CHAPTER IV

TRANSMUTATION OF BASE METALS INTO GOLD AS DESCRIBED IN THE SANSKRIT ALCHEMICAL TEST "RASĀRNAVAKALPA"[1] AND ITS COMPARISON WITH PARALLEL CHINESE METHODS

"Rasārṇavakalpa" is a Sanskrit alchemical text which chiefly deals with transmutation of base-metals into gold and silver. As seen earlier, the older attempts of such transmutations were found to be fruitless. What the alchemists obtained were metals or alloys with the colour of the desired noble metal. They adopted various methods to achieve this goal. Sometimes a homogeneous alloy of the desired colour was obtained, at other times only the surface layer of the metal was made to look like the noble metal.

A close study of the text Rasārṇavakalpa enables us to draw inferences regarding the processes involved in light of the present state of chemical knowledge.

Needham[2] analyses the so-called transmutation processes given in the Chinese alchemical texts. He differentiates them into the following five categories:

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[1] See Rasārṇavakalpa in Primary Sources.

[2] Needham, Joseph (1), Vol. 5, Pt. II, p. 189.

1. Uniform substrate alloys
2. Surface-layer enrichment by addition
3. Surface-layer enrichment by withdrawal
4. Surface-film formation
5. Special cases.

The above categorisation is adopted here for analysing the processes described in Rasārṇavakalpa.

I. Uniform Substrate Alloys

These alloys are of two types; one is the simple debasement of[3] noble metals, i.e., by adding the base metal or a suitable percentage of two or more base metals to the noble metal, the percentage of the noble metal is thus reduced without changing the colour. The product is more or less the same colour as that of the original noble metal. In the second kind of uniform substrate alloy the noble metal is totally absent. The desirable colour is achieved by mixing or alloying two or more base metals, e.g., brass-making.

i. Debasement of noble metals

Twenty-two carat gold contains 8.3 percent copper and 91.6 percent gold. By further[4] addition of copper to

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[3]Gold and silver and a few other metals are called noble metals because they do not get tarnished easily due to their being chemically inactive. They are much valued also for this reason.

[4]Needham, Joseph (1), Vol. 5, Pt. II, p. 194.

this twenty-two carat gold, the colour changes to pale yellow and to bright golden red. We come across this kind of debasement of gold by copper in Śloka 599.

"Five[5] parts of Rudanti, ground with gold and thrown into molten copper, makes it turn into impotent gold."

In this verse, the quantities of two metals are not mentioned but, since the product is termed as "impotent gold" it could be reddish and hard. The percentage of gold could not be less than fifty percent even for it to go under the name "impotent gold" because beyond fifty percent, copper will cause a distinct red tinge.

A similar process is described in Śloka 762. Here mention is made that the colour of the alloy improves by addition of more and more gold to it.

Likewise,[6] the oil of red variety of "aṅkola" is to be exuded. Copper leaves smeared with this

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[5] Rasārṇavakalpa, Śloka 599, p. 49.

रुदन्त्याश्चैव पञ्चाङ्गं स्वर्णेन सह मर्दयेत् ।
द्रुतशुल्वे प्रतिवापं निर्बीजं कनकं भवेत् ॥ 599 ॥

[6] Rasārṇavakalpa - Śloka 762, 63, p. 58.

अरुणाङ्कोलबीजस्य तैलं पूर्ववदाहृतम् ।

oil are to be roasted in Pūta (fire). This copper admixed with one niśka (a measure) of gold, becomes free from its blackish colour, odourless and when digested with three niskas of gold, are turned into gold.

Śloka 80 - line 2, Śloka 81 - line 1 describe the preparation of an alloy of gold, silver and copper, approximately in the proportions 1:2:6 by weight of the respective metals.

> This[7] copper, having the weight of three times that of silver, is to be amalgamated with the latter on being heated. If with this silver (mixed with copper), gold (half the weight of silver) is mixed, gold of pure quality will be produced.

Simple debasement of silver with copper, the colour remaining white until the latter reaches about fifty percent, after which it is yellowish until seventy percent

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FN. 6 continued

तेन प्रलिप्तनाम्रस्य पत्राणि पुटपाकतः ॥ 762 ॥
कालिमागन्धनिर्मुक्तं निष्कमात्रं कृते सति ।
त्रिनिष्केन च स्वर्णेन गालितं कनकं भवेत् ॥ 763 ॥

[7] Rasārṇavakalpa, Śloka 81-82, p. 12.

ततश्च तारमध्ये तु त्रिगुणं वाहयेत्ततः ।
हेमार्द्धमीलिते हेममात्रिका समतां व्रजेत् ।

and then distinctly red.[8] In certain conditions, therefore, a gold-like alloy is obtained with silver and copper alone. Śloka 473 gives the method for this kind of silver-copper alloy.

> The[9] compound of the two substances will be heated in two stages with equal parts of one-fourteenth of the weight of silver. Gold of the best quality and with the lustre of the rising sun is produced.

Śloka 184 describes an alloy of gold with lead.

> Lead[10] is transmuted instantly by the small balls prepared from the milky juice of Snuhi (Euphorbia Neriifolia) and half niśka of gold, by roasting over fire.

ii. Uniform alloys without the noble metal as a constituent

Uniform alloys of the second type, i.e., without having the noble metal as their constituent are preapred by

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[8] Needham, Joseph (1), Vol. 5, Pt. II, p. 223.

[9] Rasārṇavakalpa, Śloka 473, p. 40.

तयोश्चतुर्दशांशेन नारदेन प्रयोजयेत् ।
जायते च हेमं दिव्यं तरुणादित्यनर्चसम् ॥ 473 ॥

[10] Rasārṇavakalpa, Śloka 184, p. 21.

स्नुहीक्षीरं समादाय निष्कार्धं हेमं धमापयेत् ।
गुटिकाकरणेनैव नागं विध्यति तत्क्षणात् ॥ 184 ॥

two methods. First is amalgamation and the second is brass-making. Amalgams of various metals, e.g., tin, lead, copper are silver-coloured and silver amalgam itself is golden-coloured. This property is made use of in many gold-making processes. Synthesis of amalgam of tin is described in Śloka 803.

> Mercury,[11] one part, transmutes a thousand parts of killed tin (with Eraṇda - or Risinus Communis - oil). This tin remains intact as long as the moon and the stars exist.

The amalgamation of copper is described in Ślokas 260, 363 and 404.

> Copper[12] is transmuted to silver with the aid of sixty-fourth of its weight of the above-mentioned mercury. This silver gives success in the attainment of dharma, artha and kāma.

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[11] Rasārṇavakalpa, Śloka 803, p. 61

हते वङ्गे सहस्रैकं वेधते माससंमितम् ।
तद्वङ्गं वर्धमायाति यावदाचन्द्रतारकम् ॥ 803 ॥

[12] Rasārṇavakalpa, Śloka 260, p. 26.

चतुःषष्ठिप्रयोगेन गुल्ववेधं प्रदापयेत् ।
तच्छुल्वं जायते तारं धर्मकामार्थसाधनम् ॥ 260 ॥

Copper[13] becomes gold with the aid of a compound consisting of sulphur, red chalk, equal quantity of mercury and the juice of Devadali.

Mercury[14] thus rubbed loses its own character and assumes the form of a cake. This cake is to undergo steaming for three days. Copper is to be transmuted with the aid of this mercury.

In Ślokas 130-132, the method of amalgamation is combined with that of debasement of gold. By the addition of increasing amounts of gold to the copper amalgam, the required golden alloy is obtained with decreasing amounts of mercury.

O[15] Beautiful-faced! I shall now tell another means by which the performer attains siddhi. Mercury and the juice of Harindari (Nerium Odorem) kept in the hole of the cow's horn, is to be deposited in heaps of paddy. Mercury is thus killed.

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[13] Rasārṇavakalpa, Śloka 363, p. 32.

गन्धकं गौरिकयुक्तं समभागेन सूतकम् ।
देवदाली समायुक्तं शुल्वमायाति काञ्चनम् ॥ 363 ॥

[14] Rasārṇavakalpa, Śloka 404, p. 35.

मण्डपिण्डं भवेत्तावद्यावत्स्वेदं स्निग्धयम् ।
तेनैव चाष्टमांशेन शुल्वं वेधेन वेधयेत् ॥ 404 ॥

[15] Rasārṇavakalpa, Śloka 130-132, pp. 16-17.

पुनरन्यत्प्रवक्ष्यामि साधकः सिद्धिमेति च ।

> O God-praised! mercury which is killed with the juice of this plant, being digested with equal weight of gold, can attain the power of transmuting ten hundred thousand times its weight of base metals into noble metals. If digested (with gold) four times of its own weight, it (mercury) is endowed with the capacity of transmuting hundred million times its weight of base metals into noble metals. When digested (with gold) six times its own weight, mercury acquires the capacity of transmuting base metals into noble metals, by its mere touch.

Ślokas 375-378 describe the amalgamation of silver to give a golden-coloured alloy. Here the heating is in a closed crucible whereby mercury is not allowed to volatilise and escape.

> Mercury,[16] pounded with sulphur and orpiment and rubbed with bija (pure gold or pure silver) is to be deposited inside the earth for one month. Silver smeared with this, and heated in a closed crucible, becomes gold.

FN. 15 continued

हरीन्दरीरसे न्यस्य गोशृंगे च वरानने ॥ 130 ॥
धान्यराशौ निधातव्यं मृतं तिष्ठति सूतकम् ।
दिव्यौषधीरसेनैव रसेन्द्रे सुरवन्दिते ॥ 131 ॥
समे तु कनके जीर्णं दशलक्षं तु वेधयेत् ।
चतुर्गुणे दशकोटिं षड्गुणे स्पर्शवेधकम् ॥ 132 ॥

[16] Rasārṇavakalpa, Ślokas 357-385, p. 31.

गन्धकं तालपिण्डं च रसं बीजेन मर्दयेत् ॥ 357 ॥

The Ślokas 370 and 373 give the method of brass-making by using calamine or zinc carbonate, copper, copper sulphate. They are heated in the presence of sulphur, Kācalavana[17] and four kinds of basic substances; two of which are plants and two are minerals. The quantities of copper, copper sulphate and calamine added are such as to give approximate proportion of copper to zinc as 2:1. This is the proportion in common brass. The reducing action of sulphur is made use of in this process. Heating of zinc carbonate and copper sulphate will evolve acidic gases such as carbon di-oxide, sulpher di and tri-oxides which are neutralised by the basic substances which are added initially. Sulphur reduces oxides of zinc and copper to respective metals which form an alloy, i.e., brass. Oxides of sulphur which are again formed will react with the four basic substances to form salts. Kāṣalavaṇa acts as a flux in this reaction.

FN. 16 continued

भूमिस्थं मासमेकेन धारयेत्तद्विचक्षणः ।
अन्धमूषागतं ध्मातं तावतैवेन काञ्चनम् ॥ 358 ॥

[17] Kācalavaṇa is the fictitious salt procured by boiling earth impregnated with saline particles or kāṣa.

(Sulphur which has been killed and)[18] the powders of the four alkalline substances like kadali (Musa Sapientum), Apāmārga (Archyranthes Aspera), sesamum and sea-salt are to be arranged in order (one above the other) on "killed" sulphur in the crucible. Over these powders are to be arranged powdered kāṣa having the half powdered kāṣa over it.

One māṣa (a measure weight, about 6 grams) of the powder of blue vitriol and equal weight of copper-leaves are to be placed (in order) on the above substances. (Likewise) one māṣa of calamine is to be arranged over all the substances. The mouth of the crucible is to be then sealed.

The whole substance thus contained in the crucible, is to be roasted over the fire of cow-dung, until copper becomes liquid. This copper will no doubt assume the form of gold, displaying eight shines.

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[18] Rasārṇavakalpa, Śloka 370-373, line 1, p. 32.

... गन्धकम् ॥ 369 ॥

चूर्णं क्रमेण कदल्यपामार्गतिलमाक्षिकक्षाराणि चत्वारि

काचचूर्णं कृत्वा मूषायामर्द्धचूर्णं तु कृत्वा तस्योपरि क्षिपेत् ॥ 370 ॥

तुत्थचूर्णस्य माषैकं तत्समं ताम्रपत्रकम् ।

सर्परं च तथा माषं दत्वा तस्योपरि क्षिपेत् ॥ 371 ॥

काचचूर्णं पुनर्दत्त्वा मुद्रयेन्मूषिकां ततः ।

करीषाग्नौ ननौ ध्मात्वा यावद् ताम्रद्रवं भवेत् ॥ 372 ॥

तत्ताम्रं च भवेत्पीतमष्टवर्णं न संशयः । ... 373 - Line 1

The property[19] of arsenic when present in copper to the extent of two percent giving copper a golden colour is utilised in Śloka[20] 405-406.

> Mercury fixed with the aid of orpiment, is to be roasted with the juice of Mātuluṅga (Citrus Medica). One prasta of this mercury is to be taken by the wise for one month, after being well-advised (by one versed in alchemical preparations). This mercury admixed with betel-leaf and Orpiment undoubtedly turns copper and lead into heavenly gold on being roasted in "Puta".

Surface Film Formation

The other category of transmutation processes is that of a surface film formation. This surface film is either of gold itself or of a yellow-coloured compound formed on the surface, usually a sulphide.

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[19] Needham, Joseph (1), Vol. 5., Pt. II, p. 223.

[20] Rasārṇavakalpa, Śloka 405-406, p. 35.

तालकेन रसं बद्धं मातुलुङ्गो पिचेद्बुधः ॥ 405 ॥
प्रस्थं तु भक्षयेन्प्राज्ञो मासैकेन सुमन्त्रितम् ।
ताम्बूलं पीतया युक्तं सीसके शुल्वकेऽपि च ।
काञ्चनं कुरुते दिव्यं पुटेन तु न संशयः ॥ 406 ॥

II. Surface-layer Enrichment by Addition

Mercury amalgams were used for plating the metal-surfaces, i.e., gilding or silvering, before the invention of electroplating. Molten amalgam of gold and mercury (or silver and mercury) is smeared on the cleansed metal surface. On heating, mercury gets volatilised and a thin layer of gold or silver is obtained on the surface of the metal.

The descriptions of this kind of amalgamation gilding are found in Ślokas 150, 720, 600-602.

> One[21] māsa ball of mercury (mṛtgolaka) and one māsa ball of killed gold are to be rubbed, with citric acid for three days. The leaves of one "karsa" of lead, smeared with this paste of gold and mercury kept in a closed crucible when roasted becomes gold. It (gold) is to be taken out when it cools down by itself. The gold thus produced, is to be collected to attain success in the pursuit of Dharma, Artha, and Kāma.

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[21] Rasārṇavakalpa, Śloka 149-151, p. 18.

मृतगोलकमार्षैकं मार्षैकं हेमगोलकम् ॥ 149 ॥
एकीकृत्य तु संमर्द्य लुङ्गाम्लेन दिनत्रयम् ।
कर्षैकं नागपत्राणि रसकल्केन लेपयेत् ॥ 150 ॥
जायेत कनकं दिव्यमन्धमूषापुटे कृते ।
स्वाङ्गशीतञ्च संग्राह्यं धर्मकामार्थसिद्धिदम् ॥ 151 ॥

Gold,[22] mica, mercury, powder of kānta (magnetic oxide of iron) and moon-water, mixed well and roasted over fire, makes mercury attain the stage of "khota" fixation. By the "touch" of this mercury all metals are transmuted. Metals, when treated with this mercury and roasted in fire becomes gold.

Mercury,[23] gold pyrites, Vimalā (silver pyrites with golden tints), realgar, sulphur, cinnabar and amalgam of gold and mica are to be mixed thoroughly with the juice of Rudanti (Cressa Cretica) for seven days. This is to be smeared on silver foils which on roasting them over fire of cow dung and dipping, in the juice of this plant becomes gold of beautiful lustre.

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[22] Rasārṇavakalpa, Śloka 719-720, p. 55.

काञ्चनं गगनं सूतं कान्तचूर्णञ्च तञ्जलम् ।
मर्दयित्वा ध्मेदग्नौ खोरबद्धः प्रजायते ॥ 719 ॥
तस्य च स्पर्शमात्रेण सर्वलोहानि विध्यति ।
अग्निमध्ये ध्मेत्तान्तु जायते काञ्चनं शुभम् ॥ 720 ॥

[23] Rasārṇavakalpa, Śloka 600-603, p. 49.

रसञ्च मारिकञ्चैव विमला च मनःशिला ।
त्रन्धकं दरदञ्चैव हेमाभ्रकसमान्वितम् ॥ 600 ॥
रुदन्तीरसतः सर्वं मर्दयेत्सप्तवासरान् ।
तेनैव नारपत्राणि लिप्त्वा पुटेन पाचयेत् ॥ 601 ॥
तद्रसे टालयेच्चैव हेमं भवति शोभनम् ।
रुदन्तीपत्र निर्यासं हेमार्द्रकविशोभनम् ॥ 602 ॥

III. Surface-layer Enrichment by Withdrawal

A little different kind of gilding is carried out in Ślokas 602-603. (See Footnote 23.)

> Expressed juice of the leaves of Rudanti (Cresa Cretica) embedded in liquid gold and admixed with copper, is to be smeared on copper-leaves which are to be then roasted in Pūta by one who is endowed with good fortune. Thus smeared and roasted three times, copper can be turned into gold. (602, line 2, and 603)

This is the process Needham[24] names as "Surface-layer enrichment by withdrawal" of the base metal. Either an alloy of the noble metal or that of other metals with a layer of nobel-metal alloy on the surface is used in this method. When heated, the base-metal from the surface layer is oxidised and removed usually with the help of an acid. The noble-metal remains unchanged and this leaves its layer on the surface of the alloy. In the above-mentioned Śloka, copper is first coated with copper-gold alloy and subsequent heating causes copper to form copper oxides which are dissolved in organic acids, whereas gold remains

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FN. 23 continued

मर्दयेत् शुल्वके श्रीमान् शुल्वपत्राणि लेपयेत् ।
लेपञ्च पुटपाकञ्च त्रिभिस्तत्काञ्चनं भवेत् ॥ 603 ॥

[24] Needham, Joseph (1), Vol. 5, Pt. II, p. 250.

unchanged and gilding is thus achieved. The plant Rudanti (Cressa Cretica) provides the organic acid required in the process.

IV. Surface Film Formation and Tinging

A thin layer of yellow sulphide of copper is formed on the surface when copper is exposed to sulphur. The sulphur-giving substances are cinnabar, realgar, orpiment and sulphurous waters. A clear indication of sulphide film formation is in Sloka 79, 744 and 696.

> O[25] Goddess! Sulphur is to be macerated in the juice of Nisāçara. Afterwards it is to be macerated seven times with the juice of Dvipadi (Mesua Ferrea). Silver when annointed with this becomes gold having intrinsic value of one-forth of the value of pure gold.

In this process, sal ammoniac is used to protect the metal surface from oxidation, which helps to make the surface clear as required for the formation of a good sulphide film. The use of ammonium salts for clearing the metal surface is noticed in Sloka 744.

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[25] Rasārnavakalpa, Sloka 79, p. 12.

निशाचररसे देवि गन्धकं भावयेन्नतः ।
तमत्र सप्तवारन्तु द्विपद्याम्ब रसेन तु ॥ 78 ॥
तारपत्रस्य लेपेन त्वर्द्धार्द्धं काञ्चनोपमम् ॥ 79 line 1

> Equal[26] weights of poisonous water, sulphur and orpiment (Haribija), mixed well with the urine of goat, is to be smeared on copper-leaves. O Goddess! roasted in pūta are turned into gold which resemble the colour of cochineal.
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> Copper[27] smeared with water of that kuṇda (tank) is to undergo roasting and is turned into gold by combining with odouriferous matter contained in the water.

Both chloride and carbonate of ammonia attack and colour many metals. This is probably the process in Śloka 113-114.

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[26] Rasārṇavakalpa, Śloka 744, p. 56.

विषोदकं गन्धकञ्च हरिबीजञ्च तत्समम् ।
अनामूत्रे तु संश्लिष्टं ग्रुल्वपत्राणि लेपयेत् ॥ 744 ॥
पुटपाकेन देवेशि दिव्यं भवति काञ्चनम् । 745 Line 1

[27] Rasārṇavakalpa, Śloka 696, p. 53.

संगृह्य तज्जलं तेन ग्रुल्वपत्राणि लेपयेत् ।
हेमं भवति धमानानि तस्यैव तु सुगान्धिनः ॥ 696 ॥

> Calamine[28] is to be macerated seven times with the essence of sal-ammoniac. That rasa (i.e., mercury) which consumes mica, calamine, tikṣṇaloha and lead are to be rubbed together with the essence of sal-ammoniac. (By this process) instantly mercury and calamine become amalgamated. Tikṣṇa, lead and so also copper, on being dyed with calamine, take the form of gold having the lustre of the egg of tortoise.

Dyeing lead with manjiṣtha, i.e., madder, in the presence of sal-ammoniac is noticed in Śloka 110.

> Manjistha[29] and red sandal on being poured into the essence of sal-ammoniac, are to be rubbed afterwards. O Goddess! lead is to be saturated with this mixture. Application of this mixture seven times on lead, will produce gold (from lead).

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[28] Rasārṇavakalpa, Śloka 112-114, p. 15.

नरसाररसैर्माव्यं रसकं सप्तवारतः ।
तद्रसं रसकं चैव तीक्ष्णलोहं च पन्नगम् ॥ ११२ ॥
नरसाररसेनैव तेनैवैकत्र मर्दयेत् ।
तत्क्षणाज्जायते बद्धो रसस्य रसकस्य च ॥ ११३ ॥
तीक्ष्णं नागं तथा शुल्वं रसकेन तु रञ्जयेत् ।
समस्तं जायते हेमकूर्माण्डकसमप्रभम् ॥ ११४ ॥

[29] Rasārṇavakalpa, Śloka 110-111, p. 15.

नरसाररसे दत्त्वा माञ्जिष्ठारक्तचन्दनम् ॥ ११० ॥
स्वरसे मर्दयेत्पश्चात्पन्नगं देवि सेचयेत् ।
सप्तवारेन तद्द्रव्यं काञ्चनं कारुणोदितम् ॥ १११ ॥

V. Special Cases

Gold-making by all the four categories mentioned by Needham in Chinese context is described in the text Rasarṇavakalpa.

Some processes which Needham considers as special cases are absent in Rasārṇavakalpa. Some of these special cases give purple[30] gold. This variety of purple gold contained ninety-five percent copper, one percent silver and 1.05 percent gold; and the purple film is formed upon treatment with the solution of copper acetate, copper sulphate and acetic acid. This kind of purple gold is mentioned in other Sanskrit texts, which we will discuss in a later chapter.

Mosaic gold is conspicuously absent. Ge Hong,[31] the fourth century Chinese alchemist, describes a process for making stannic sulphide, i.e., mosaic gold, by heating tin sulphur and sal-ammoniac. All these substances are frequently mentioned in Rasārṇavakalpa, in a number of syntheses but not that of mosaic gold.

In this way we find that gold-making by various methods was carried out in India at the time of the

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[30] Needham, Joseph (1), Vol. 5, Pt. II, pp. 257, 264.

[31] Needham, Joseph (1), Vol. 5, Pt. II, p. 271; also see Needham, Joseph (3).

writing of the text Rasārṇavakalpa (probably around the eleventh century AD).

The other aspects of alchemy, i.e., elixir-synethsis, are also a prominent feature of this text. A number of recipes are given for elixirs used in the attainment of strength, long life and immortality. Various plant products, mercury, orpiment, realgar, other metals like iron, copper, gold, etc. and their combinations were used in these elixirs. Pills were made using honey, ghee, goat's milk, etc.

In a section on the plant Devadāli (Luffa Echinata), the author gives a recipe for an elixir.

> Leaves,[32] flowers, roots of this excellent medicinal plant are to be taken. The wise should powder (desired) parts of the plant after drying it in shade.

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[32] Rasārṇavakalpa, Śloka 525-530, pp. 44-45.

सपत्रपुष्पमूलाच्च गृहीयात्तां महौजधीम् ।
छायाशुष्कञ्च तां कृत्वा चूर्णयेच्चविचक्षणः ॥ 525 ॥
तन्त्रसेनैव संभाव्य लोहपात्रे च बुद्धिमान् ।
संस्थाप्य सान्नीधाग्नैः पक्वं पात्रं निरन्तरम् ॥ 526 ॥
पाचनान्ते पुटं कृत्वा वमनं तस्य कारयेत् ।
विरेचनं क्रियमाणे तु गोमूत्रं च पाययेत् ॥ 527 ॥

This powder macerated in the juice of this plant and deposited in an iron vessel, is to be kept constantly near fire for fifteen days.

After roasting, it is to be enveloped in a pūta and purified by the process of emesis and purgation. It is then to be dipped into cow's urine.

The sādhaka should then undergo (self-purification by means of) purgation. Take this plant-product along with honey and clarified butter on an auspicious day, when occurs the conjuction of the star with the moon.

It is taken for three weeks, the sādhaka is endowed with an immense power of holding up the earth. By taking this drug for four weeks he becomes free from wrinkles and grey hair, and is cured of all diseases. He lives a long life of three hundred years. By taking this drug for six months he enjoys a long life of thousand years.

Throughout the text we encounter plants with characteristic constituents and chemical actions. The appropriate application of plants and their extracts reveal the extensive research and experimentation carried out by the alchemists. Some of the plants are used as

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FN. 32 continued

ततो विरेचनं कृत्वा नस्त्रे च शुभे दिने ।
मधुसर्पिः समायुक्तः सरसो यत्नतो भवेत् ॥ 528 ॥
त्रिसप्तोह च सम्पूर्णे साधको धारयेद्धरां ।
चतुर्थे सप्तके प्राप्ते वलयः पलितानि च ॥ 529 ॥
सर्वव्याधिविनिर्मुक्तो जीवेद्वर्षशतत्रयम् ।
मासषट्क प्रयोगेन जीवेद्वर्षसहस्रकम् ॥ 530 ॥

organic[33] dyes, reducing[34] agents, organic acids[35] and bases.[36]

The "Poisonous Water" or "Viṣodaka"

Needham[37] mentions a passage from the text "Yu Yang za zu" written by "duan Cheng shi" in the year 863 AD. The writer gives an account of the happenings in the year 648 AD, in which an Indian prince was captured by the Chinese ambassador, Wang xuan ce, and was presented to the Chinese emperor. An Indian scholar who accompanied the captured Indian prince, describes a kind of water to the Chinese emperor. This description agrees with that of a mineral acid Viṣodaka (poisonous water) given in the

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[33]E.g., katutumbi (Langenaria Vulgaris), which is Indian bottle gourd, has a musk-like odour. Musk itself stains the paper yellow (c.f. Chopra, R. N., p. 466) kūṣmaṇḍi (Beninsara Cerifera), i.e., wax-gourd also contains a yellow dye.

[34]E.g., Citraka, i.e., Plumbagin is mentioned to contain a reducing sugar (c.f. Chopra, R. N. and others, p. 386).

[35]E.g., Mātuluṅga (citrus medica) contains citric acid, see RSK, p. 124.

[36]E.g., Apāmārga contains saponins and kadali contains amines, which are bases. (RSK, pp. 121, 123.)

[37]Needham, Joseph (1), Vol. 5, Pt. IV, p. 197.

Rasārṇavakalpa text.[38] The etymology of the Chinese word for mineral acid also suggests its origin in the Sanskrit word "Viṣodaka". We will study this episode in detail in the chapter on Transmission of scientific ideas between India and China.

The above-mentioned evidence suggests that, though the compilation of the text Rasārṇavakalpa took place in the eleventh century AD, its chemical contents were probably known in India some five centuries earlier.

In this way we find that a close study of gold-making processes or aurifaction in Rasārṇavakalpa reveals similarities between these processes to those current in Chinese alchemy. Most of the processes mentioned in the Chinese texts are also found in this text. In particular, gold-making by the first four categories, viz. (i) Uniform substrate alloys, (ii) Surface-layer enrichment by addition, (iii) Surface-layer enrichment by withdrawal, and (iv) Surface film formation is found in the text Rasārṇavakalpa.

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[38] See Rasārṇavakalpa in Primary Sources, p. 55.