relation of gemstones to the planets.
(C) Opacity and transparency of gemstones.
(D) Beauty and scarcity of gemstones.

(A) Crystal Systems

As per the shapes of crystals, there are 7 different types of gemstones.

(1) Cubic: The gemstones in the cubic system have the highest symmetry. Their length, breadth and height is equal, e.g. Diamond (*Vajra*).

(2) Tetragonal: This system is defined having four-fold axis. e.g. Zircon.

(3) Hexagonal: Hexagonal crystals have six-fold symmetry. e.g. Ruby, Blue sapphire, Emerald .

(4) Trigonal: These have three-fold symmetry. e.g. Spinel

Ruby (*Suryakant*), Rock crystal (*Sphatika*), Yellow sapphire.

(5) Monoclinic: This system has a minimum symmetry of one two-fold axis. e.g. Albite. They are usually linear, having less width, e.g. moonstone.

(6) Orthorhombic: The minimum symmetry of this system is three two-fold axes. e.g. Cat's eye (*Vaidurya*).

(7) Triclinic: These crystals have no axis of symmetry, so the gemstones within this system are the least symmetrical. e.g. Spinel Ruby (*Suryakant*).

(B) Gemstones Favourite to the Planets

It is firm belief in almost all the cultures of the world that the planets have certain effects on the human body. These effects, good or bad, can be augmented or averted by wearing certain gemstones, which are said to be favourite of those planets. They are as follows:

Sun - Ruby
Moon - Pearl or Yellow sapphire
Mars - Coral
Mercury - Emerald or Pearl
Jupiter - Yellow sapphire or Emerald
Venus - Diamond
Saturn - Blue sapphire
Dragon's head (*Rahu*) - Hassonite
Dragon's tail (*Ketu*) - Cat's eye

(C) Opacity and Transparency of Gemstones

The individual crystalline structure of a gemstone interacts with light in unique way and determines the optical properties of each gem species. Effects produced by light passing *through* a gem (transparency) and those produced by the *reflection* of light (opacity) are the unique characteristics of a

gemstone. The gemstones like diamond, sapphire and ruby are so structured that light entering them gets completely refracted internally and hence produce beautiful play of light, whereas zircon, topaz and cat's eye are opaque and mearly reflect the light from their polished surfaces.

(D) Beauty and Scarcity of Gemstones

The beauty of a gemstone mainly depends upon its colour. The colour of a gem depends largely on the way it absorbs light. Each gem in fact has a unique colour "fingerprint" (known as its absorption spectrum). Hardness is one of the key qualities of a gemstone, which makes it more durable. The shape, weight and scarcity adds to the qualities and the gemstones become more valuable. The gemstones like diamond and ruby are the most valuable ones than yellow sapphire, emerald and pearl. Whereas hassonite, garnet and coral fall in the ordinary category.

Physical Properties of the Gemstones

The physical properties of gemstones like their hardness, their specific gravity or density, and the way they break or "cleave", depend on chemical bonding and the atomic structure within the stone. For example, diamond is the hardest natural material known, and graphite is one of the softest, yet both are made up of the same element, carbon.

(1) Hardness

Hardness is measured how well a stone resists scratching. Every stone can be tested and classified using Mohs' scale of hardness, which gives every mineral a figure from 1 to 10. The scale was devised by the German mineralogist Friedrich Mohs. According to Mohs' scale, the hardness of Talc - 1, Gypsum - 2, Orthoclase - 6, Quartz - 7, Topaz - 8, Corundum - 9 and of the Diamond is 10.

(2) Specific Gravity

The specific gravity (SG) of a gem is an indication of its density. It is calculated by comparing the stone's weight with the weight of an equal volume of water. The greater a stone's specific gravity, the heavier it will feel. For example, a ruby (SG 4.00) will fell heavier than an emerald (SG 2.71) of similar size.

(3) Cleavage and Fracture

Gems cleave and tend to break along planes of weak atomic bonding. When a gemstone breaks along a surface which is not related to its internal atomic structure, is called as fracture. Fracture surfaces are generally uneven.

Optical Properties of the Gemstones

(1) Colour

Colour is the most obvious visual feature of a gem, but in fact it is just one of many optical properties. White light is made up of the rainbow (spectral) colours, and when it is incident upon a gem some spectral colours are absorbed. Those that are not absorbed, pass through or gets reflected back, giving the gem its colour.

Allochromatic gems are coloured by trace elements or impurities that are not essential part of their chemical composition. For example, corundum is colourless when pure, but impurities (usually a metal oxide) in it create the red stones we know as rubies, blue-green and yellow sapphires. The colour of idiochromatic gems comes from elements that are essential part of their chemical composition. For example, peridot, is always green as its colour is derived from its essential constituent, iron. Pleochroic gems exhibit different shades, viewed from different directions.

(2) Refractive Index

When a ray of light meets the surface of a gemstone, some light is reflected, but most passes in. Because it has a different optical density from air, the light slows down and is bent from its original path (refracted). The amount of refraction within a gem is called its refractive index (RI). The refractive index is measured with the help of an instrument known as refractometer. Refractive index of diamond is 2.42.

(3) Double Refraction (DR)

Phenomenon in which each ray of light is split in two as it enters a non-cubic mineral. Each ray travels at a different speed and has its own refractive index. The difference between the two gives double refraction (DR) i.e. birefringence. For example, ruby and topaz possess this optical property.

(4) Lustre

The overall appearance of a gemstone, its "lustre" is determined by the way light is reflected from its surface. It is related to the degree of surface polish. Gemmologists use a variety of terms to describe lustre and its degree of intensity. For example, "splendent" means the stone that reflects light like a mirror. "Earthy" or "dull" means the light is reflected little. Stones with a lustre comparable to diamond are described as "admantine". The faceted gems have a glass-like, most transparent, "vitreous" lustre. The precious metals have a "metallic" lustre. The organic gems show a range from "resinous" to "pearly" and "waxy" lustre.

(5) Stars

Some precious stones do have patterns, like lines, spots, or an opened umbrella, or stars. These patterns continue to

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appear even if the stone is polished. They reduce the attractive quality of stones. Such stones are not subjected to cutting and facetting.

Natural Inclusions (Defaults or Flaws) of Gemstones

Defaults of the stone are internal features of gems. They may be solids, liquids or gases that the crystal enclosed as it grew, or cleavages, cracks and fractures that filled (or partly filled) after the host material finished growing.

Although usually regarded as flaws such defaults today are often seen as finger printing of a stone. They can also be invaluable in identifying a gem, because some are peculiar to a particular species, while others occur only in a particular locality.

Ayurvedic texts have mentioned five types of flaws, which are as follows:

ग्रासत्रासश्च बिन्दुश्च रेखा च जलगर्भता ।
सर्वरत्नेष्वमी पञ्च दोषाः साधारणा मताः ।।
क्षेत्रतोयभवा दोषा रत्नेषु न लगन्ति ते । (र.र.स.4:33)

The common most five types of flaws observed in the gemstones are *grasa* (opacity), *trasa* (varience in colour), *bindu* (dots), *rekha* (lines) and *jalagarbhata* (resembling a water-drop or bubble). (Rasaratnasamuchchaya 4:33)

The flaws commonly observed in the gemstones are briefed.

Grasa:Some part of a gem is opaque or possesses a black coloured part.

Trasa:The gemstone possesses other than its natural colour, in addition.

Bindu:Different coloured dots are observed in a gemstone, which are normally absent.

Rekha:There are few lines in the structure of a gemstone, where it many a times splits.

Jalagarbhata:The opacity in a gemstone resembles to a water drop. In reality it is not related to water at all.

The gemstone becomes more valuable when it has minimum flaws. All these aspects are concerned about a gemstone with reference to its valuation as an ornamental asset. Gemstones, in Ayurvedic pharmacy, undergo the processes like incineration and their preparations in a form of fine powders, and hence it may not be possible to prepare medicines from such costly gemstones. Basically, the medicinal preparations of ruby, coral and diamond are very sparingly used and moreover, their manufacture is a costly affair. While preparing *bhasma* of these gems, instead of stones, their fillings is commonly used, which are formed during cutting.

We will study gemstones and semiprecious stones in brief, with considering various aspects about their synonyms, occurrence, physical properties, purification, powdering, properties, medicinal usage with their dosage and media of intake.

(1) Manikya (Ruby)

• Synonyms: Ruby is also known by various names in Sanskrit, like *Rangamanikya, Padmaraga, Raviratna, Kuruvinda, Lohita, Vasuratna, Laxmipushpa, Arunopala, Shonopala, Shonaratna* etc.

• English Name: Ruby or Burma Ruby. (Family-Corundum)

• Occurence

Ruby is found in Burma, Sri Lanka, Africa and in India - Karnataka state and Katak.

• Characteristics

It is red in colour, heavy, clear and possesses dichroic property i.e. it depicts two colours. It is star-shaped, before faceting.

• Properties

1. It is red in colour and heavy.
2. Its hardness is 9, as per Mohs' scale.
3. Refractive Index - 1.76.
4. With heat, it cracks or becomes dull in lustre.
5. Chemical composition of *Ruby* is Al_2O_3. It chiefly contains aluminium and oxygen and traces of iron oxides render red colour to it.

• Varieties

Four varieties of *Manikya* have been mentioned in Ayurvedic texts.

(1) ***Padmaraga Manikya:*** It is lotus-coloured (i.e. whitish red), lustrous, transparent, parabolic shaped, heavy, smooth, highly bright and pleasant.
(2) ***Nilagandhi Manikya:*** Generally obtained from the bed of the river - *Nila ganga.* It is red in colour with a bluish lustre emerging from inside.
(3) ***Kuruvindaja Manikya:*** It grows from a stone named *Kuruvindam* (corundum), is highly red and beautiful.
(4) ***Saugandhika Manikya:*** It grows out of *Sugandhika* (spinel), is yellowish red.

Out of four varieties, the first two are common and have similar properties. Thus these two varieties are used for medicinal purpose.

• Approval

The rubies with defects like holes, absence of lustre, roughness, flatness, lightness, deformity of size and absence of transparency etc. are not accepted to be used for medicinal purpose. Heaviness, transparency, roundness, uniformity and brilliance are its acceptable qualities.

• Purification

शुद्ध्यत्यम्लेन माणिक्यं जयन्त्या मौक्तिकं तथा ।

(र.र.स.4:60)

Manikya is purified by steaming it in the sour juice for three hours. The sour juice of lemon is commonly used. After steaming, *Manikya* is washed with hot water.

(Rasaratnasamuchchaya 4:60)

• Incineration

लकुचद्रावसम्पिष्टैः शिलागन्धकतालकैः ।
वज्रं विनान्यरत्नानि म्रियतेऽष्टपुटैः खलु ।। (र.र.स.4:63)

For the incineration of *Ruby*, it is taken in equal quantity, along with orpiment, realgar and sulphur . All these, together, are rubbed with the juice of *Lakucha*, a sour fruit. Then it is sealed in saucers and subjected to *gajaputa* for 8 times. With this procedure, except diamond, the incineration of all gemstones can be obtained. Though it is mentioned, the incineration of coral and pearl are not prepared by this method. As both possessing cooling property, are first rubbed with rose water or cow's milk and then subjected to *gajaputa* for 2 to 3 times. Incineration of other gemstones is prepared by *putapaka* method.

(Rasaratnasamuchchaya 4:63)

After preparing an inceneration of a gemstone, it cannot be predicted exactly about the final product formed. By addition of orpiment and realgar and rubbing with them, the *bhasma* will contain traces of arsenic. In unani system, the ruby is used in the form of its fine powder (*pishti*).

• Properties and Usage

A ruby duly purified and incinerated increases appetite and works well as aphrodisiac. It alleviates *Kapha* and *Vata doshas*. It augments the body strength, improves memory and exerts anti-tubercular effects. It also averts evil spirits.

• Dosage: 30 to 60 mg. with honey.

(2) Mukta (Pearl)

• Synonyms: Pearl has various synonyms in Sanskrit like *Mukta, Muktaphala, Shuktija, Shashiratna, Niraja, Induratna, Shashipriya, Shoukteya, Sindhujata* etc.

• English Name: Pearl and Margorita (Latin).

• Occurrence

Naturally pearls have been harvested from the Persian Gulf, the Gulf of Mannar (Indian Ocean), and the Red Sea for thousands of years. Both freshwater and saltwater pearls are cultivated in Japan and China.

• Characteristics

A good pearl is agreeable to eye-sight, white, appears to be smeared with oil, big in size, globular, bright and clear as water.

• Genesis of Pearl

Pearl is an organic gem. Natural pearls form around foreign bodies that have made their way inside the shells of marine or freshwater shells. Commonly, the pearl are obtained from Pearl Oyster, which secrete their own secretions as a natural defence, when an irritant-foreign body (such as a piece of grit) enters the shells. The secretions invade the foreign body and get solidified. Further, many more layers are formed of these secretions, from which, the pearl is finally formed.

There are two types of secretions, of which the first is translucent, which is chemically $CaCO_3$ i.e. calcium carbonate. The other type of secretion is, more transparent, which is chemically 'Canchialian' - $C_{30}H_{48}N_2O_2$. The rays of light get reflected from these various layers, at different depths and planes, and thus the pearl looks beautiful.

Cultured pearls are produced artificially in large fisheries, many in the shallow waters off the shores of Japan and China. The oyster shells are opened, a small piece of foreign body is introduced inside the shell and it is closed again and reintroduced in water. The so called 'cultured' pearls cannot be differentiated from 'Natural' pearls.

• Properties

1. Pearl is orthorhombic in structure and opaque, bright, white in colour with blackish, pinkish or bluish tint.
2. Its hardness is 2.5 - 3.5 as per Mohs' scale.
3. Specific gravity 2.67 - 2.75.
4. Chemical composition of pearl is $CaCO_3$, $C_3H_{18}N_9O_{11}nH_2O$.

• Varieties

Pearl grows in fish, elephant, boar, conch, frog, bamboo and oyster. As per its origin, it is called as elephant-pearl, fish-pearl, bamboo-pearl, conch-pearl and oyster-pearl etc.

• Approval

A good pearl is white, bright like moon rays, looking unctuous, big in size and round shaped. It is used for medicinal purpose. Whereas, a bad pearl is devoid of brightness, tawny-coloured, half-white, resembling salt in appearance, should be rejected.

• Purification

जयन्तीस्वरसेनेह दोलायन्त्रे विधानतः ।
यामैकं सततं स्विन्नं मौक्तिकं शुद्धिमाप्नुयात् ।। (रसतरंगिणी 23:67)

The pearls are purified by steaming in the juice of the leaves of *Jayanti* (Sesbania egyptica) for three hours, with the help of *dola yantra.* Various methods have been mentioned in the texts for the purification of pearls. The pearls are also purified by dipping them in the sour juice, especially of lemon, or sour buttermilk for three days. Every day, the juice is changed and replaced.

(Rasatarangini 23:67)

• Incineration

विमलं मौक्तिकं गव्यपयसा परिपेषितम् ।
त्रिधा लघुपुटे पक्वं मृतं स्याच्छशिसुन्दरम् ।। (रसतरंगिणी 23:70)

The purified pearls are rubbed with the cow's milk and then subjected to heating in *laghu puta* for three times. Snow-white incineration of the pearls is obtained. Instead of cow's milk, purified pearls are processed with rose water and subjected to three *laghu putas.* As the pearls are of cooling property, instead of giving heat treatment, the purified pearls are processed with rose water for 21 days and finally powdered, and used for medicinal purpose.

(Rasatarangini 23:70)

• Properties and Usage

Mouktika bhasma possesses cold potency and hence is highly esteemed in alleviating the aggravated *Pitta dosha* by its hot and sharp attributes. It is the cardinal remedy for high fever, burning sensation in the body and bleeding disorders like *raktapitta.* It also strengthens the heart and alleviates palpitation, chest pain and fatigue. It arrests bleeding through sputum (haemoptysis) in tuberculosis.

It also alleviates *Vata dosha* and increases the vitality and longevity.

• Dosage: 30-120 mg; with milk or sugar.

• Formulations

Brihadvatachintamani, Praval-panchamrita, Kamadudha, Laxmivilasa, Vasantakusumakar, Suvarnamalinivasanta etc. contain *Mouktika bhasma* as one of the ingredients.

(3) Pravala (Coral)

• Synonyms: Coral i.e. *Pravala* has various synonyms in Sanskrit, like *Pravalaka, Bhoumaratna, Vidruma, Abdhijatu, Angaraka, Visheshottha, Latamani, Raktakanda, Raktanga* etc.

• English Name: Coral.

• Occurrence

Most precious coral is found in warm waters. Japanese coral is red, pink or white; which is also found on the Mediterranean and African coasts. Black and golden coral is found off the coasts of West Indies, Australia, and the Pacific islands.

• Characteristics

Most corals are red, white and bluish in colour. The surface of these coral "branches" has a distinctive patterning made by the original skeleton - either stripped or like wood grain. Black and golden corals are made of a horn-like substance called conchiolin.

• Genesis of a Coral

Coral is made up of the skeletal remains of marine animals called Anthezoa polypus. These tiny creatures live in colonies which form branching structures as they grow, eventually forming coral reefs and atolls.

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• Properties

Coral is opaque, red in colour. The white and grey coloured corals are harder than red one. Red coral is the most valuable as a jewel and a medicine as well. Its hardness is 3 and S.G. 2.6.

• Varieties

According to their colour, main three types are white, grey and red. Another categorisation is done by which part of coral is use. The basal part is known as *Pravala mula*, whereas the porous tubelike branches above the base are called as *Pravala kanda*. Both are similar in their properties.

Coral may be imitated by porcelain, stained bone, glass, plastic, or rubber and gypsum mixtures.

• Approval

Saffron red coloured like heavy, unctuous looking, oblong, even and smooth coral should be accepted for medicinal purpose. Though the basal part (*Pravala mula*) and branches (*Pravala kandi*) have similar properties, the branches i.e. *Pravala kandi* is recommended for medicinal use.

• Purification

जयन्त्याः स्वरसेनेह दोलायन्त्रे तु विद्रुमम् ।
यामैकं सुपरिस्विन्नं शुद्धिमायात्यनुत्तमाम् ।। (रसतरंगिणी 23:131)

The corals are purified by steaming in the juice of the leaves of *Jayanti* (Sesbania egyptica) for three hours with the help of *dola yantra*. (Rasatarangini 23:131)

Corals can also be purified by dipping them in diluted lemon juice for 3 to 4 hours. It can also be purified by steaming in the juice of *Tandulaja* or *Tanduliya* (Amaranthus spinosus).

• Incineration

Pravala bhasma is prepared by three methods and they are known as (i) *Chandraputi;* (ii) *Suryaputi*; (iii) *Agniputi.*

(1) ***Chandraputi pravalabhasma:***Purified corals are triturated, in the mortar of stone, with the rose water and the mixture is dried in moonlight. The process is repeated for 21 times, thus fine powder obtained is known as *Chandraputi pravalabhasma* or *Pravala pishti*. It is believed that the moonlight augments the cooling property of coral. It is pinkish in colour.

(2) ***Suryaputi pravalabhasma:***Similar procedure as mentioned above is followed, the only difference is the mixture is dried in sunlight. The fine powder of coral obtained is called as *Suryaputi pravalabhasma.* It is pinkish white in colour.

(3) ***Agniputi pravalabhasma:***In this method the purified corals are first processed with the aloe juice and then subjected to heating in *laghu putas*. The process is repeated for three times. The final preparation is a white coloured fine powder, called as *Agniputi pravalabhasma.*

• Properties and Usage

Pravalabhasma alleviates *Pitta* and *Kapha doshas.* In diseases caused by aggravation of *Pitta dosha,* due to its hot and sharp attributes, *Chandraputi Pravalabhasma* is the drug of choice. In diseases of *Kapha dosha* dominence, *Suryaputi* or *Agniputi pravalabhasma* is used.

Pravalabhasma, in general, is useful in burning sensation of the body, eyes, hands and feet due to aggravated *Pitta dosha.* It also relieves high fever. It arrests the bleeding, in *raktapitta*, through nose, urine, faeces etc. It is also useful in cough, tuberculosis and pleurisy; of *Kapha* origin.

• Dosage

240 - 480 mg. with milk, milk with sugar in *Pittaja* disorders and with honey in *Kaphaja* diseases.

• Formulations

Pravalabhasma is one of the ingredients of *Pravala panchamrita, Panchamrita guti, Brihadvatachintamani, Vasantakusumakar, Putapakvavisha, Jvarantakaloha, Kamadudha* etc.

(4) Tarkshya (Emerald)

• Synonyms: *Tarkshya* i.e. Emerald, has various synonyms in Sanskrit, like *Marakata, Garutmata, Rouhineya, Garudankita, Souparni, Budharatna* etc.

• English Name: Emerald (Family - Beryl).

• Occurrence

Emerald is found in granites, pegmatites and schists; as well as alluvial deposits. The finest emeralds are from Colombia. Other sources are Austria, Australia, India, Brazil, South Africa, Egypt, U.S., Norway and Zimbabwe.

• Characteristics

Emerald derives its beautiful green colour from the presence of chromium and vanadium. It has hexagonal crystal system and possesses dichroic optical property, i.e. it exhibits two colours viz. green and blackish green. It is a transparent gemstone.

• Properties

Emerald has 7.5 hardness as per Mohs' scale and its specific gravity is 2.7 or 2.89. Refractive index of emerald is 1.57. It fades out when exposed to heat. The chemical composition of Emerald is $Be_3Al_2\ (SiO_3)_6$. It contains beryllium, aluminium and silicon in oxide form.

• Approval

The features of a good Emerald are green colour, softness, heaviness, brightness and radiating rays. It is approved as a quality gemstone and is used for medicinal purpose. A bad Emerald is tawny, rough, flat-shaped and light.

• Purification

सुरभीपयसा यामं दोलायन्त्रे विधानतः ।
विपाचितं मरकतं विशुद्ध्यति सुनिश्चितम् ।। (रसतरंगिणी 23:107)

It is purified by steaming (*swedan*) in cow's milk for three hours, with the help of *Dola yantra*. (Rasatarangini 23:107)

• Incineration

माणिक्यमारणोद्दिष्टविधिभ्यामतियत्नतः ।
अष्टधा पुटितं तार्क्ष्यं म्रियतेऽत्र न संशयः ।। (रसतरंगिणी 23:108)

Like *Manikya bhasma* procedure, Emerald gets incinerated when subjected to heat for 8 times in *gajaputa*. For that, first it is taken in equal quantity, along with orpiment, realgar and sulphur and rubbed with the sour juice of *Lakucha* fruits. Then it is sealed and subjected to *gajaputa*, for eight times. A fine powder of Emerald is formed.

(Rasatarangini 23:108)

• Properties and Usage

Incineration of Emerald alleviates all three *doshas*, when aggravated. It stimulates appetite, increases vitality and strength and augments *ojas*. It works well as an aphrodisiac. It eliminates the toxins and oedema and is beneficial to heart.

• Dosage

30-120 mg. with appropriate *anupana*, as per requirement.

(5) Pushaparaga (Yellow Sapphire)

Until the end of 19th Century "Yellow Sapphire" was known as "Oriental Topaz" (only blue corundum was called sapphire). At present, the stone of Jupiter marketed in India, is not Topaz, but Yellow Sapphire.

• Synonyms: Yellow Sapphire i.e. *Pushparaga*, has few synonyms in Sanskrit, like *Pushaparaja, Pitarakta, Guruvallabha, Pitamani, Gururatna* etc.

• English Name: Yellow Sapphire (Corundum).

• Occurrence

Yellow Sapphire occurs in Queensland and New South Wales (Australia). A greenish yellow sapphire occurs in Thailand, and purely yellow stones in Sri Lanka, Montana (U.S.A.) and East Africa.

• Characteristics

Yellow Sapphire makes unusual and attractive gemstones in their own right. Yellow Sapphire occurs in a range of different colours from golden yellow, orange, pink to even green stones. Topaz has a darker shade of yellow than Yellow Sapphire. The different colours found in the stones are due to small amount of metal oxide impurities.

• Properties

1. Hardness of Yellow Sapphire is 9 as per Mohs' scale.
2. Its specific gravity is 4.00
3. Refractive index is 1.76 to 1.77
4. Chemical composition is Al_2O_3
5. The crystal structure is trigonal.
6. Its birefringence (DR) is 0.008
7. It has a vitreous lustre.

• Approval

A good Yellow Sapphire is heavy, transparent, well-shaped, appears to have its surface smeared with an oily substance and smooth. A bad Yellow Sapphire is devoid of lustre, contains inclusions and is tawny or pale white.

• Purification

कुलत्थक्वथितोपेतैः काञ्जिकैः स्वेदितं समम् ।
दोलायन्त्रे पुष्पराजं यामैकेन विशुद्ध्यति ।। (रसतरंगिणी 23:91)

Pushparaga i.e. Yellow Sapphire is purified in the sour gruel and decoction of *Kulattha* (Dolichos biflorus) by steaming in *dola yantra* for three hours. Yellow Sapphire loses its colour or fades out because of heating. (Rasatarangini 23:91)

• Incineration

माणिक्यमारणोद्दिष्टविधिभ्यामतियत्नतः ।
मारयेत् पुष्पकराजन्तु रसतन्त्रविचक्षणः ।। (रसतरंगिणी 23:92)

The inineration of Yellow Sapphire is similar to that of Ruby. (Please see under Ruby). (Rasatarangini 23:92)

• Properties and Usage

A Yellow Sapphire duly purified and incinerated alleviates *Kapha* and *Vata doshas*. It stimulates the appetite and improves digestion. It is used with great benefit in burning sensation, vomiting, intoxication and skin disorders. It also improves the memory.

• Dosage: 30-120 mg. with honey.

(6) Hiraka (Diamond)

• Synonyms: Diamond i.e. *Vajra* or *Hiraka*, has few synonyms in Sanskrit, like *Hir, Abhedya, Bhargavapriya, Shatakoti, Kulisha, Vajraka, Pavi, Vidyut* and *Sayaka* etc.

• English Name: Diamond.

• Occurrence

Diamond forms at high temperatures and pressures 80 KM (50 Miles) or more underground. India and later Brazil were the main producers. However, since the discovery of diamond in Kimberlite rock in South Africa (around 1870), the main producers, today, are Australia, Ghana, U.S.A., U.S.S.R., Namibia and Botswana.

• Characteristics

Diamonds are graded by four C's i.e. by colour, cut, clarity and carat (weight). Diamond is the hardest material on Earth, and this, combined with its exceptional lustre and brilliant fire, has made it the most highly prized of all gems. Pure, colourless diamond is the most popular, but other varieties from yellow and brown to green, blue, pink, red, grey and black - are also found. Diamond crystals are well formed because of its uniform arrangement of their constituent carbon atoms. They are cubic.

• Properties

1. The hardness of diamond is 10 as per Mohs' scale.
2. It is transparent and lustrous gem.
3. Its specific gravity is 3.52
4. Refractive index of diamond is 2.42. As it is high, diamond glows and looks bright.
5. It resists heat and at high temperature, it becomes black.
6. When burnt with oxygen, it burns out and releases CO_2.
7. Its chemical composition is C.

• Varieties

Three kinds of *Vajra* i.e. diamond are described in ancient texts. They are Masculine, Feminine and Neuter.

(1) Masculine Diamond (*Pumvajra*): It has six or eight angles or faces. They are very bright and resemble in lustre, like rainbow.

(2) Feminine Diamond (*Strivajra*) :It has six angles and are full of spots and lines. It is parabolic, slightly heavy and depressed at the extremities.

(3) Neuter Diamond (*Napumsakavajra*):It is three angled, thin and elongated. It is round in shape, devoid of angles and heavy.

In addition to this classification, the diamonds are classified into four groups to which names of the fur most occuring classes of people viz. *Brahmin, Kshatriya, Vaishya* and *Shudra*. They are supposed to be effective when used by people of respective caste and class. Many books classify diamonds as per their most prominent colour viz. white, red, yellow and black.

• Approval

Masculine diamond is supposed to be the best amongst all. The feminine diamonds should be worn by females and neuter by enuchs; as per ancient texts.

• Purification

कुलत्थक्वाथके स्विन्नं कोद्रवक्वथितेन वा ।
एकयामावधि स्विन्नं वज्रं शुद्ध्यति निश्चितम् ।। (र.र.स.4:34)

The Diamonds are purified by steaming them in the decoction of *Kulattha* (Dolichos biflorus) or *Kodrava*, for three hours in *dola yantra*. There are other methods to purify diamond also. By *nirvapana* procedure, diamond can be purified in lime water or in mercury.

(Rasaratnasamuchchaya 4:34)

• Incineration

हीरकं विमलं तालं तथा रोगशिलामला ।
समं समं समादाय खरखल्वे विमर्दयेत् ।।

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त्रिवर्षारूढकार्पासशिफास्वरसयोगतः ।
सम्पेष्य कामं यामैकं निदाघे परिशोषयेत् ।।
विशुष्कं सम्पुटे न्यस्य पुटयेत्तु महापुटे ।
एवं चतुर्दशापुटैर्हीरकं याति पञ्चताम् ।। (रसतरंगिणी 23:22-24)

Purified Diamond, orpiment and realgar are finely ground, in equal quantity. The juice of roots of cotton plant (grown for 3 years) is added to it and round shaped discs are prepared from this mixture. They are dried in sunlight and subjected for heating in *Mahaputa* for 14 times and thus, *Hiraka bhasma* is prepared. It is smooth, lustreless (*nischandra*) and white in colour.

(Rasatarangini, 23:22-24)

There are various methods of incinerating diamonds.

• Properties and Usage

Hiraka bhasma is well known for its rejuvenating property. It augments the body strength as it promotes to build all body tissues. It is used in tuberculosis, anaemia, ascites, cancer like diseases, with great benefit. It is beneficial to heart and aphrodisiac. It is also the best *yogavahi*. It works well in old age as a preventive as well as curative medicine.

• Dosage

The dose of *Hiraka bhasma* is very small. It is 1.2 mg to 2 mg. For easy administration, one percent *Hiraka bhasma* is added to *Rasasindura* and the mixture is given 125 to 250 mg. Appropriate medium of vehicle is selected as per requirement. Commonly, it is given along with honey or milk.

(7) Nilama (Blue Sapphire)

• Synonyms: *Nila* i.e. Blue Sapphire, has various synonyms in Sanskrit, like *Indranila, Shouriratna, Nilamani, Nilotpala, Trinagrahi, Vachinama, Shaniratna* etc.

• English Name: Blue Sapphire (Family - Corundum).

• Occurrence

Good quality sapphire is found in Burma, Sri Lanka and India. The best Indian sapphire is cornflower blue, found in Kashmir, either in pegmatites or as waterworn pebbles in alluvial deposits. Sapphire from Thialand, Australia and Nigeria are dark blue, nearly appearing black. Other localities include Montana (U.S.A.), Brazil, Kenya, Cambodia, Malawi and Colombia.

• Characteristics

All gem-quality corundum that is not red (ruby) is called sapphire, yet this name is popularly associated with the colour blue. Other colours like pale purple or greenish blue are due to iron and titanium impurities. Blue Sapphire is transparent, hexagonal gem with dichroic property.

• Properties

1. It has deep blue colour and vitreous lustre.
2. Its specific gravity is 4.00
3. Its Refractive index is similar to that of diamond, 1.76 - 1.77
4. The chemical composition is Al_2O_3.
5. Hardness is 9 as per Mohs' scale.

• Varieties

Ancient texts have mentioned two varieties of *Nila*.

(1) ***Jalanila***: It is whitish blue in colour, pale, light. Seven varieties of *Jalanila* are mentioned.

(2) ***Indranila***: It is dark blue in colour, heavy. Reddish blue or pale purple coloured gems are also known as *Indranila* or *Raktamukhinila*.

• Approval

A good *Nila* is of uniform lustre, heavy, appearing to be

smeared with an oily substance, transparent, globular, with a play of brilliance inside.

• Purification

नीलीस्वरससंयुक्तं दोलायन्त्रे विधानतः ।
यामैकं परिपक्वं तु नीलं शुद्ध्यति निश्चितम् ।।

(रसतरंगिणी 23:99)

Blue Sapphire is purified by steaming it in the juice of *Nili*, for three hours in *dola yantra.* (Rasatarangini 23:99)

• Incineration

Incineration of Blue Sapphire is done by a similar procedure that is followed for that of Ruby. (Please see Ruby)

• Properties and Usage

Nilamani bhasma i.e. incineration of Blue Sapphire alleviates all three *doshas* viz. *Vata, Pitta* and *Kapha.* It also detoxifies the toxins and is used to treat various skin diseases. It is aphrodisiac and increases the body strength.

• Dosage: 30 to 60 mg. with proper vehicle.

(8) Gomeda (Hessonite)

• Synonyms: *Gomeda* i.e. Hessonite, has few synonyms in Sanskrit, like *Rahuratna, Gomedaka, Tamomani, Gomutrajambu, Pingasphatika* and *Bahuratna. 'Gomeda'* denotes that it resembles the colour of cow's fat.

• English Name: Hessonite (Grossular Garnet).

• Occurrence

The best hessonite garnets are found in Sri Lanka in metamorphic rocks, or gem gravels and sands. In Madagascar hassonite is always referred to as cinnamon stone. Other localities include Brazil, Canada and Siberia (Russia) as well as Maine, California and New Hampshire in U.S.A.

• Characteristics

Grossular garnets occur in very wide range of colours, from colourless to black. The orange-brown colour of hessonite grossular garnet is due to manganese and iron inclusions.

• Properties

1. Hardness of hessonite is 7.25 as per Mohs' scale.
2. Specific gravity is 3.65
3. Refractive index is 1.73 - 1.75
4. It has no birefringence (DR).
5. Structure of hassonite is cubic crystals.
6. Chemical composition is Calcium aluminium silicate.

• Approval

Hessonite which is transparent, heavy, devoid of flaws, smooth, bright, yellow in colour, unctuous looking, is of good quality. Whereas, rough, pale, flat-shaped and devoid of brightness is of bad quality.

• Purification

निम्बूकस्वरसेनेह दोलायन्त्रे विधानतः ।
परिस्विन्नं यामैकं शुद्धिमायात्यनुत्तमाम् ।। (रसतरंगिणी 23:123)

Hessonite is purified by steaming in lemon juice for three hours with the help of *dola yantra.* (Rasatarangini 23:99)

• Incineration

Purified hassonite is subjected for incineration by a similar procedure to that of incineration of ruby. (Please see - Ruby, Incineration of Ruby).

• Properties and Usage

Gomeda bhasma i.e. calx or incineration of hessonite is used to stimulate the appetite. It improves digestion and

digest the *ama* as well. It is beneficial to the skin, hence used in various dermatoses. It is also mentioned that it improves the memory. It alleviates *Kapha* and *Pitta doshas.* It works well in wasting diseases and anaemia.

• Dosage: 30 to 120 mg. with proper vehicle.

(9) Vaidurya (Cat's Eye)

• Synonyms: *Vaidurya* i.e. Cat's Eye, has numerous synonyms in Sanskrit, like *Viduraranta, Keturatna, Viduraja, Bidalaksha, Vayaja, Rashtraka, Balasurya, Abhraroha, Meghakharankura* etc.

• English Name: Cat's Eye or Cymophane.

• Occurrence

Cat's Eye and alexandrite are the two varieties of Chryosoberyl. Of which, cat's Eye is found in Sri Lanka, Brazil and China.

• Characteristics

Cat's Eye when cut *en carbochon*, has a near white line across a yellowish grey stone, due to canal-of feather-like fluid inclusions, or needle-like inclusions of rutile. The most highly prized cat's eye colour is a light golden brown, often with a shadow that gives a light and dark "milk and honey" effect.

The name Chrysoberyl is from the Greek *Chrysos* meaning golden and *beryllos* which refers to the beryllium content.

• Properties

1. Hardness of Cat's Eye is 8.5 as per Mohs' scale.
2. Its specific gravity is 3.72
3. Its Refractive index is 1.75
4. The structure is orthorhombic.
5. The chemical composition is $BeAl_2O_4$.

• Varieties

The gem is of three different varieties viz.

1. Yellowish black;
2. Reddish blue; and
3. White black.

It is also categorised by giving the simily of its colour viz.

1. Of the colour of green bamboo leaf;
2. Of the colour of peacock's neck; and
3. Tawny-coloured like a cat's eye.

Though not mentioned in Ayurvedic texts, three varieties of *Vaidurya* are mentioned as *Kanakakheta, Dhumrakheta and Krishnakheta.*

• Approval

Of all these, those which are commendable are heavy, smooth, devoid of the general flaws, pellucid and transparent. The one, which is blackish-white, smooth-surfaced, transparent, heavy, bright and appears to contain inside it a mark resembling a swinging scarf, is commendable.

• Purification

त्रिफलाक्वथितोपेतं वैडूर्यं याममात्रकम् ।
दोलायन्त्रे परिस्विन्नं शुद्धिमायात्यनुत्तमम् ।। (रसतरंगिणी 23:115)

The purification of Cat's Eye is done by steaming in the decoction of *triphala* for three hours in *dola yantra.*

(Rasatarangini 23:115)

• Incineration

Purified *Vaidurya* is incinerated as per method which is used for Ruby.

• Properties and Usage

Vaidurya bhasma alleviates mainly *Pitta dosha*, arrests the haemorrhages, is cooling, mild laxative, improves diges-

tion, increases body strength and longevity. It also increases the acuity of vision.

• Dosage: 30 to 120 mg. with milk and sugar.

SEMIPRECIOUS STONES

So far, we have seen the information of nine gemstones. They are known as *maharatna*, meaning the great gemstones. All these are very precious, rare, costly, attractive and durable stones. It is not always affordable to use them for medicinal purpose. There are other stones than these, which are less costly and easily available. These are known as semiprecious stones (*uparatna*). There are innumerable minor and amorphous stones. When a particular precious stone is not available, the semiprecious stone having nearly similar properties is used in Ayurvedic pharmacy. Commonly used semiprecious stones are mentioned in the following stanza.

वैक्रान्तं सूर्यकान्तश्च चन्द्रकान्तो नृपोपलः ।
पेरोजकश्च स्फटिकं क्षुद्ररत्नगणो ह्ययम् ।। (रसतरंगिणी 23:154)

The group of gems viz. *Vaikrant* (Fluorite), *Suryakant* (Spinel), *Chandrakant* (Moonstone), *Rajavarta* (Lapis lazuli), *Peroja* (Turquoise) and *Sphatika* (Rock crystal) are called, together, as *Uparatna* or *Kshudra ratna*, i.e. semiprecious stones. (Rasatarangini 23:154)

Let us see information about them in brief.

(1) Vaikranta (Tourmaline)

Vaikrant is called as 'Fluorspar' in English and in geology it is known as 'Fluorite'.

Vaikrant is described in Chapter 12, under Maharasa, as Tourmaline. (Please refer to Chapter No.12)

(2) Suryakanta (Spinel)

• Synonyms: *Suryakanta* i.e. Spinel, has numerous synonyms in Sanskrit, like *Suryamani, Suryopala, Diptopala, Vanhigarbha, Jwalanopala and Katakinja* etc.

• English Name: Spinel, Spinel Ruby, Bela's Ruby, Sun Stone.

• Occurrence

Spinel occurs in granites and metamorphic rocks, and is often found in association with corundum. It occurs in Burma, Sri Lanka, Madagaskar in a wide range of colours. It is also found in Australia, Russia, Sweden, Italy, Brazil and Turkey.

• Characteristics

Wide range of colours of spinel are due to the presence of various impurities and its transperancy ranges from transparent to almost opaque. Red spinel, coloured by chromium and iron is the most popular, although for many years it was thought to be a variety of ruby. Star stones are rare, but when cut *en carbochon* may show 4 to 6 rayed stars. It contains sodium, aluminium, silicon, calcium and oxygen elements.

• Properties

1. Structure of spinel is cubic.
2. Hardness is 5.5 to 8 as per Mohs' scale.
3. Specific gravity is 2.5 to 3.6
4. Refractive index is 1.72
5. Chemical composition of spinel is $MgAl_2O_4$

• Varieties

Modern gemmology categorises five varieties of spinel as following:

1. Bela's Ruby - Red coloured, like ruby.

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2. Almandine spinel - Yellowish in colour.
3. Lionastase spinel - Dark green coloured.
4. Sapphire spinel - Blue in colour.
5. Rubysail - Orange coloured.

• Approval

A good quality spinel is transparent, unctuous looking, spotless and slightly hard. As it emits fire, when sunrays reflect from its surface, hence the name '*Suryakanta*'.

• Purification

The procedure of purification of spinel is not mentioned in texts.

• Incineration

सूर्यकान्तः सुसम्पिष्टः शिलाबलिसमन्वितः ।
सप्तधा पुटितो यत्नान्म्रियते नात्र संशयः ।। (रसतंगिणी 23:186)

The gemstone is first finely powdered and mixed with equal quantity of pure realgar and sulphur and sealed properly in saucers and subjected for heating for 7 times. The fine powder *bhasma* is formed. There is no mention of type of *puta*, but according to few, *gajaputas* should be the choice. (Rasatarangini 23:186)

• Properties and Usage

Suryakanta bhasma, is hot in potency and alleviates *Vata* and *Kapha doshas*. It is *rasayana* i.e. rejuvenating and also improves intellect.

• Dosage: Not mentioned in texts. 30 to 60 mg, usually is recommended with proper vehicle.

(3) Chandrakanta (Moonstone)

• Synonyms: *Chandrakanta* i.e. Moonstone, has a few synonyms in Sanskrit, like *Chandramani, Chandropala, Shashikanta, Indukanta* etc.

• English Name: Moonstone (Family - Orthoclase)

• Occurrence

The best quality moonstones are found in Burma and Sri Lanka. Other localities include India, Madagascar, Brazil, U.S.A., Mexico, Tanzania and European Alps.

• Characteristics

Moonstone is the opalescent variety of orthoclase, with a blue or white sheen, rather like the shine of the moon after which it is named. Thin albite layers give an attractive blue; thicker layers produce a white "schiller". It is smooth, cooling to the sight, monoclinic in structure.

• Properties

1. Hardness of moonstone is 6 as per Mohs' scale.
2. Specific gravity is 2.57
3. Refractive index is 1.52 - 1.53
4. Lustre is vitreous i.e. like a glass.
5. Structure is monoclinic
6. Chemical composition is $KAlSi_3O_8$

• Varieties: Not mentioned in texts.

• Approval

Moonstone which is cooling, soft and possessing a yellow tinge is supposed to be the best one.

• Purification: Not mentioned in texts.

• Incineration

कुनटीहिङ्गुलोपेतः कन्यानीरेण पेषितः ।
चन्द्रकान्तः सुपुटितो नात्र संशयः ।।

(रसतरंगिणी 23:190)

Incineration of Moonstone is prepared by rubbing it with pure cinnabar and realgar in the juice of aloe. Then the

mixture is subjected to heating by giving in *puta* systematically. (Rasatarangini 24:190)

• Properties and Usage

Chandrakanta bhasma i.e. incinerated Moonstone, is extremely cooling, unctuous, alleviating *Pitta dosha* and mitigates *raktapitta* - bleeding disorders.

• Dosage: 30 to 60 mg, with proper vehicle.

(4) Rajavarta (Lapis Lazuli)

• Synonyms: *Rajavarta* i.e. Lapis Lazuli, has few synonyms in Sanskrit, like *Nripavarta, Avartamani, Nilashma, Nripopala, Lajavarda* etc. The treatise Rasaprakash Sudhakar quotes *Rajavarta* under *Maharasa* category.

• English Name: Lapis Lazuli.

• Occurrence

Lapis Lazuli is usually found as boulders or within limestones. The best quality Lapis Lazuli is from Afghanistan and has been used in many famous pieces, including the mask of Tutankhamun. It is also found in Burma, U.S.A., Chile and Russia. In India, it is found in Ajamer.

• Characteristics

Lapis Lazuli is a blue rock made up of several different minerals, including lazurite, sodalite, hauyne, calcite and pyrite. Its colour varies, but it is the intense dark blue, clear, unctuous looking, heavy, cubic in structure. Its chemical formula is $Na_4(NaS_3Al)Al_2(SiO_4)_3$.

• Properties

1. The crystal structure is cubic.
2. Hardness is 5.2 as per Mohs' scale.
3. Refractive index is 1.48 (mean)
4. Specific gravity is 2.27.

• Varieties: Not mentioned in texts.

• Approval

A genuine *Rajavarta* is blue in colour with red shade, heavy, smooth, devoid of dirt and whiteness.

• Purification

सगव्यमूत्रः सक्षारो निम्बूकद्रवयोगतः ।
स्विन्नो नृपोपलो यामं शुद्धिमायात्यनुत्तमाम् ।। (रसतरंगिणी 23:193)

Rajavarta is purified by steaming it for three hours in *dola yantra.* First, it is finely powdered and mixed with cow's urine, *yavakshara* and lemon juice. Then it is subjectd to steaming. (Rasatarangini 23:193)

It is also mentioned that instead of cow's urine, it can be purified by using water or juice of flowers of *Shirisha* (Albizzia lebbek) during steaming.

• Incineration

लङ्गाम्बुगन्धकोपेतो राजावर्तो विचूर्णितः ।
पुटनात्सप्तवारेण राजावर्तो मृतो भवेत् ।। (र.र.स.4:79)

Purified *Rajavarta* is first finely powdered. Then pure sulphur and fruit juice of *Jambira* (Citrus limonum) is added and rubbed together. Then it is subjected to heating in *gajaputas* seven times. The fine calx or *bhasma* of *Rajavarta* gets formed. (Rasaratnasamuchchaya 4:79)

In few texts, it is mentioned that purified fine powder of *Rajavarta,* sulphur and fruit juice of *Jambira* should be rubbed together for three days. Instead of *Jambira* the juice of *Bhringaraja* (Eclipta alba) can also be used.

• Properties and Usage

Incineration of Lapis Lazuli (*Rajavarta*) boosts up appetite, improves digestion and is rejuvenating. It alleviates *Vata* and *Kapha doshas.* It is useful as bulk promoting

(brimhana) and pacifies aggravated *Pitta dosha*. It is beneficial in diseases like diabetes mellitus, anaemia, tuberculosis and wasting diseases.

• Dosage: 30 to 60 mg, with proper vehicle.

(5) Perojaka (Turquoise)

• Synonyms: *Peroja* i.e. Turquoise, has few synonyms in Sanskrit, like *Perojaka, Haritashma* etc.

• English Name: Turquoise

• Occurrence

Sky-blue turquoise from Iran and a greener variety from Tibet are famous. Other localities include Chile, Australia, Turkastan, Mexico, U.S.A. and England.

• Characteristics

A good quality turquoise is sky-blue to green in colour. It is amorphous and opaque.

• Properties

1. Hardness of turquoise is 6.0 as per Mohs' scale.
2. Specific gravity is 2.80.
3. Refractive index is 1.61 - 1.65.
4. Crystal structure is triclinic.
5. It contains water elements, hence changes its colour.
6. Heat, Sunlight, acids, alkalis and sweat are detrimental to its colour.

• Varieties

Not mentioned in texts, however few texts mention 2 types: *Bhasmanga* - ash coloured and *Harita* - green.

• Purification

Purification of Turquoise is done by similar process used for purification of Lapis Lazuli.

• Incineration

Preparation of incineration of Turquoise is done by similar procedure to that of Lapis Lazuli.

• Properties and Usage

Incineration of Turquoise is astringent and sweet in taste. It exerts mild laxative effect and stimulates the appetite. It detoxifies the effects of all types of toxins on the body.

• Dosage: 120-240 mg, with proper vehicle.

(6) Sphatika (Rock Crystal)

• Synonyms: *Sphatika* has various synonyms in Sanskrit, like *Sphatikashma, Sphatikopala, Shalipishta, Dhoutashali, Shivapriya, Shivaratna, Amalamani* etc.

• English Name: Rock Crystal (Quartz).

• Occurrence

Although found worldwide, important sources are Brazil, Swiss and French Alps, Madagascar etc.

• Characteristics

Rock crystals are colourless, transparent, hexagonal prisms, with pyramidal ends and striations perpendicular to their length. They are often twinned, their cleavage is poor and fracture conchoidal.

It is much hard than glass and reflects various colours like rainbow, when sunrays reflect from its surface. Rock crystals are clear, devoid of stains and lines and cooling for touch.

• Properties

1. Hardness of Rock crystal is 7.00 as per Mohs' scale.
2. Specific gravity is 2.65.

3. Refractive index is 1.54.
4. Crystal structure is trigonal.
5. Its lustre is vitreous.
6. Chemical composition is SiO_2.

• Varieties

Varieties of *Sphatika* are not mentioned in texts.

• Purification

Purification procedure of Rock crystal is similar as that of Lapis Lazuli.

• Incineration

Incineration of Rock Crystal is prepared by similar procedure to that of Lapis Lazuli.

• Properties and Usage

Sphatika bhasma i.e. incinerated Rock Crystal, is sweet in taste and has cold potency. It pacifies *Pitta dosha* and burning sensation in the body. It is also used to purify the blood. It is beneficial in fever, burning sensation and excessive thirst.

• Dosage: 240-480 mg, with rose water.

(7) Vyomashma (Jade)

• Synonyms: *Vyomashma* i.e. Jade, has various synonyms in Sanskrit, like *Sangeyashaba, Yashaba, Bhimapashana* etc.

• English Name: Jade or Jadeite.

• Occurrence

Jade is found in metamorphic rocks and as alluvial pebbles and boulders. The most important source of jade is Burma. In India, it is found in Kashmir and Ladakh. Other sources are Japan and California (U.S.A.).

• Characteristics

It resembles an emerald in colour but not in brightness. A wide range of colours including green, lilac, white, pink, brown, red, blue, black, orange and yellow is seen in jades but the most prized variety, imperial jade, is a rich emerald-green, due to chromium. The crystal structure is monoclinic and crystals are opaque. Jadeite commonly has a dimpled surface when polished.

• Properties

1. Hardness of Jade is 7.00 as per Mohs' scale.
2. Refractive index is 1.66-1.68.
3. Specific gravity is 3.33.
4. Lustre is greasy to pearly.
5. Chemical composition is $Na(Al, Fe) Si_2O_6$.

• Purification

The procedure of purification of jade is similar to that of purification of ruby.

• Incineration

This procedure is similar to that of ruby.

• Fine Powder of Jade

Purified jades are rubbed with rose-water for 21 days. A fine powder (*pishti*) formed, is then used for medicinal purpose.

• Properties and Usage

The *bhasma* i.e. incineration or *pishti* i.e. fine powder of jade is used for medicinal purpose. It increases the dryness in the body. It also improves digestion. It alleviates colics in urinary stones and gastritis. It is beneficial in splenic diseases and also improves memory.

• Dosage: 450 mg to1 gm, with proper vehicle.

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(8) Palanka (Onyx)

• Synonyms: There is no synonym to *Palanka* (Onyx).

• English Name: Onyx (Family - Chalcedony).

• Occurrence

Found worldwide, they are formed by the deposition of silica in gas cavities in lavas, which results in the distinctive bands.

• Characteristics

Onyx, sard and sardonyx are all varieties of the microcystalline quartz, chalcedony. Onyx is similar to agate, but it has straight rather than curved bands. Onyx is green, pale green or black in colour.

• Properties

1. Hardness of Onyx is 7.00 as per Mohs' scale.
2. Specific gravity is 2.61.
3. Its refractive index is 1.53-1.54.
4. The crystal structure is trigonal.
5. Lustre is vitreous.
6. Chemical composition is SiO_2.

• Varieties

Palanka i.e Onyx, is categoriesed into three varieties according to its colour viz. 1) Black, 2) Yellowish-black and 3) Grey.

There is no mention about the purification, incineration, medicinal properties and usage, of *Palanka* (Onyx). Many a times, in ornaments it is used as a substitute for emerald.

(9) Rudhira (Carnelian)

• Synonyms: *Rudhira* (Carnelian) is also known as *Raktankita*.

• English Name: Carnelian (Family - Chalcedony).

• Occurrence: The best carnelian is found in India.

• Characteristics

Also called as Cornelian, is a translucent, reddish orange variety of Chalcedony. *Rudhira* i.e. Carnelian is reddish in colour resembling the colour of parrot's beak. The Sanskrit word *rudhira* means blood. The various shades of red are due to the presence of iron oxide. Stones may be uniformly coloured or faintly banded.

• Properties

1. Hardness of Carnelian is 7.00 as per Mohs' scale.
2. Crystal structure is trigonal.
3. Specific gravity is 2.61.
4. Refractive index is 1.53.
5. Lustre is vitreous to waxy.
6. Chemical composition is SiO_2.

Like *Palanka*, there is no mention in texts, about *Rudhira* regarding its purification, incineration, medicinal properties and usage.

(10) Puttika (Peridot)

• Synonyms: *Puttika* i.e. Peridot, has few synonyms in Sanskrit, like *Haritamani, Dhrutamani, Haritopala* etc.

• English Name: Peridot.

• Occurrence

Peridot is found on St-John's Island (Egypt), in China, Burma, Brazil, Hawaii and Arizona (U.S.A.), Crusaders brought peridot to Europe in the Middle Ages, transporting stones from St. John's Island in the Red Sea.

• Characteristics

Peridot has an olive or bottle-green colour due to the pres-

ence of iron; and a distinctive oily or greasy lustre. It has a high birefringence. When rubbed on a silk-cloth, *Puttika* loses its shine.

• Properties

1. The Hardness of Peridot is 6.5 as per Mohs' scale.
2. Its Specific gravity is 3.34
3. Refractive index is 1.64-1.69.
4. Lustre is vitreous or greasy.
5. Its birefringence is 0.036.
6. Crystal structure is orthorhombic.
7. Chemical composition is $(MgFe)_2 SiO_4$.

• Varieties

According to modern gemmology, two varieties of peridot are categorised according to colour.

1. Dark green coloured peridot is called as Olivine.
2. Yellowish green peridot is called as Chryosolite.

There is no mention about the purification, incineration, medicinal properties and usage, of *Puttika*.

(11) Sugandhika

There is no synonym to *Sugandhika* and its proper scientific name as per gemmology, is not known.

It is found in blue, black or in red colour. It is transparent, with a yellowish shade. Otherwise, there is no mention about *Sugandhika*.

(12) Trinakanta (Amber)

• Synonyms: *Trinakanta* i.e. Amber, is known as *Kaharuba* or *Kadaroba*.

• English Name: Amber.

• Occurrence

Amber occurs in the Baltic region, particularly along the coasts of Poland and the former U.S.S.R. Amber from Burma is called *Burmite* and Sicilian amber is known as *Simetite*. Other localities include Mexico, France, Spain, Italy, Germany, Romania, Canada, Czechoslovakia and U.S.A.

• Characteristics

Amber is the fossilized resin of trees. Most amber is golden, yellow to golden orange; but green, red, violet, black amber is also found. It usually occurs as transparent to translucent nodules or small, irregular shaped masses, often with a cracked or weathered surface.

Amber may contain insects, moss, lichen, or pine needles that were trapped millions of years ago while the resin was still sticky. When rubbed, amber produces a negative electrical charge that arrests dust. When rubbed on a cloth, it smells like a lemon.

• Properties

1. The Hardness of Amber is 2.5 as per Mohs' scale.
2. Its crystal structure is amorphous.
3. Specific gravity is 1.08.
4. Refractive index is 1.54-1.55.
5. Its lustre is resinous.
6. Chemical composition is a mixture of organic plant resins, mainly $C_{10}H_{16}O$.

• Medicinal Usage

Amber i.e. *Trinakant*, is not purified or incinerated before use. It is processed for 21 times with rose water and fine powder (*pishti*) is used as medicine. It is the most effective remedy to arrest bleeding through nose, piles, sputum

(haemoptysis), and in diarrhoea and dysentery. It alleviates *Pitta dosha*, burning and hyperacidity.

- Dosage: *Trunakant pishti* is given 1 to 2 gm; with honey.

Properties of Gemstones

No.	Name and Chemical Composition	Structure	Hardness	S.G.*	R.I.*	D.R.*
1.	Ruby (*Manikya*) Al_2O_3	Trigonal	9	4.00	1.76-1.77	0.008
2.	Pearl (*Mouktika*) $CaCO_3$, $C_3H_{18}N_9O_{11}nH_2O$	Orthorhombic	3	2.71	1.53-1.68	N/A
3.	Coral (*Pravala*) $CaCO_3$ or $(C_3H_{48}N_9O_{11})$	Trigonal	3	2.68	1.49-1.66	N/A
4.	Emerald (*Tarkshya*) $Be_3Al_2(SiO_3)_6$	Hexagonal	7.5	2.71	1.57-1.58	0.006
5.	Yellow Sapphire (*Pushparaga*) Al_2O_3	Trigonal	9	4.00	1.76-1.77	0.008
6.	Diamond (*Vajra, Hiraka*) C	Cubic	10	3.52	2.42	None
7.	Blue Sapphire (*Nila*) Al_2O_3	Trigonal	9	4.00	1.76-1.77	0.008
8.	Hessonite (*Gomeda*) $Ca_3Al(SiO_4)_3$	Cubic	7.5	3.65	1.73-1.75	None
9.	Cat's-Eye (*Vaidurya*) $BeAl_2O_4$	Orthorhombic	8.5	3.71	1.74-1.75	0.009

*S.G. = Specific gravity.

*R.I. = Refractive index.

*D.R. = Double refraction or Birefringence.

Properties of Semiprecious Stones

No.	Name and Chemical Composition	Structure	Hardness	S. G.	R. I.	D. R.
1.	Fluorite (*Vaikrant*) CaF_2	Cubic	4	3.18	1.43	None
2.	Spinel (*Suryakant*) $MgAl_2O_4$	Cubic	8	3.60	1.71-1.73	None
3.	Moonstone (*Chandrakant*) $KAlSi_3O_8$	Monoclinic	6	2.57	1.52-1.53	0.005
4.	Lapis Lazuli (*Rajavarta*) $(Na,Ca)_8(Al,Si_{12}O_{24}(SO_4)Cl_2(OH)_2$	Various	5.5	2.80	1.50 (mean)	None
5.	Turquoise (*Peroja*) $CuAl_6(PO_4)_4(OH)_8 5H_2O$	Triclinic	6	2.80	1.61-1.65	0.004
6.	Rock Crystal (*Sphatika*) SiO_2	Trigonal	7	2.65	1.54-1.55	0.009
7.	Jade (*Vyomashma*) Na (Al, Fe) Si_2O_6	Monoclinic	7	3.33	1.66-1.68	0.012
8.	Onyx (*Palanka*) SiO_2	Trigonal	7	2.61	1.53-1.54	0.004
9.	Carnelian (*Rudhira*) SiO_2	Trigonal	7	2.61	1.53-1.54	0.004
10.	Peridot (*Puttika*) $(Mg, Fe)_2 SiO_4$	Orthorhombic	6.5	3.34	1.64-1.69	0.036
11.	Amber (*Trunakant*) Mainly $C_{10}H_{16}O$	Amorphous	2.5	1.08	1.54-1.55	N/A

Chapter 17

Calcium Compounds

Calcium Compounds are categorised under the name *Sudha varga*. The word *Sudha* has several meanings e.g. Nectar, good liquid, good drink, honey, etc. However, few authors of 18th century have used this word to indicate a specific class of the medicinal substances, which are basically calcium compounds. Thus the word *Sudha varga*, in context of Rasashastra means a group of medicinal substances which are basically calcium compounds. It is to be kept in minds that this classification of medicinal substances is totally based on knowledge of chemistry and hence came in to existance quite late. Naturally one would not find reference of '*Sudha varga*' in ancient classical texts of Rasashastra. The substances included in this class were used in ancient times but were not classified so. e.g. coanches, oystershells, pearls, corals, cowries, etc. There were constant additions to this class e.g. egg shells, back of tortoise, sepia etc. Quite recently some minerals, which are not calcium compounds, but have similar properties are also included in this class e.g. *Dugdhapashana*, *Koushe-yashma* etc. Let us first see some information about the element Calcium.

Calcium is a soft, silvery-white metallic element found most widely in such rocks as chalk, limestone and marble. It is one of the most abundant metals and makes up about 3.5% of the earth's crust. It reacts readily with both oxygen and water. In nature, it occurs only in compounds - chiefly as calcium carbonate, calcium fluoride and calcium sulphate.

Sir Humphry Davy, an English chemist, first isolated calcium as a pure metal in 1808. However, the ancient Egyptians, Greeks, Romans and Indians knew about calcium compounds and used them to make mortar.

Formation of Organic Calcium Compounds

Limestone is a type of rock made up mostly of calcite, a mineral form of calcium carbonate. Most fresh water and sea water contain calcium carbonate. All limestones are formed when the calcium carbonate gets deposited. There are two ways by which limestones are formed: (1) those formed completely without aid of living organisms and (2) which are formed by living organisms. Many aquatic organisms, in this kind, prepare organic calcium carbonate out of their bodies and use it to make their shells and bones. The oysters, clams, corals, snails and sea urchin do this. When the animals die, the shells and bones are broken up by waves into shell and coral sand and mud. Most of the limestone layers in all part of the earth were once shell or coral sand and mud.

Natural chalk is a soft, fine-grained white limestone. It was formed as a mud on the bottom of an ancient sea. It consists largely of tiny shells and crystals of calcite, both made up of the compound calcium carbonate.

Calcium has an atomic number 20 and an atomic weight of 40.08. Its chemical symbol is 'Ca'. It belongs to the group of elements called "alkaline earth metals". Calcium melts at 839^{0}C and boils at 1484^{0}C. It has a density of 1.5 grams per cubic centimeter at 20^{0}C.

Calcium is essential to all living things, especially human beings and other animals. It is vital from the growth and maintenance of the bones and teeth, and it helps the blood

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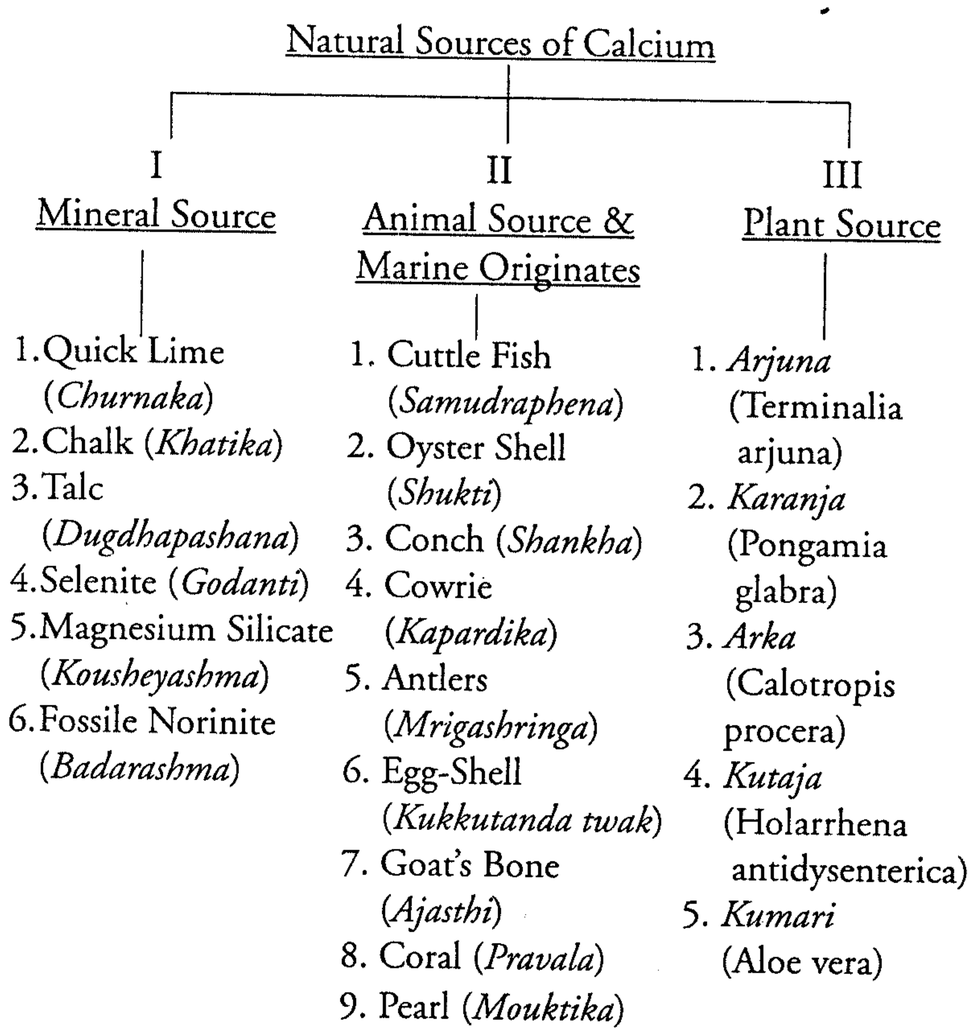
to clot and the muscles to contract. The metabolism of calcium and its exchange takes place between gut, plasma, bone and kidney. The regulation of plasma calcium is under influence of parathyroids, calcitonin and T_3-T_4 hormones of thyroid, glucocorticoids and sex hormones viz. androgens and oestrogens.

Thus natural sources of Calcium can be summarised in a flow chart as under:



Amongst these, we have already studied *Kapardika* (*Sadharana Rasa*) and *Pravala* and *Mouktika* in Gemstones and Semiprecious Stones in previous chapters. The remaining ones are described here.

I. Mineral Source of Calcium

(1) Churnaka (Quick Lime)

• Synonyms: *Churnaka* i.e. Quick Lime, has few synonyms in Sanskrit, like *Churna, Sudha, Soudhavilepana* and *Shilakshara.*

• English Name: Quick Lime, CaO. It is used as medicine in the converted form after reacting with water, which has chemical formula $Ca(OH)_2$ and called as slaked lime.

• Characteristics

The crystals are irregular in shape and white in colour. When water is added to quick lime, the chemical reaction results in production of heat and steam. It is called an exothermic reaction. It is represented as:

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Thus slaked lime and lime water are formed.

• Occurrence

Most quick lime is made from small chunks of limestone. Limestone consists chiefly of calcium carbonate ($CaCO_3$). To produce quicklime, manufacturers place crushed limestone in a special oven, called *kiln*, and heat it to a temperature of about 2000°F (1204°C). This process releases carbon dioxide (CO_2), from the limestone, leaving a lump of powdery, greyish-white quicklime.

The reaction is represented as:

$$CaCO_3 \rightarrow CaO+CO_2$$

• Properties

As such, quick lime is not directly used for medicinal purpose, as it produces heat and is irritant. It is used in the form of lime water. To prepare lime water first slaked lime

is prepared then 240 mg of slaked lime and caustic is mixed into 50 ml. of water and kept for 9 hours, then it is filtered and filled in coloured glass bottle.

• Usage

Limewater has anti-diarrhoeal, anthelmintic and antacid properties. In children, it is ten times diluted with water and given to improve the digestion of milk, to alleviate abdominal pain and colitis. For adults, the dosage is 15 - 20 ml.

(2) Khatika (Chalk)

• Synonyms: *Khatika* i.e. Chalk, has various synonyms in Sanskrit, like *Khatini, Khati, Varnika, Dhawalaya, Lekhani, Shukladhatu, Varnalekhika* etc.

• English Name: Chalk or Pipeclay, $CaCO_3$

• Occurrence

Chalk is found in the form of marble, limestone, calcite or islandspar; in nature. Pipeclay is one of these varieties. The chalk is a soft, fine-grained limestone. It was formed as a mud on the bottom of an ancient sea. It differs from many pure, fine-grained limestones only in still being soft and easily rubbed off. That is, it did not change into hard rock. The white cliffs of Dover are thick layers of chalk.

• Varieties

Bhavaprakash has mentioned two varieties of *Khatika*, as *Khati* and *Gourakhati* i.e. dull and bright white coloured, respectively.

Both the varieties are similar in their medicinal properties.

• Purification

खटीचूर्णं शुद्धपात्रे निधाय विमले जले ।
प्रक्षालयेद्विधानज्ञो विशुद्ध्यति न संशयः ।। (रसतरंगिणी 11:210)

Fine powder of chalk is taken in a glass vessel and four times of its quantity water is added to it. The mixture is stirred well for some time and kept. Then it is filtered through a fine cloth and dried in the sunlight and used.

(Rasatarangini 11:210)

• Properties and Usage

Chalk is bitter and sweet in taste and has cold potency. It pacifies aggravated *Pitta dosha*. It is used in treating burning sensation in body, blood disorders and diseases of eyes. The chalk with a green colour is beneficial in diarrhoea.

• Formulation

'Mugdha rasa' is prepared by rubbing purified chalk with purified mercury.

(3) Dugdhapashana (Talc)

• Synonyms: *Dugdhapashana* i.e. talc, has few synonyms in Sanskrit, like *Dugdhapashanika, Kshiri, Madhavi, Soudha, Medasannibha, Dugdhashma, Gomedasannibha, Vajrabhra, Diptika* etc.

• English Name: Talc, Magnesium Silicate ($MgSiO_3$).

• Purification & Incineration: Not mentioned in texts.

• Properties and Usage

It increases and improves the taste sensation, relieves the fever, alleviates abdominal pain, flatulence, heart diseases and cough. It also eliminates the burning sensation of the skin.

Topically, the fine powder applied on the cuts and wounds arrests the bleeding and discharge. Internally it is the best remedy for bleeding piles and dysentery.

• Dosage: 120-240 mg, with proper vehicle

(4) Godanti (Selenite)

• Synonyms: *Godanti* i.e. Selenite, has few synonyms in Sanskrit, like *Godantika, Godanta, Godant* etc.

• English Name: Selenite, ($CaSO_4$, $2H_2O$).

• Varieties

Ayurvedic texts had mentioned four varieties of *Godanti*, according to size. They are:

1. *Kanarupa*
2. *Talakriti*
3. *Pindakriti*
4. *Kousheyakriti*

According to modern chemistry, three varieties are there.

1. Selenite - Transparent, crystalline, fine, sheets.
2. Alabaster - Opaque and granular in form.
3. Satinspar - Transparent, also known as Gypsum.

Few Ayurvedic texts had mentioned *Godanti* as a variety of *Haratala* (Opiment). These two substances are entirely different. Orpiment is a toxic substance, whereas, selenite is not.

• Occurrence

Selenite is found during low-tides in ocean and also found as a mineral in mines. In India, it is found in abundance, in Kangra valley in Punjab. Other localities include Maharashtra, Tamilnadu and Rajasthan.

• Purification

गोदन्तं निम्बूनीरेण द्रोणपुष्पी रसेन वा ।
यामार्द्धेनैव सुस्विन्नं विशुद्ध्यति न संशयः ।। (रसतरंगिणी 11:239)

Selenite is purified by steaming it in lemon juice or in the juice of *Dronapushpi* (Leucas cephalotus), for 1.5 hours.

(Rasatarangini 11:239)

• Incineration

शरावसम्पुटान्तःस्थं गोदन्तं सुविशोधितम् ।
म्रियते पुटितं भस्म जायते शशिसुन्दरम् ।। (रसतरंगिणी 11:240)

The pieces of purified selenite are kept in properly sealed saucers and subjected to heating in *gajaputa*. A white coloured calx of *Godanti* is formed, which looks beautiful like a moon. (Rasatarangini 11:240)

Another method mentioned, is to roast the pieces of purified *Godanti* directly in fire and then powdered. The powder is then processed with aloe juice and dried in the sunlight. It is then subjected to heating *gajaputa*.

• Properties and Usage

Godanti bhasma is extremely cooling, alleviates *Pitta dosha*, arrests bleeding, and ameliorates hyperacidity. It helps healing the ulcers in acid-peptic disease. In burning sensation of body, it is the choicest remedy. It arrests bleeding in diarrhoea, dysentery. It works well in calcium deficiency disorders like rickets, intermittent claudication (calf pain), backache in osteoporosis. In children, it helps to promote their growth and strengthen teeth. In women it effectively controls bleeding in menorrhagia and curbs leucorrhoea.

• Dosage: 60 to 120 mg, with honey.

(5) Kausheyashma (Magnesium Silicate)

Though this substance does not contain calcium, it is incorporated here, for convenience only.

• Characteristics

It is a soft, fragile stone with red-yellowish tinge, but moreover white in colour. Artificially it is prepared by pressing silk threads. *Kousheyashma* is a bad conductor of heat, hence used to protect from fire, in form of clothes.

It contains magnesium and silica.

• Properties and Usage

The calx of *Kousheyashma* is beneficial in diabetes mellitus, menorrhagia and dental infections. According to few, it is also useful in epilepsy.

• Dosage:200 to 240 mg. with proper vehicle (*anupana*).

(6) Badarashma (Fossile Norinite)

• Synonyms: *Badarashma* is also known as *Ashmabhid*, in Sanskrit. In unani medicine, it is called as *Yahuda* or *Hajaratbera*.

• English Name: Fossile Norinite or Fossile Encrinite.

• Characteristics

The stones are of the shape of jujube fruit, hence the name. The stones are tapering at both ends, grey in colour, with lines on the surface. It is tasteless and odourless. From inside, the colour of the stone is greenish-white. Chemically it is composed of lime and grit.

• Occurrence: Found in abundance in Arabastan.

• Purification: Washed with hot water and dried.

Badarashma Pishti: Fine powder (*pishti*) of *Badarashma* is processed with rose water for 3 days. According to others, it can be processed with Sandalwood water or Calotropis procera latex. The fine powder can also be prepared by rubbing the powder of stones in the juice of banana stem, for 7 days.

• Properties and Usage

As it is cooling, instead of its incineration, its fine powder is prepared so as to preserve its cooling property.

It is one of the choicest remedy in urinary disorders associated with burning sensation, frequency and difficulty of urination. It works well in scanty urination (oligouria), anuria, dysuria and in urinary stones. It possesses diuretic and also litholytic property, hence, is the best panacea for urinary stones. In urinary obstruction, the paste of *Badarashma* (by rubbing on stone with water) is applied on the suprapubic region i.e. below the umbilicus.

• Dosage: 500 mg to 1 gm, with rose water or sandalwood water.

II. Animal Source of Calcium

(Including Marine Originates)

(1) Samudraphena (Cuttlebone)

• Synonyms: *Samudraphena* i.e. Cuttlebone, has numerous synonyms in Sanskrit, like *Phena, Saphena, Phenaka, Abdhiphena, Shushkashushka, Payonidham, Sindhuja, Laghavanjana* etc.

• English Name: Sepia, Cuttlefish.

• Scientific Name: Sepia officinalis (Sepiidae)

• Characteristics

Cuttlefish is a *mollusk* (soft boneless animal) in the same class as the squid. It is found in most seas except those surrounding the Americas. It usually lives in deepwater, but it is sometimes found near the shore. It ranges in size from about 3 inches to about 6 feet. The body is brown with crossbands and purple spots. It is brilliantly metallic in sunlight and often changes colour. The body of cuttlefish is oval and surrounded with a frilled fin.

The cuttlefish has eight short arms and two long tentacles (feelers) that surround the mouth. Both the arms and the tentacles have four rows of hard and rough suckers. The

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tentacles can be pulled into pockets behind the eyes. The cuttlefish uses its arms to attach itself to objects, and to capture marine life for food.

The cuttlefish has an internal shell called as the *cuttlebone*. The broad cuttlebone is spongy and chalky. It is fed to canaries and parrots because of its lime food value. It is also used in making toothpaste. Ayurveda has utilised it for medicinal purpose. Though it is commonly translated that *Samudraphena* as cuttlefish, precisely it is cuttlebone.

The cuttlefish moves by forcing water in or out of the space between the cuttlebone and the body. To hide from its enemies, the cuttlefish can darken the water as it moves by pouring out an inky substance containing a brown pigment called '*sepia*'. Ink made from sepia was widely used in ancient times. When cuttlefish dies, its all organs get disintegrated and the cuttlebone (*Samudraphena*) floats on the surface of the sea. It is collected near the coasts.

• Physical Properties

1. *Samudraphena* i.e. cuttlebone, is white brownish in colour having bright white inner surface.
2. It is oblong in shape, tapering at the ends.
3. It is very light, fragile.

• Chemical Composition

Chemically it contains chiefly calcium carbonate ($CaCO_3$), alongwith organic elements.

• Purification

समुद्रफेनः सम्पिष्टो निम्बु तोयेन शुद्ध्यति । (रसचण्डाशु पृष्ठ 72)

The fine powder of cuttlebone is soaked in lemon juice for its purification. It is dried in sunlight and then used.

(Rasachandanshu, p.72)

Cuttlebone contains calcium carbonate and is very fragile. Practically, it is soaked in the lemon juice for 3 days. The procedure of *Marana* is not required. Being an animal originate, it adopts easily with human body and gets absorbed.

• Properties and Usage

Samudraphena alleviates *Pitta* and *Kapha doshas*, has cold potency and astringent taste. It is *lekhana* and is beneficial for eyes. It is seldom used singly, but used in combination. For example, it is used in following mixtures:

(1) Purified *Samudraphena* + *Mriddarashringa* (equal quantity) + honey, as per requirement. This mixture is used for dressing the wounds.

(2) Purified *Samudraphena* + rock candy powder (equal parts) is used in a form of *anjana* to treat corneal opacity.

(3) *Samudraphena* powder is roasted and put into ears to mitigate discharge in otitis.

Samudraphena mitigates *Kapha dosha* as well as toxic metabolites.

• Dosage: 250 mg.

(2) Shukti (Oyster's Shell)

• Synonyms: *Shukti* i.e. Oyster Shell, has various synonyms in Sanskrit, like *Shuktika, Dirghakoshika, Toutika, Durnama* etc.

• English Name: Oyster shell.

• Scientific Name: Crassostrea virginica (American oyster).
Ostrea edulis (European oyster).
Pinctada margaritifera (Pearl oyster)

• Occurrence

Oyster is a type of shellfish found in oceans and coastal inlets in regions with mild to tropical climates. Oysters have a soft, edible body inside a hard, two-piece shell. The shell is often sharp-edged and very irregular in shape. Oysters live at the sea bottom close to the shore, where the water is usually quiet and not deep. Oysters in the United States come from undersea farms that are located along the Atlantic, Pacific and Gulf coasts.

An Oyster's shell consists of two parts called *valves*. Oysters are often called *bivalves*, which means two valves. The valves are held together at one end by a hinge. One valve is deeper, larger and thicker than the other valve; and the oyster's body rests on it. The second valve acts as a lid.

The oyster usually keeps the valves of its shell open just a bit. When an enemy comes near, the oyster snaps the valves shut by means of a strong muscle called *adductor*. The fleshy layer of the skin, the *mantle*, lines the inside of the shell and surrounds the body organs. It produces liquid substances that harden and form the shell. It also makes the colours and designs that appear in the shell. Most oysters live about 7 years, but some live as long as 20 years.

• Chemical Composition

Oyster's shell is composed, mainly, of Calcium Carbonate - $CaCO_3$, alongwith other organic elements.

• Varieties

Two varieties of *Shukti* i.e. Oyster, are mentioned in Ayurvedic texts:

1. *Muktashukti* -The one in which pearl is formed.

2. *Jalashukti* -Which are not capable of forming pearls.

The properties of each variety are different, but both of them are used for medicinal purpose.

• Purification

जयन्त्याः स्वरसेनैव शुक्तिं दोलगतां पचेत् ।
यामैकेनैव नियतं शुक्तिः शुद्धिमवाप्नुयात् ।। (रसतरंगिणी 12:65)

Oyster's shell is purified by cooking them in the juice of *Jayanti* (Sesbania egyptica), with the help of *dola yantra*, for three hours. (Rasatarangini 12:65)

Also, instead of *Jayanti* juice, it can be done by steaming in lemon juice, with the help of *dola yantra*. Before subjecting it for purification, oyster shells are cleaned properly.

• Incineration

शुक्तिकां खण्डशः कृत्वा सम्पुटस्थां ततः पुटेत् ।
हिमकुन्देन्दुसङ्काशा शुक्तेर्भूतिं समाहरेत् ।। (रसतरंगिणी 12:67)

The shells are crushed into fine pieces and sealed properly in saucers and subjected to heating in *gajaputa*. Fine, white coloured incineration (*bhasma*) of oyster's shell is formed. (Rasatarangini 12:67)

Many a times, after giving one *gajaputa*, it is processed with aloe juice and then again one *gajaputa* is given. In practice, it is seen that the *bhasma* is snow-white in colour and does not irritates tongue, when tasted.

Few texts mention, that in saucers, the pulp of aloe is kept above and beneath the purified shells and then *gajaputa* is given. On cooling on its own, it is processed with the lemon juice. With this procedure, the *bhasma* prepared is very soft and snow-white in colour.

• Properties and Usage

Jalashukti is unctuous, stimulates appetite, improves digestion and alleviates the intoxication. It is cooling and alleviates *Pitta dosha*. *Muktashukti* is bitter in the taste, improves the appetite and taste sensation. It also reduces the urine sugar and is used in diseases like heart diseases, asthma and colics.

• Dosage

Shuktibhasma is given 240 to 480 mg, with proper vehicle.

(3) Shankha (Conch)

• Synonyms: *Shankha* i.e. Conch, has numerous synonyms in Sanskrit, like *Samudraja, Kambu, Kshudra, Sunada, Shankhanaka, Trirekha, Dirghanada and Kamboja.*

• English Name: Conch.

• Scientific Name: *Strombus gigas* - Queen Conch. (Phyllum - Mollusca)

• Occurrence

Conches live on the floor of tropical seas. There are many kinds of conches. But in North America, the word conch most commonly means the queen conch, also called the pink conch. The conch ranges from Bermuda, the Bahamas, and the Florida Keys to West Indies. It grows to a length of about 1 foot.

Characteristics

Conch is a large sea snail with a heavy, spiral shell. The shell varies widely in colour from white through pink, yellow, and orange; and has hornlike knobs. The flesh of the queen conch is valued as food and as fish bait. For thousands of years, people have used conch shells as trumpets.

In India, in ancient times, the blowing of conch shells was practiced during wars, to frighten the enemy. In Hindu prayers conch shell is a symbol of *Akash* (space, one of the *Panchamahabhutas*). It is believed that blowing of conch shell averts the evil powers. The external shell is formed as a spiralled out extension of the inner core.

• Chemical Composition

Like Oyster's shell, Conch is also composed, mainly, of Calcium Carbonate -$CaCO_3$, alongwith organic elements.

• Varieties

Two varieties viz. Levorotatory i.e *Vamavarta* and Dextrorotatory i.e. *Dakshinavarta* are mentioned, of which the latter one is supposed to be auspicious. If the pointed mouth like portion is held infront the tall like portion backwards and the opening slit upwards, then these varieties can be recognised easily. The Levorotatary variety is most common while Dextrorotatary is rare.

• Purification

अम्लैः सकाञ्जिकैश्चेव दोलास्विन्नः स शुद्धयति । (र.र.स.4)

Small pieces of conch shells are put in a cloth-pouch and steamed with lemon juice in *dola yantra* for 12 hours and then washed well with hot water. (Rasaratnasamuchchaya 4)

• Incineration

शुद्धशङ्खस्य खण्डानि शरावे स्थापयेत्सुधीः ।
शरावेण पिधायाथ यत्नात्सन्धि प्रलेपयेत् ।।
आतपे त्वथ संशोष्य पुटेत् गजपुटे भिषक् ।।
स्वतःशीतं समुद्धृत्य खल्वे सञ्चूर्णयेद्भिषक् ।।
चूर्णितञ्चाथ विज्ञाय सम्पुटस्थं ततः पुटेत् ।
एवं पुटद्वयेनैव शङ्खको मृतिमाप्नुयात् ।। (रसतरंगिणी 12:17-19)

Purified pieces of conch are properly sealed in saucers,

dried in the sunlight and subjected to heating for giving one *gajaputa*. After cooling, sealing is taken out and conch is further cut into pieces. Again sealed and *gajaputa* is given. This procedure is repeated for two times.

It is also mentioned that conch pieces are directly heated in intense fire and then finely powdered. Purified conch pieces are given many *laghuputas* also. (Rasatarangini 12:17-19)

Another procedure mentioned, is that purified conch is given, once or twice, *gajaputa* and the powder is processed with aloe juice, followed by another *gajaputa*. The final product of *Shankhabhasma* is said to be an ideal one, when it does not irritate the tongue when tasted.

• Properties and Usage

Shankha bhasma i.e. incinerated conch shell, is hot in potency, astringent in property and is the drug of choice for hyperacidity (*amlapitta*) and peptic ulcer (*parinama shula*). It stimulates the appetite, improves digestion, eliminates flatulence and averts vomiting. It is a potent astringent, hence beneficial in diarrhoea, dysentery and chronic colitis. It ameliorates acne, improves complexion and also augments the strength. The dextroratatory variety, which is rare, is supposed to have devine powers, which are described in the texts. Interested persons may refer the original texts.

• Dosage: 240 to 480 mg, with proper vehicle.

Formulations

Agnikumar, Kamadudha, Pravalapanchamrita, Shankha vati, Shankhodara, Sutashekhara, Lokanath rasa, Prataplankeshwar, Vantihridrasa, Mahashankhavati, Chandrodaya varti etc.

(4) Kapardika (Cowrie)

Already mentioned. (Please refer Chapter No. 14 - *Sadharana Rasa*)

(5) Mriga-shringa (Antlers)

• Synonyms: *Mriga-shringa* i.e. Antlers, has various synonyms in Sanskrit, like *Harina-shringa, Mrigavishana, Ena-shringa* etc.

• English Name: Antlers, Deerhorn.

• Characteristics

Deer have hornlike growths that are not true horns. These growths are called *antlers*. Antlers are outgrowths of bone that are part of a deer's skull. Their hard, bony structure and sharp points make them extremely dangerous weapons. Deer that live in mild or cold climates shed their antlers each winter and begin to grow a new set in late spring. New antlers are soft and tender and grow rapidly. A thin layer of skin over the antlers is called *velvet*, as it is soft. As the antlers reach full size, the velvet dries and the deer scrapes it off on the ground or against trees or bushes. All antlers have branches that end in *tines* (points or prongs).

Antlers differ from horns, which are strong, hard layers of skin with a bony core. On cross section, bony core looks dark brown in colour, whereas peripheral region is yellowish-white. There are more than 60 species of deer including caribou, elk, marsh deer, moose, mule deer, musk deer and reindeer.

In ancient Ayurvedic scriptures, few species of deer have been mentioned, whose antlers are used for medicinal purpose.

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हरिणैणकुरङ्गर्क्षगोकर्णमृगमातृकाः ।
शशशम्बरचारुष्कशरभाद्या मृगाः स्मृताः ।।

(अष्टांगहृदय, सूत्रस्थान 6:43)

The species, which are termed '*mriga*' are *harina, ena, kuranga, hriksha, gokarna, mrigamatrika,* (*Kasturi mriga*) *Shasha* and *Shambara.* (Ashtanga Hridaya, Su. 6:43)

• Chemical Composition

Mriga-shringa is chiefly composed of calcium and phosphorus and its chemical composition is - $Ca_3(PO_4)_2$, along with other organic elements.

• Purification

Antlers are cleaned with mild acidic solution.

• Incineration

मृगशृङ्गं समादाय करपत्रेण कर्तयेत् ।
खण्डशः कारयित्वा च अङ्गाराग्नो दहेत्ततः ।।
सुदग्धञ्चाथ विज्ञाय खल्वे सञ्चूर्णयेद्भिषक् ।
रविदुग्धेन सम्पेष्य चक्रिकाः कारयेत्ततः ।।
शरावसम्पुटान्तःस्थं पुटेत्तीव्राग्निना भिषक् ।
त्रिवारं पुटनादेणविषाणं मृतिमाप्नुयात् ।।

(रसतरंगिणी 12:105-107)

Antlers are cut into fine pieces and burnt in fire. Then they are triturated into a fine powder. The powder is rubbed with the latex of *Arka* (Calotropis procera) and made into circular discs. These discs are properly sealed in saucers and subjected to heating by giving 3 *gajaputas.* The fine *bhasma* i.e. calx is formed. (Rasatarangini 12:105-7)

Few texts mention that antlers are burnt into jet black powder (*mashi*), which renders a black coloured *bhasma.* The black coloured *bhasma* is rich in phosphate, whereas white coloured, in calcium.

• Properties and Usage

Mrigashringa bhasma is one of the choicest remedy in treating cardiac pain due to angina pectoris or ischaemic heart diseases. It is recommended to be taken along with cow's ghee, as vehicle. It also works well in cardiac debility, congestive cardiac failure and cardiomyopathy.

Mrigashringa bhasma alleviates *Kapha dosha*, hence it is salutary in asthma, pneumonia, pleurisy and cough.

• Dosage: 1 gm, with proper vehicle.

(6) Kukkutanda tvak (Egg-shell)

• Synonyms: Egg, has synonyms in Sanskrit, like *Anda, Dimba* etc.

• English Name: Egg.

• Characteristics

It has been included in this group in texts written in 20th century. Birds' eggs vary greatly in size, shape and in colour. Hen's Eggs are white in colour, oblong in shape with tapering blunt ends. It is commonly 1" to 2"thick and 2" to 3" long. The shell (*tvak*) is composed of two main layers - an inner *mammary* layer and and outer *spongy* layer. These layers contain pores so water and gases can pass through the shell. A thin film called *bloom* covers the outside of a fresh egg. Bloom tends to seal the egg's pores, reducing the loss of water and gases. Eggs laid by different hens sometimes vary greatly in thickness of shell and the size and number of pores.

• Chemical Composition

The eggshell is composed almost entirely of Calcium Carbonate - $CaCO_3$. This provides the embryo with calcium for the formation of bones and for other body-building purposes.

• Purification

Eggshells are purified by soaking them in saline water for 5-6 hours.

• Incineration

Eggshells are purified in saline water and dried in the sunlight and properly sealed in saucers and subjected to heat in *gajaputa*. A fine incineration, white in colour, is formed.

• Properties and Usage

An eggshell being a rich source of calcium, its *bhasma* is beneficial to build bony tissues in our body. It is useful in children in treating rickets and also to facilitate dental eruption. In hairfall, it works well as a prevention as well as cure. It also helps in nursing mothers, during pregnancy and in children as the best supplement of calcium.

Kukkutanda tvak bhasma (incineration of egg shell) is also indicated in cough, asthma, tuberculosis with cavitation, diarrhoea and menorrhagia.

• Dosage: 250 to 500 mg, three times a day.

In *Pitta* diseases, vehicle is butter and in *Vata* and *Kapha* diseases, it is honey.

(7) Ajasthi (Goat's Bone)

Goat's bone i.e. *Ajasthi* is also a new addition to this class. It might have infered as a substitute for deer horn. She-goat's bones are burnt and *bhasma* is prepared. *Ajasthi bhasma* is indicated in rickets, nursing mothers, hairfall, during dental eruption, during pregnancy as a natural rich source of calcium. Chemical composition of goat's bones is predominently organic calcium compounds, with other organic elements. It is recommended with honey, in a dose of 250 to 500 mg, three times a day.

(8) Pravala (Coral)

Please see Chapter No. 16, (Gemstones and Semiprecious stones)

(9) Mukta (Pearl)

Please see Chapter No. 16, (Gemstones and Semiprecious stones).

III. Plant Source of Calcium

Few plants like *Arjuna* (Terminalia arjuna), *Karanja* (Pongamia glabra), *Arka* (Calotropis procera), *Kutaja* (Holarrhena antidysenterica) and *Kumari* (Aloe vera) contain calcium compounds in considerable amounts..

सर्वादा सर्वभावानां सामान्यं वृद्धिकारणम् ।
ह्रासहेतुर्विशेषश्च प्रवृत्तिरुभयस्य तु ।। (चरकसंहिता-सूत्रस्थान 1:44)

'Similar is homologous and so enriches the similar;
A dissimilar is heterologous and hence it depletes'.

This is called the doctrine of homologous vs. heterologous i.e. '*Samanya-Vishesha Siddhanta*'

(Charaka Samhita, Su. 1:44)

The fundamental principle which is a law of nature, is utilised in Ayurveda for selevtice use of products of natural drugs, and diets for increasing or depleting the similar or dissimilar biological components of the melieu interior in the living body. If in a diseased state a particular category of materials in the body are decreased, a physician has to select similar or homologous drugs, diet and overall life-style. The calcium compounds (*Sudha varga*) are utilised in the same way.

Chapter 18

Poisons and Semipoisons
(Visha & Upavisha)

In the classification of various substances which are used as raw materials for preparation of various drugs, we have come across many substances which are posionous in nature. For example Copper sulphate (*Sasyaka*), Arsenic trisulphide (*Haratal*), Arsenic oxide (*Somala*) etc.

For detail study of such poisonous substances there is a separate subject for examination for students of 2nd year Ayurvedacharya course. viz. 'Agadatantra'. However many poisonous substances are of plant origine, and they are used for preparation of Herbominal drugs, it is necessary to study some of such plants from the Rasashastra point of view. The topics to be covered under this Chapter are Etimology of the word *Visha*, its synonyms, its types and subtypes, substances included under these types, their procurement and storage, their poisonous properties. In addition, various processes to which these are subjected before formation of drugs like purification (*shodhana*), incineration (*marana*), their indications for internal use etc. will also be discussed.

Etimology of the word 'Visha'

The Sanskrit verb from which this word is derived is 'वि + सद्', which means to create a state of body in which there is total loss of power, and extreme lithargy. From this verb a noun viz. 'विषाद', is formed which indicates such stage. It also means dejection, sadness, grief, sorrow, disappointment, despondency, dispair, etc. It can be easily inferred

that all these are symptoms which are basically due to affection of mind and body, or in other words these are various psychosomatic disturbances. Hence a substance which create '*Vishada*' in body is termed as 'विष'. Almost similar views are given in the following verse:

दृष्ट्वैतद्, यद्विषीदन्ति जनास्तस्माद् विषं मतम् ।
नरं वा विषिणीत्येतन्मृत्युपाशैस्ततो विषम् ।। (र.त. 24:1)

The verse further states that it can lead to death even. In short and in simple language, any substance which produces very harmful effects on mind and body is called as *Visha* or poison.

Synonyms of the word 'Visha'

There are many Sanskrit words which are synonyms of the word *Visha*.

1. *Garala*
2. *Kalakuta*
3. *Kshweda* are some of them.

विषं क्ष्वेडश्च गरलं कालकूटश्च तन्मतम् । (र.त. 24:42)

Classification of Poisons

If various compendia, texts, treatises and other literature is browsed, many methods of classification of poisons can be revealed. The criteria for classification are different and hence the substances included in each class may vary from author to author. However the most common method of classification is based upon the occurrance of the poison.

It classifies the poison in 3 different classes. They are :

(a) Sthavara: The poisons which are obtainable from static, nonmobile sources are included under this class, and therefore includes substances obtained from plants and mines. Various Arsenic and Copper compounds and poi-

sons of plant origine like Acontium ferox are examples of this class.

(b) Jangama: The poisons which are obtainable from mobile / living / animal sources are included in this class. The poisons of serpents, scorpions, dogs, insects etc. are included in this class.

खन्यौषधाश्रयं यत्तु विषं तत् स्थावराह्वयम् ।
सर्पादिजन्तुप्रभवं विषं जङ्गमसंज्ञकम् ।। (र.त. 24:3)

(c) Sanyogaja: All artificial poisons are included in this class which is also known *Gara visha*.

It is seen in various texts of Rasashastra, that mainly plant products are used in preparation of various drugs in which the plant products are essential for processes like *shodhana* and *marana* for *Bhavana, Nirvapana, Dhalana* etc. and therefore poisonous plant products are classified, with their toxicity as the parameter for classification. Those plant substances which are very toxic are termed as *Visha* and those which are comparatively less toxic are called as *Upavisha*.

There is yet another term viz. '*Visha-varga*' which is used to indicate the useful and available poisonous substances. They are all grouped under this term. Naturally different texts written in different periods and by different authors contain varying names under the class *Visha-varga*. The number of poisons included also varies from 5 to18.

In this chapter the information is restricted to Poisonous plants which are classified as *Visha* and *Upavisha*.

Occurrance of Poisons and Semipoisons

The static or nonmobile sources of poisons are plants and mines, however the concentration of poisonous properties is not uniformly distributed in all the parts of the plants.

The parts where such poisonous properties are concentrated are used. Such parts can be :

1. Tubers (*Kanda*)
2. Bark (*Sara*)
3. Resins (*Niryasa*)
4. Flowers
5. Roots
6. Fruits
7. Leaves
8. Thick external skin of the stems, plants and
9. Latex.

Because mines are the sources of various metallic and mineral poisons, it is also included in the above list.

कन्दः सारोऽथ निर्यासः पुष्पं मूलं फलं दलम् ।
त्वक् क्षीरं खनिरित्यास्य ह्यधिष्ठानानि वै दश ।। (र.त. 24:5)

Collection of Poisonous Plants

The respective useful parts of the poisonous plants are to be collected when such plants are newly grown, and the useful parts are '*Guru*' in nature, solid in appearance. The parts must be of proved usefulness. There should not be plants having antidotes activity near by. The required parts should be unaffected by environment and ripe.

Attributes of Poisons: Almost all poisons (of plant origine) show some common attributes. Their degree of percentage changes from plant to plant. These are :

1. Laghu
2. Ruksha
3. Vishada
4. Vyavayi
5. Tikshna
6. Sukshma

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7. Ushna
8. Unexplainable tests

Effects of Poison on the Body

Poisonous plants when inadvertently or otherwise are ingested in sufficient quantity, they produce certain symptoms, which are common to all plant products. These symptoms are manifested in the body in bouts (*vegas*). Their severity depends on the toxicity and amount of the poison ingested.

1. In the first stage or bout : Sluggishness and slowing down of the body movements.
2. 2nd bout : Tremors in the body
3. 3rd bout : Burning sensation in body
4. 4th bout : Loss of sensation and/or consciousness
5. 5th bout : Froath & excessive salivation from the mouth
6. 6th stage : Paralysis of upper extremity
7. 7th stage : Heaviness in the body
8. 8th stage : Death

Purification of Poisons

Before poisonous plants are theraputically used they are to be subjected to a process called as purification. This process reduces the toxicity of the poisonous plant product considerably and keeps it to required optimum level.

ये दुर्गुणा विषेऽशुद्धे ते स्युर्हीना विशोधिते ।
तस्माद्विषं प्रयोगेषु शोधितं योजयेद् भिषक् ।। (आ.प्र. 6:47)

If and when such purification processes are carried out the poisonous substances are attributed with certain properties. These are (1) *Rasayana*, (2) *Yogawahi*, (3) *Tridoshaghna* (4) *Brimhana* (5) *Viryavardhaka*, (6) *Pranadayi*.

विषं प्राणहरं प्रोक्तं व्यवायि च विकासि च ।
वातश्लेष्महृदाग्नेयं योगवाहि मदावहम् ।।
तदेव युक्तियुक्तं तु प्राणदायि रसायनम् ।
पथ्याशिनां त्रिदोषघ्नं बृंहणं वीर्यवर्धनम् ।। (आ.प्र. 5:45-46)

'Marana' of the Poison :

Before the poison is used theraputically it is subjected to yet another process called as *Marana*. Though the word '*Marana*' usually consists of giving intense heat to incinerate the substance, here, in this case it consists of just intimately mixing Borax in the poison in equal proportion. This reduces the toxicity of the poison. Further if black pepper is added in twice the quantity of the poison by weight, and then the mixture in tritutrated both *Shodhana* and *Marana* can be achieved together.

समटङ्कणसम्पिष्टं तद्विषं मृतमुच्यते ।
योजयेत् सर्वरोगेषु न विकारं करोति च ।।
तुल्येन टङ्कणेनैव द्विगुणेनोषणेन च ।
विषं संयोजितं शुद्धं मृतं भवति सर्वधा ।। (आ.प्र. 5:60-61)

It is said about the therapeutic property of the poison that when diseased conditions and symptoms are not brought undercontrol by using Mercurial and other mineral products, (which are supposed to be very potent and effective) then in such cases use of poison is very effective. Especially the diseases of *Vata* and *Kapha* dominance are more prone to get destroyed.

नानारसौषधैर्ये तु दुष्टा यान्तीह नो गदाः ।
ते नश्यन्ति विषे दत्ते शीघ्रं वातकफोद्भवाः ।। (आ.प्र. 5:62)

The Dose of the Poison :

The units of measuring weights in the period of the texts must be recalled and understood first.

A single grain of Mustard seed was smallest practical

weight. Weight of six such mustard seeds was considered as one *Yava* and two such *Yava* were equal to one *Gunja*. One *Gunja* in present day is equal to 120 mg. Hence one *Yava* will be equal to about 60 mg. The theraputic dose of the poison as advised in the texts is ⅛th of *Yava*, which comes to about 7.5 mg. It is further stated that as per requirement and necessity, it can be increased up to a *Gunja* i.e. up to 120 mg.

The General Antidotes

The following is a list of substances which are used to treat symptoms arising out of long term use of overdose of poisons.

1. Borax
2. Turmeric
3. Juice of Meghanada
4. Sarpakshi
5. Putrajivaka
6. Lemon juice
7. Powder of Terminalia arjuna
8. Vandhyakarkotaki
9. Trishulika
10. Gojihva
11. Ghee prepared from cow s milk
12. Goat milk

General instructions to the patient who is under treatment with poisons. The following substances, go better with the treatment and patients should be advised to restrict their diet to these substances :

1. Ghee
2. Milk
3. Sugar

4. Honey
5. Wheat
6. Rice
7. Black pepper
8. Rock salt
9. Black grapes (dried)
10. Sweet liquids
11. Cold liquids

Patients are also advised to be in cold climate, cool atmosphere. They should observe strict abstinance.

If the original verses of Ayurveda Prakash which are quoted above, are observed critically the word *Visha* is used in singular form (*Ek vachana*). In otherwords it is in connection with a single poison. In classification of a poisonous plant materials viz. *Visha* and *Upavisha*, only Aconitum ferox is mentioned under the *Visha* class. Hence it seems the above mentioned procedures are for Aconitum ferox only, however there are scholars who consider such procedures for all the poisonous plant products.

POISONS
(Visha)

Only one plant '*Vatsanabha*' (Aconitum ferox), is classified under the group of poisons. (*Visha varga*).

Vatsanabha

Sanskrit name: Vatsanabha

Sanskrit synonyms: Visha, Amrit, Ugra, Garal, Maran, Nag, Kshweda, Stokaka, Mahaushadha, etc.

English name: Monk's hood, Aconite

Latin name: Aconitum ferox (Wall)

Family: Ranunculaceae

Hindi name: Vachhanabha

• Botanical Description

A shrub 30 to 60 cm. high, grows well above 5000 feet height in Kashmir, Nepal and Garawal regions. The leaves are short with a hairy stalk. Flowers are blue in colour resembling to those of pea. The fruit is thorny and the seeds are black in colour and winged.

The rhizomes are 9 cm in length and 1.5 cm to 3 cm in breadth. Externally it is brown in colour but inside it is whitish in colour, oily and shiny.

The rhizomes which are well-grown, big, heavy and unctuous or oily are selected for medicinal usage. The fresh rhizomes are first purified and then used for the medicinal usage, as they are poisonous. *Vatsanabha* rhizomes have a depressant effect on the heart, cause burning sensation in the body and produce fatal effects.

• Purification

The rhizomes of *Vatsanabha* are cut into small pieces (pea-sized) and put into the cow's milk to undergo *swedana* procedure in *dolayantra* for about 6 hours. Sometimes it is also purified by soaking the rhizomes in cow's milk and drying them in the sunlight. The rhizomes contain aconite, a toxin.

• Properties & Uses of Purified Vatsanabha

It is pungent, bitter and astringent in taste, sweet in post digestive effect and hot in potency. It is rejuvenating and *yogavahi*. It alleviates all three *doshas*, especially *Kapa dosha*.

It stokes *agni*, augments the body strength and is used to treat various diseases like gout, asthma, cough, splenic disorders, piles, colitis, tumours, skin afflictions, anaemia, fever and sciatica. It is also useful in nightblindness, earache, low-backache, conjunctivitis, etc. Externally, it is applied in serpant, rat and scorpion bites, with great benefit.

• Treatment of Vatsanabha Poisoning

(1) Poisonous symptoms due to overdosage of *Vatsanabha* are treated with *tankana* (borax) and ghee.

(2) Emesis induced by giving orally, the goat's milk in excess, causes vomiting and alleviates the poisonous effects.

(3) The juice of *Haridra* (turmeric) or *Sarpakshi* juice or ghee is used for the same.

(4) The substances like butter, cow's milk, goat's milk, pulp of black resins, rock candy, asafoetida and the juices of *Prishniparni*, *Jambu* bark-skin, *Tanduliya* and the pulp of *Udumbara* bark-skin are helpful in treating the poisoning caused by *Vatsanabha*.

• Formulations

Vatsanabha, alone, is not used as a drug. It is always used in combinations viz. *Mrityunjaya rasa*, *Hinguleshwar rasa*, *Panchamrita rasa*, *Anandabhairava rasa*, *Sutashekhara rasa*, *Kaphaketu rasa*, *Shivatandava rasa*, *Amritrasayana*, etc.

SEMIPOISONS
(Upavisha)

The plants mentioned in Rasaratnasamuchchaya under the group of *upavisha* are : *Langali*, *Vishatinduka*, *Bhallataka*, *Karavira*, *Bhanga*, *Dhattura* and *Arka*. The group of this seven plants, together, is known as '*Upavisha Varga*'.

In Rasatarangini, total number of plants mentioned as *Upavisha Gana* are eleven. They are : *Vishatinduka bija*

(seeds), *Ahiphena, Jayapal, Dhattura bija* (seeds), *Bhanga, Gunja, Bhallataka, Arkakshira* (latex), *Langli, Snuhikshira* (latex) and *Karavira* (roots). We shall study these plants in brief.

(1) Vishtinduka

Sanskrit name: Vishatinduka

Sanskrit synonyms: Kupilu, Karaskara, Kunchavriksha, Kulaka etc.

English name: Nux vomica

Latin name: Strychnos nux-vomica (Linn)

Family: Loganiaceae

Varga: Upavisha

Hindi name: Kuchila

• Botanical Description

The tree grows upto the height 12-16 metres. The leaves are glabrous, having slight odour. The flowers are small, greenish-white smelling like turmeric. The fruits are ovoid like guava, yellow when ripe, with a very hard shell. The fruit pulp is tender, white and very bitter. The seeds are 2-5 in each fruit, 2 cm in breadth and 0.5 mm in thickness. The seed is big, round like a button, convex on the outer side, soft and covered with striations. The seeds are used for medicinal purpose, after purification. The fruit contains 1.25 to 1.5% strychnine.

• Purification

(1) The seeds are soaked in the sour gruel (*kanji*) for three days. Then the skin of the seeds is separated and they are dried in the sunlight. Finaly, the seeds are ground into a fine powder and then used.

(2) The seeds are fried in ghee by slow heating. The skin of seeds gets separated and then the seeds are finely powdered.

(3) Seeds are soaked in the cow's milk and subjected to *swedana* in *dolayantra* for three hours. The skin of seeds in then separated and the seeds are ground into a fine powder.

• Properties and Uses of Purified Vishatinduka

It is bitter and pungent in taste, pungent in the post digestive effect and hot in potency. It is light, dry and sharp in attributes. It alleviates all three *doshas*, especially, *Kapha* and *Vata*.

It is an appetiser, digestant, diuretic, aphrodisiac, alleviates hyperacidity, improves the taste sensation and mitigates body fats. It is used to treat various diseases like colitis, hysteria, flatulence, dyspepsia, dyspnoea, asthma, cardiac debility, pulmonary oedema, paralysis and facial palsy etc.

• Toxic Effects

Impure *Vishatinduka* causes delirium and paralysis. It creates symptoms like muscular spasms, opisthotonus, tremors and dilation of the pupils.

• Antidote

The toxic effects are alleviated by giving the juice of stalks of betel leaves alongwith cow's ghee.

• Formulations

Agnitundi rasa, Navajeeva rasa, Lakshmivilas rasa, Shulanirmulan rasa, Suptivatari rasa, Vishatinduka vati, Kupiluhingwadi vati, Karaskaradi yoga etc.

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(2) Ahiphena

Sanskrit name: Ahiphena

Sanskrit synonyms: Phaniphena, Nagaphena, Niphena, Ahiphenaka, etc.

English name: Opium

Latin name: Papaver somniferum (Linn.)

Family: Papaveraceae

Varga: Upavisha

Hindi name: Aphim

• Botanical Description

The shrub is 1 to 1.5 metres in height. The leaves are long and wide, alternately arranged with serrated margins. The flowers are red or black and white in colour. The fruit has the size of pomegranate fruit having different cells, small size, and it gets reptured on its own. This is called as 'doda'. The fruit shell is called as 'poshta'. Seeds are white or black in colour, unctuous and sweet. They are known as poppy seeds (poshta dana or khaskhas). The latex of this fruit is called as 'Aphoo'. The raw fruit is incised in the evening and on the next day, early in the morning, the latex is scratched and dried. This is morphine.

The chemical composition reveals that it has 29 different active principles amongst which morphine (5.2%), codeine (0.3 - 4%), thebaine (0.3%) and narcotine (2 to7%) are the main principles.

• Purification

First of all the latex collected is mixed with small quantity of water and then filtered through a fine cloth. Then it is mixed with little amount of cow's milk and heated on a

low flame. When it becomes thick, it is cooled and the clean *Ahiphena* is procured.

It is then purified by processing (*bhavana*) it with ginger juice from 7 to 21 times and finally, a pure form of *Ahiphena* is ready.

• Properties and Uses of Purified Ahiphena

It is bitter and astringent in taste, pungent in the post digestive effect and has hot potency. It has an intoxicating property as its special potency (*prabhava*). It alleviates *Kapha* and *Vata doshas*, but aggravates *Pitta dosha*. In higher doeses it aggravates *Vata* and mitigates *ojas* and produces delirium.

It is astringent, appetiser, digestant, sedative, analgesic, anticonvulsant, styptic in properties. Externally, it is useful as an analgesic and anti-inflammatory, and is used in inflammation of joints, pleura and peritoneum.

Ahiphena is useful in various diseases like anorexia, dyspepsia, bleeding disorders, dysentery, colitis, insomnia. It constricts the pupils and increases intraoccular pressure. *Ahiphena* is stimulant in small dose (30-120 mg) and in high dose it acts as depressant.

It is contraindicated in children, old people, diabetics, renal diseases, pregnancy, pneumonia and meningitis.

• Formulations

Ahiphenasava, *Dugdha vati*, *Nidrodaya vati*, *Karpura rasa*, *Vedantaka malahar*, *Sindura bhushan rasa*, *Mangalodaya vati* etc.

(3) Jayapal

Sanskrit Name:Jayapal

Sanskrit synonyms: Dantibija, Rechak, Sarak, Tittriphala, Kumbhibija, Maladravi, Shodhani, etc.

English name: Kroton

Latin name: Croton tiglium (Linn.)

Family: Euphorbiaceae

Varga: Eranda kula

Hindi name: Jamalgota

• Botanical Description

This is an evergreen small tree. The leaves are 5 to 10 cm. long, slimmy, oblong with 3-5 veins. The flowers are unisexual, greenish yellow, in clusters. Fruits 2 to 5 cm. long, oval but triangular and seeds brown in colour. The seeds contain tiglinic acid, crotonic acid and croton oil. The chief ingredient of the oil is crotonolic acid, which exerts the strong puragative action.

• Purification

The rind of the seeds is removed and then boiled in cow's milk for 1-2 hours. The seeds are then washed with hot water and triturated with lemon juice. Finally, they are dried in sunlight and preserved for use. Elimination of oily part of the seeds helps reducing the irritation of the gastric mucosa.

• Properties and Uses of Purified Jayapal

Jayapala is pungent in taste and post-digestive effect and has hot potency. It possesses heavy, unctuous and sharp attributes. It alleviates *Kapha* and *Vata doshas.*

It is used as a strong purgative in ascites, chronic constipation, intestinal worm infestations and anasarca.

• Toxic Effects

Impure *Jayapal* exerts strong purgative action, abdominal colics, gastritis, hyperhidrosis and bradycardia.

• Antidote

Drugs of sweet taste and cold potency like cow's ghee, cow's milk, butter milk and hot water, lemon juice, sugar are useful as antidote.

• Contraindications

Jayapal should not be used in children, old people, debility, lean individuals, pregnancy and ano-rectal diseases.

• Formulations

Ichchhabhedi rasa, Jalodarari rasa, Jwarari rasa, Anjanabhairava rasa, Vrishchik-vishahara lepa, etc.

(4) Dhattura

Sanskrit name: Dhattura

Sanskrit synonyms: Kitava, Unmatta, Kanaka, Mahamohi, Matula, Matta, Madakar, Shivapriya, etc.

English name: Thorn apple

Latin name: Dhattura stramonium (Linn.)

Family: Atropaceae

Varga: Upavisha

Hindi name: Dhattur

• Botanical Description

Five varieties of *Dhattura* are mentioned in Raja Nighantu, as per the colour of its flowers viz. white, black, blue, red and yellow. The black flowered variety is said to be of more medicinal values.

It is a coarse weedy annual, reaching over 1 metre in height. The leaves are pale green, unequal at the base. The flowers are solitary, large, 10-15 cm. long, with corolla tubular-funnel shaped. The fruit is about 5-6 cm. long, subglobose capsule, covered with fleshy prickles. The seeds are numerous, closely packed, smooth and yellowish brown in colour. Atropine and scompolamine have been isolated from the seeds. The seeds are intoxicant, hence purified before the use.

• Purification

The seeds are boiled in cow's milk or cow's urine for three hours in *dolayantra*. Then they are washed with hot water, dried and then used.

• Properties and Uses of Purified Dhattura

Dhattura is astringent, sweet and bitter in taste, pungent in the post digestive effect and has hot potency. It has a special potency (*prabhava*) as a narcotic. It possesses light and dry attributes and is quickly absorbed (*vyavayi* and *vikasi*). It alleviates *Kapa* and *Vata doshas*.

Externally, the leaf juice is applied in alopecia. The paste of turmeric with juice of *Dhattura* leaves is used in mastitis. In mastitis with galactorrhoea, hot fomentation of leaves is effective. The seeds are beneficial in treating lice and dandruff.

Internally, *Dhattura* is benevolent in treating various diseases like fever with chills, asthma, cough, pain in abdomen, diarrhoea, dysentery and dermatoses.

• Toxic Effects

Impure *Dhattura* exerts the symptoms like dryness of mouth, laryngeal oedema, hoarseness of voice, dilatation of pupils, dryness of skin, narcosis and finally death.

• Antidote

Cow's milk with sugar, *Vacha churna* and curds, the paste of *Samudraphala* triturated in cow's urine are the antidotes of *Dhattura* poisoning.

• Formulations

Kanakasava, *Lakshmivilas rasa*, *Mahajwarankusha*, *Sutashekhara*, *Kanakasundara*, *Pralapantaka rasa* and *Unmadgajankusha rasa* etc.

(5) Bhanga

Sanskrit name: Bhanga

Sanskrit synonyms: Matulani, Madani, Vijaya, Jaya, Mohini, etc.

English name: Indian hemp.

Latin name: Cannabis sativa (Linn.)

Family: Cannabinaceae

Varga: Bhanga kula

Hindi name: Bhang

• Botanical Description

This plant has not been described by Charaka, Sushruta and Vagbhata, but has been described by Bhavaprakash and others.

The herb grows upto 3 metres height. The branches are thin and tender, covered with tiny hair. The leaves are alternate, having 3-7 leaflets arising from each leafstalk. The flowers are small and appear in clusters. The fruits are small, round and granular. The seeds are flat. 'Bhang' means tender branch having flowers, fruits and seeds. 'Ganja' is a female cluster flower containing a resin. And

'Charas' is a substance resembling resin, collected from the leaves and branches of this plant.

It contains resin (charas) canabinone, volatile oil, gum, fat, sugar, wax and potassium nitrate. The plant is intoxicating, narcotic and analgesic. Thus it should be purified before use.

• Purification

It is boiled in cow's milk for 3 hours using *dolayantra*. Then it is washed with water, dried and roasted with cow's ghee on a low flame.

• Properties and Uses of Purified Bhanga

Bhanga is bitter in taste, pungent in the post-digestive effect and has hot potency. It possesses light, dry attributes. It has a special potency (*prabhava*) as narcotic (*madaka*). It alleviates *Vata* and *Kapha doshas*, but aggravates *Pitta dosha*.

It is an appetiser, digestant, astringent, diuretic, hypnotic, aphrodisiac, narcotic and cholegogue in properties. *Bhanga* is beneficial in treating various diseases, asthma, cough, dysmenorrhoea, insomnia and sexual debility etc. Externally used, *Bhanga* ground in a paste, has a diaphoretic and analgesic action.

• Toxic Effects

Excess dose leads to toxic symptoms. In primary stage, *Bhanga*, leads to symptoms like vertigo, laughing, incoherent speech, delirium, tingling in skin, numbness in the skin, feeling laxity and drowsiness. Sometimes patient becomes violent and then in the second stage, intoxication becomes more severe and deep sleep is induced.

• Antidote

Bhanga poisoning is treated by stomach wash, to drink buttermilk, *Bahubija kalka*, curds with *Shunthi* paste etc.

• Formulations

Jatiphaladi churna, *Madanodaya modaka*, *Trailokyavijaya vati*, etc.

(6) Gunja

Sanskrit name: Gunja

Sanskrit synonyms: Chudamani, Raktika, Krishnachudika, Rakta, Tamrika, Aruna, Kamboji etc.

English name: Indian licorrice root

Latin name: Abrus pricatorius (Linn.)

Family: Leguminoseae

Varga: Upavisha

Hindi name: Ratti, Ghughachi

• Botanical Description

Gunja is a creeper with many branches. The leaves resemble tamarind leaves having 20-40 leaflets. Flowers are pink, bluish and appear in cluster. The legumes are 1.5 - 3.5 cm. long containing red, white and black coloured seeds. White coloured seeds are said to be more poisonous. In old days, goldsmiths used one seed of *Gunja* as a unit of weight, which is known as one *Ratti*. Red coloured seeds have a black spot on their tips. The roots and leaves are sweet in taste like that of *Yashtimadhu* (liquorice). The legumes, roots and seeds are used for medicinal purpose. The seeds are poisonous, thus are purified first and then used.

• Purification

Gunja seeds are purified by boiling them in sour gruel (*kanji*) for 3 hours in *dolayantra*.

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• Properties and Uses of Purified Gunja

Gunja seeds are bitter, pungent and astringent in taste, pungent in the post-digestive effect and has hot potency. It possesses light, dry and sharp attributes. It alleviates *Kapha* and *Vata doshas.*

Seeds ground in a paste are applied in skin disorders, chronic ulcers and alopecia. Internally, they are used in *Vata* diseases like paralysis, thigh pain, etc. In works well as an aphrodisiac as well as a general tonic.

• Toxic Effects

Powdered seeds in excess dose causes toxic symptoms like vomiting, diarrhoea, dysuria and cardiac arrest.

• Antidote

The juice of *Chavali* (*Rajmasha*) is given with sugar.

• Formulations

Gunjagarbha rasa, Gunjajivan rasa, Gunjabhadra rasa, Gunjadi taila etc.

(7) Bhallataka

Sanskrit name: Bhallataka

Sanskrit synonyms: Agnimukha, Anala, Krimighna, Arushkara, Vatari, Tapana, Shophakrita, etc.

English name: Marking nut

Latin name: Semecarpus anacardium (Linn.)

Family: Anacardiaceae

Varga: Upavisha

Hindi name: Bhilava

• Botanical Description

It is a medium sized tree growing upto 10-15 metres in height. The bark is grey in colour and exudes an irritant

secretion on incising. The leaves are 30-60 cm. long and 12-30 cm. broad. They are glabrous above and pubescent beneath. The flowers are greenish-white, in panicels. The fruits are 2-3 cm. long, heart shaped, green when raw and turn black on ripening. The ripened fruit contains black, oily and highly vesicant juice; which produces blisters in the skin, on contact. This juice is used tradionally for marking the cloths, hence the plant is known as 'Marking nut'. The fruit, which contains 32% vesicating oil, is used for medicinal purpose, hence is purified before use.

• Purification

Take out the *Bhallataka* fruits alongwith the stalk and keep it in the powder of bricks, for a period of one week. Clean and wash thoroughly by rubbing it, then boil it with milk. Finally, wash it in hot water and dry. This purifies *Bhallataka.*

• Properties and Uses of Purified Bhallataka

Bhallataka is sweet and astringent in taste, sweet in the post-digestive effect and has hot potency. It alleviates *Vata* and *Kapha doshas.* It possesses light, unctuous, hot and sharp attributes. It is extremely heat generating, appetiser, digestant, rejuvenative and aphrodisiac herb.

Externally, the seed oil mixed with sesame oil is used on wounds and sores to prevent the pus formation. In cracked feet, it is mixed with *rala.* Topical application of its oil effectively controls pain in swollen joints.

Internally *Bhallataka* is used to treat a wide range of diseases. It is extremely beneficial in tumours, piles of *Kapha* and *Vata* origin, colitis, dermatoses, flatulence, pain in abdomen, ascites, bronchial asthma, cough, worms and also works well as an aphrodisiac and rejuvenative.

• Toxic Effects

Impure or pure *Bhallataka* if taken in excess dose causes pruritus, burning sensation of anus and tip of the penis, excessive perspiration and thirst. The amount of urine excreted becomes scanty, red or dusky. Topical application causes burning sensation, pruritus and signs of inflammation.

• Antidote

For topical toxic effects, application of sesame oil, coconut oil, ghee etc. alleviate the symptoms. When systemic toxic effects are observed, *Pitta* alleviating herbs like *Durva*, *Sariva*, *Dhanyaka* etc. are used internally.

• Formulations

Bhallataka rasayana, *Bhallatakasava*, *Bhallataka kshirapaka /ksharal taila*, *Tiladi* and *Bhallataka modaka*, *Amritabhallatakavaleha*, *Sanjivani guti* etc.

(8) Karavira

Sanskrit name: Karaveer

Sanskrit synonyms: Hayamara, Vajimara, Ashwamara, Ashwaghna, Ashwantaka, etc.

English name: Rose berry (Spurge)

Latin name: Nerium indicum (Mill)

Family: Apocyanaceae

Varga: Upavisha

Hindi name: Kaner

• Botanical Description

Karavira tree grows upto 3 to 4 metres in height. The root and stem produces branches and sub-branches and thus

makes the tree thickly trellised one. The leaves are in threes, 10-15 cm. long, linear, lanceolate and tapering at the end. On scraping the leaves and bark, latex oozes. The flowers are white, red, yellow and blue in colour and fragrant. The fruit is round or oval in shape, 8 to 10 cm. long. The legumes contain many seeds, which are light and dusky. The root-skin and roots are used for medicinal purpose.

• Purification

The roots are boiled in cow's milk for three hours in *dolayantra*. Then they are washed with hot water, dried and ground before use.

• Properties and Uses of Purified Karavira

It is pungent, bitter and astringent in taste, pungent in the post-digestive effect and has hot potency. It possesses light, dry and sharp attributes. It alleviates *Kapha* and *Vata doshas*.

Externally, the application of root paste is helpful in skin disorders, ulcers and ringworm infection. In conjunctivitis the juice of leaves is instilled into eyes. The root paste is applied topically in piles.

Internally the plant is seldom used because of its toxicity.

• Toxic Effects

Impure or in high doses, it causes cardiac depression, feeble pulse, cardiac arrest, respiratory arrest and then leads to death.

• Antidote

After stomach wash, cow's ghee should be given.

• Formulations

Karaviradya taila, *Karavira yoga* etc.

(9) Langali

Sanskrit name :Langali

Sanskrit synonyms: Vishalya, Hali, Garbhapatini, Agnijihva, Dipta, etc.

English name: Wolf's bane, Glory lilly

Latin name: Gloriosa superba (Linn)

Family: Liliaceae

Varga: Upavisha

Hindi name: Kalihari

• Botanical Description

A climber having attractive flowers has a stalk about 3 to 4 metres in length. The stalk near the ground is crooked like a plough and narrowed distantly. The leaves are stalkless, 15-20 cm. long with hook like tip and climbs taking its support. The flowers are 9-12 cms. long, yellow and red in colour towards periphery. The fruits are 5 cm. long, with multiple round seeds within.

The tuber contains resin, superbine, gloriojine and starch. In very small dose, it causes burning, delirium, nausea and vomiting, when taken orally. Hence, it is seldom used internally. Even for using externally, it is first purified.

• Purification

The tubers of *Langali* are soaked in cow's urine for one day, then dried and used.

• Properties and Uses of Purified Langali

It is bitter and pungent in taste, pungent in the post-digestive effect and has hot potency. It possesses light and sharp attributes. It has a special potency (*prabhava*) as abortefi-

cient i.e. it causes abortion. It alleviates *Vata* and *Kapha doshas*.

Internally, it is used in very low doses as an appetiser, cholegogue, anthelmintic and in difficult labour.

Topical applications of its paste is useful in piles, lymphadenitis, ulcers and swellings. To facilitate the labour, its paste is applied on palms and soles, lower abdominal region and groins. It also facilitates the separation of placenta. To induce abortion, a small piece of its tuber is kept in vagina.

• Toxic Effects

Impure tubers of *Langali* or its excess dose causes abortion and topically causes inflammation, oedema and bleeding at the site. In excess doses, internally, it causes burning sensation in the stomach, acute gastritis, vomiting and diarrhoea.

• Antidote

The substances alleviating *Pitta dosha* like milk, ghee, butter are recommended in diet.

• Formulations

Langali rasayana, *Kasisadi taila* etc.

(10) Arka

Sanskrit name: Arka

Sanskrit synonyms: Tulaphala, Kshiraparna, Shwetarka, Mandar, Alarka, Vasuka, Arkanama, Arkaparna, Raktarka (for red variety) and Shuklarka, Tapana, Supushpa, Vrittamallika (for white variety)

English name: Swallow wort

Latin name: Calotropis procera (R.Br.)

Family: Asclepiadaceae

Varga: Upavisha

Hindi Name: Madar

• Botanical Description

It is a shrub reaching 3-5 metres in height, with thick twisted branches. The young branches are bluntly quadrangular and the bark is ash coloured, covered with a white woolly down. The leaves are large, opposite, spreading, decussate, whitish green in colour, 10-15 cm. long and 3-7 cm. broad. The flowers are rather large, beautiful lilac or purple tinged, arranged in umbellate corymbs on erect cylindrical stout peduncles. The fruits are short, ovoid, curved, thick, fleshy follicles covered with white woolly pubescence.

The root skin, latex (*arka kshira*), flowers, leaves and the *kshara* (alkali) of *Arka* are used for medicinal purpose. The latex has a very strong purgative action.

• Properties and Uses of Arka

Arka is pungent and bitter in taste, pungent in the post-digestive effect and has hot potency. It possesses, light, dry and sharp attributes. It alleviates *Kapha* and *Vata doshas.*

Topically, latex is used in lymphadenitis, tumours, inflammation and alopecia. The leaves are heated and wrapped on the inflammed joints. Latex is also used in toothache and piles.

• Toxic Effects

In large doses, the leaf juice and latex produces toxic symptoms like burning in throat, irritation of the stomach, nausea, vomiting, diarrhoea, tremors, vertigo and convulsions.

• Antidote

First of all withdraw the use of *Arka* or its preparations. The milk and ghee are recommended in the diet.

• Formulations

Mahavatavidhwansa, Ekangavira, Arkavaleha, Arkadi churna, Sutikabharana, Pravalapanchamrita, etc.

(11) Snuhi

Sanskrit name: Snuhi

Sanskrit synonyms: Snuka, Guda, Gandira, Sudha, Vajrantaka, etc.

English name: Common milk hage.

Latin name: Euphorbia neriifolia (Linn.)

Family: Euphorbiaceae

Varga: Upavisha

Hindi name: Thuhara

• Botanical Description

It is a shrub growing 2-6 metres in height. The trunk and branches are covered with thorns. The leaves are 15-30 cm. long, glabrous, thick and fleshy. The flowers are tiny, greenish yellow in colour. The fruit is 1 cm. long with three sacs, containing flat seeds. It has nearly six hundred varieties. The roots, bark, leaves and latex are used for medicinal purpose. The latex exerts a very strong purgative action. It is used in preparing the medicated threads (*kshara sutra*), used in treating fistula in ano.

• Purification

The latex (*snuhi kshira*) and the juice of tamarind leaves (4:1) are mixed together and dried in the sunglight. The latex gets purified.

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• Properties and Uses of Purified Arka kshira

It is pungent in taste and post digestive effect, and has hot potency. It possesses light, sharp and unctuous attributes. It alleviates *Kapha* and *Vata doshas.*

It is an appetiser, digestant, purgative and used in preparing *kshara sutra.* It is used in various diseases like toothache, dermatoses, impotency, piles, ascites, tumours, hepatosplenomegaly, gout and rheumatic disorders.

• Toxic Effects

The latex of *Snuhi* causes a strong purgation.

• Antidote

The cow's ghee is recommended in the diet.

• Formulations

Snuhyadi taila, Vajrakshara, Snuhyadi varti etc.

Chapter 19

The Drugs & Cosmetics Act, 1940

About upto hundred years back i.e. in the period of beginning of the last century, it was customary that Ayurvedic Doctors used to prepare various drugs required in their practice themselves. This was possible mainly because of two reasons. (i) Easy availability of the raw materials in required quantity. (ii) Easy and simple methods of preparation which require machines and instruments available in kitchen of any home. This was true especially for drugs prepared from plant and animal products. For drugs of Rasashastra origine, where the methods are rather tedious, complicated and time consuming the preparation was carried out by one or two skilled workers appointed by the Doctor himself under his own supervision. It was also customary to prescribe raw materials to the patients, they were explained methods of preparation and patients used to prepare their own drugs.

The concept of 'Kitchen Pharmacy' was in actual practice in that period. It was advantageous in two ways : (i) As the selection of raw materials and preparation of drugs was under direct supervision of the Doctor, the quality of the prepared drug was optimum. (ii) The 'overhead' charges being minimum, the drugs were cheap and effective for the patients. In the later period however, this tradition gradually became impracticable and declined. There were many reasons to bring about this change. 1) Increased demand for raw material; 2) Decreased production of the raw material due to deforestation and urbanization of the land; 3) Many fold increase in the requirement of the prac-

ticing Doctors. To overcome these difficulties new industries in the form of Ayurvedic Pharmaceuticals were instituted in the socities. That business also flurished and the number of such industries increased many folds.

It is human nature to earn as much money as possible in industry with as less capital as possible and with as less hardwork as possible. Therefore we observe products of inferior quality in the market. This is also true as far as Pharmaceutical industry is concerned. Such inferior products in Pharmaceutical industries require additional surveillance because they are directly related to the health of human beings and human lives. Therefore, Government has to prepare and impliment laws so that such activities of bad elements from the society will be curbed, prevented, discouraged. In such laws every possible step for deception is considered as well as requirement of ideal conditions are illustrated. In 1940, the then British Indian Government felt the need of such a law and framed it as "DRUGS AND COSMETICS ACT 1940".

One may wonder, why this law is included in the syllabus of an Ayurvedic Graduation course. Presently the law has two-fold concern with Ayurvedic Doctors. Market scope of Ayurvedic Drugs has increased tremendously in last two-three decades. More and more Ayurvedic graduates are entering in the Production and Sell of Ayurvedic Drugs. Same is true with cosmetic industry. Any cosmetic product, may it be in the form of oils, facepacks, shampoos or soaps, when it is marketed with the prefix 'AYURVEDIC' that is sold like hot cakes in the market and hence it is necessary for such prospective enterpreneurs that they should have atleast basic knowledge of Laws governing the business. He should not be under

wrong impression that any Ayurvedic Doctor can prepare Ayurvedic drugs or cosmetic products and sell them in the market without any restrictions.

The other point of concern is rather more important and more practical oriented. When an Ayurvedic Doctor uses medicines on a corectly diagnosed patient and does not get expected results, he suspects that the purchased drug is of inferior quality. With the knowledge of this law he may be able to lodge complaints to various law enforcement authorities. It is, therefore, necessary that every medical student must have at least cursory knowledge of this law.

However, the students are expected to have knowledge of this law as medical students and not as a student of law. This law governs production, packing, distribution and sell of drugs and cosmetics from all the medical disciplines such as Allopathy, Homeopathy, Unani, Ayurved etc. However, a separate part of the Act has been devoted to production, sell, distribution of Ayurvedic drugs and cosmetics to which we should pay more attention.

When such an Act is drafted, the law-makers have to think from all possible angles to seal off all possible loopholes. Any act therefore, necessarily includes (1) Detailed Title; (2) Terminological words with their definitions; (3) Various rules and regulations regarding enforcement of the law and procedures to impliment them; (4) Nature of punishments and other concerned points. To include all these and many other similarly concerned points every act is written in various chapters. Every chapter is devoted to a separate subject. All necessary points under that subject are written and explained under various sections of that chapter. More detailed information under that sections is given with various alphabets as heading of subsection. If

necessary numbers are also used to subclassify such information. This point will be more clearly explained with an example. Suppose, a person has prepared a medicine using adulterated constituents. Then complaint against such person will be registered under subsection (a) of section 27 of Chapter 4. Due to changing policy of the concerned government, and change in many other factors this Act has been changed from time to time and these changes are also incorporated in the Act.

One thing must be made clear in the beginning. We are going to study this Act as a student of Ayurveda and not as a student of Law. In addition, in the syllabus the scope of this study and other details are not mentioned. Hence we are going to study this Act as far as it is applicable to Ayurvedic drugs only and that too in General term. Information of this Act regarding other parts will be imparted in rather abridged form.

General Information

It will be evident from the title of this Act that it was enacted in 1940. India at that time was under British Colonial rule as per Government of India Act, 1935. Legislatures of all the provinces existing during the period had passed resolutions that the British India Government should form such an Act and therefore this Act was drafted and passed on 10th April, 1940.

This act consists of 6 chapters. The first chapter is Introductory in which general information regarding extent of the Act, comencement, jurisdiction, definations of various technical words used in the Act etc. is given. The following is important information from this chapter from point of view of an Ayurvedic student.

(1) This act extents to Allover India.

(2) The provision of this act shall be in addition to, and not in derogation of the Dangerous Drugs Act 1930 and any other Law for the time being in the force.

(3) Definition of Ayurvedic, Siddha or Unani drug:

All medicines intended for internal or external use for or in the diagnosis, treatment, mitigation or prevention of disease or disorder in human beings or in animals and manufactured exclusivedly in accordance with the formulae described in the authorative books of Ayurvedic, Siddha and Unani Tibb system of medicine specified in the first schedule.

(4) Patent or Proprietary medicines in relation to Ayurvedic, Siddha and Unani Tibb system of medicine are - All formulations containing only such ingredients mentioned in the formulae described in the authoritative books of Ayurveda, Siddha and Unani Tibb. Systems of medicine specified in the first schedule but does not include a medicine which is administered by parenteral route and also formulation included in the autharitative books as specified in the clause (a) (which is defination of Ayurvedic drug).

These two terms, from legal point of view, are defined here as far as their constituents are concerned and it is directed here that all such constituents must be Ayurvedic only. Presently, in the Global perspectives, nobody can claim rights to manufacture, sell or use of drugs mentioned in the classical text books. These drugs are called as proprietory drugs. But if one devises new drugs using Ayurvedic constituents, he can claim rights to manufacture and use such a drug by following a specific procedure. Such drugs, which are to be manufactured by a person or company exclusively by rights are called as patent drugs.

The second chapter is totally devoted to formation of Technical Advisory Board, Central Drug Laboratory, Drugs Consultative Committee, their jurisdictions and functions, their powers and working procedures etc. But this whole chapter is not applicable to Ayurvedic drugs because a separate chapter is devoted to these points for Ayurvedic Drugs.

The third chapter concerns with Import of drugs and cosmetics and various definitions, rules and regulations regarding them. The terms like 'Standard drug', 'Misbranded drug', 'Adulterated Drug' and 'Spurious Drug' are defined in this chapter. In addition, rights of the central government to ban import of certain drugs and cosmetics, the procedures of registering offences, nature of penalties etc. are described in this chapter. This chapter also is not directly related to Ayurvedic drugs.

The fourth chapter consists of information about manufacture, distribution, sell etc. of drugs. Definations of standard, misbranded, spurious and adulterated drugs manufactured in India are again proferred. (In previous chapter these definitions were for imported drugs) Again penalties for breaking the rules etc. points are also mentioned in this chapter. It is clearly mentioned at the end of this chapter that it is not applicable to Ayurvedic Drugs.

The next chapter is entitled as Chapter IV-A. This chapter is fully meant for Ayurvedic drugs. This has been mentioned in Section 33-B.

To impliment this Act for Ayurvedic, Siddha and Unani Tibb. systems of medicine, the Central Government is supposed to set up, in cooperation with the state government, various committees, laboratories, etc. for which

members from respective fields, various inspectors, technicians etc. are to be appointed. Procedures for these appointments are explained in this Chapter. The most important part as far as Ayurvedic drugs is various definitions of the words used in connection with Ayurvedic drugs which are of below normal qualities and one is not supposed to manufacture, sell and distribute such drugs, otherwise that will be considered as an offence. Students who are aspiring drug producers, should learn by heart these definitions.

(1) Misbranded Ayurvedic Drugs

An Ayurvedic, Siddha or Unani drugs shall be deemed to be misbranded:

(a) if it is so coloured, coated, powdered, or polished that damage is concealed or if it is made to appear of better or greater theraputic value that it really is; or

(b) if it is not labelled in the prescribed manner; or

(c) if its label or container or anything accompanying the drug bears any statement, design or device which makes any false claim for the drug or which is false or misleading in any particular way.

(2) Adulterated Drugs

An Ayurvedic, Siddha or Unani drug shall be deemed to be adulterated:

(a) if it consists, in whole or in part, of any filthy, putrid or decomposed substance; or

(b) if it has been prepared, packed or stored under insanitary conditions whereby it may have been contaminated with filth or whereby it may have been rendered injurious to health; or

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(c) if its container is composed, in whole or in part of any poisonous or deleterious substance which may render the contents injurious to health; or

(d) if it bears or contains, for purpose of colouring only a colour other than one which is prescribed; or

(e) if it contains any harmful or toxic substances which may render it injurious to health; or

(f) if any substance has been mixed therewith so as to reduce its quality or strength.

(3) Spurious Drugs

An Ayurvedic, Siddha or Unani drug shall be deemed to be spurious:

(a) if it is sold or offered or exibited for sale under a name which belongs to other drug; or

(b) if it is an imitation of or is a substitute for another drug or resembles another drug in a manner likely to deceive or bears upon it or upon its label or container the name of another drug, unless it is plainly and conspicuously marked so as to reveal its true character and its lack of identity with such other drug; or

(c) if the label or container bears the name of an individual or company purporting to be the manufacturer of the drug, which individual or company is fictitious or does not exist; or

(d) if it has been substituted wholly or in part by any other drug or substance; or

(e) if it purports to be the product of a manufacturer of whom it is not truely a product.

After learning these various difinitions the Act now states

that manufacture, sell or distribution of any misbranded, adulterated or spurious Ayurvedic, Siddha or Unani drugs is prohibited. Any patent or proprietory drug should not be sold, distributed or manufactured by any person unless the true list of every constituent is displayed on the container or label in prescribed form. Stock and exibition of such drugs is also not allowed.

It is important to note that these terms are not applicable to drugs which a Doctor manufactures himself for use of his patients only or if it is prepared for the purpose of test, analysis etc.

This Act further describes in detail the power of Central Government to prohibit manufacture, sell, distribution of Ayurvedic Drugs, the appointment and duties of Government Analysts, Inspectors.

If these conditions are not followed, the Government penalizes the offender. Nature of such penalties are also described in this Act. The Government also has right to confiscate the unproperly prepared, distributed, stored or sold Ayurvedic Drugs.

We have already seem that in the first schedule of the Act there is a big list of Ayurvedic Books. The Government has right to amend this first schedule. The procedure to amend the schedule is mentioned at the end of the chapter.

The last chapter i.e. Chapter V (Actually it is the sixth chapter, but the previous chapter is numbered as IV-A instead of V and hence this chapter is numbered as chapter V) is named as Miscellaneous. It contains information about powers bestowed upon the Government in various situations about execution concerning this Act to State

Government. Various offences concerning this Act have been listed and procedures to register such offences by the authorities is explained. But we may not go into details.

As has been explained at the beginning of this chapter, this law is to be studied by students of Ayurvedic course in a limited scope. The purpose of inclusion of this Act in syllabus is to inform the student that a separate law exists for manufacture, distribution, stock and sell of Ayurvedic drugs, there are some regulatory terms and conditions which if they are not followed properly are liable for punishment.

A very important point is, this Act is not applicable to Vaidyas producing medicines for their own patients.

PLATES

Maharasa

Krishna Abhraka
(Mica - black variety)

Shweta Abhraka
(Mica - sheet impure)

Suvarnamakshika
(Chalcopyrite)

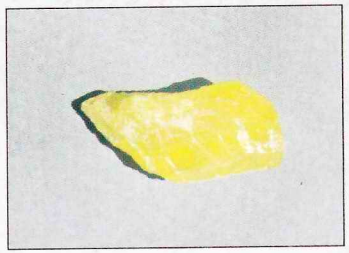
Suvarna Vimala
(Cubic sulphide of iron)

Shilajatu
(Black bitumen)

Sasyaka
(Blue vitriol)

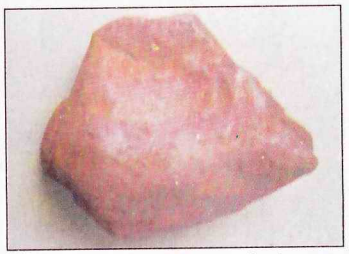
Rasaka (Zinc ore)

Uparasa



Gandhaka (pita) (Yellow Sulphur)

Kankshi (Alum)



Gairika (Hematite)

Shuddha Kankshi
(Alum purified, burnt)

Haratala (Orpiment)

Manashila (Realgar)

Rasanjana

Nilanjana (Galena)

Kankushtha
(Root extract of Rheum emodi)

Sadharanarasa

Kampilla
(Mallotus phillippinensis)

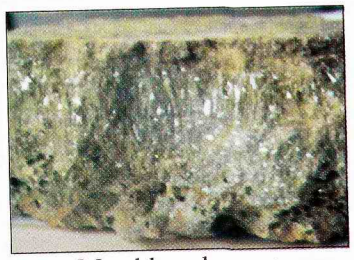
Gouripashana(Vitrious arsenic)

Navasagar
(Salammoniac)

Kaparda
(Cowrie)

Vahinijara
(Ambergrees-synthetic)

Hingula
(Cinnabar)



Mruddarashrunga
(Litharge)

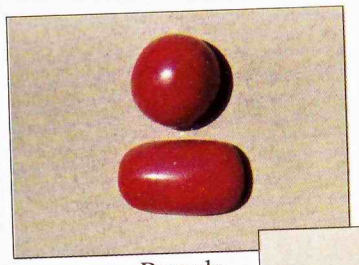
Ratne (gemstones)

Manikya
(Ruby)

Mouktika
(Pearl)

Pushparaga
(Yellow Sapphire)

Tarkshya
(Emerald)



Pravala
(Coral)

Vajra
(Diamond)

Gomeda
(Hessonite)

Neela
(Blue Sapphire)

Vaidurya
(Cat's-eye)

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Uparatne (semiprecious stones)

Suryakant
(Spinel)

Chandrakant
(Moon stone)

Rajavarta
Lapis lazuli)

Peroja
(Turquoise)

Sphatika
(Rock crystal)

Vyomashma
(Jade)

Palanka
(Onyx)

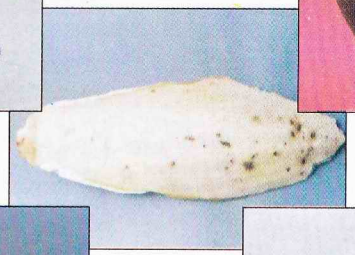
Puttika
(Peridot)

Trunakant
(Amber)

Sudhavarga (calcium compounds)

Muktashukti
(Pearl oyster)

Mrugashrunga
(Antler)



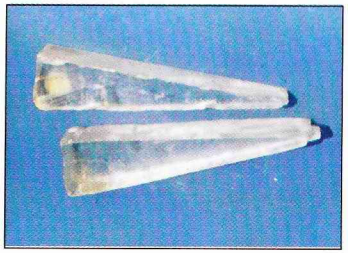
Samudraphena
(Cuttlebone)

Shukti (Oyster shell)

Shankha (Conch)

Kaparda (Cowrie)

Pravala (Coral)



Godanti (Selenite)

Badarashma
(Fossile encrinite)

Plants - as calcium source

Kutaja
(Holarrhena antidyseterica)

Karanja
(Pongamia glabra)

Kumari
(Aloe vera)

Arka
(Calotropis procera)

Arjuna
(Terminalia arjuna)

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