

# METALS AND METAL USE IN ANCIENT SRI LANKA

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The discovery of metals and the acquisition of the knowledge and skills of metal use is considered a major leap-forward in the evolution of human civilisation. The first metal made use of by man appears to be copper, and subsequently, its alloy with tin produced bronze which was the strongest metal until iron was found. Copper as a material for making implements has several superior qualities when compared with stone. It could be easily melted and shaped and reshaped according to requirement. Copper implements could retain their shapes for a long time, and even when broken, could be joined together or re-moulded unlike stone implements. Thus, because of these implications and qualities and the revolutionary consequences it brought about, the copper-bronze metallurgy has even been hailed as the first approximation to international science.<sup>1</sup>

The knowledge of copper-bronze technology was possessed not only by the peoples of the middle-east and Egypt, where civilisations first emerged, but also by communities in India and South America.<sup>2</sup> The Bronze Age lasted only for a few millennia when iron, a still stronger metal, was found; and man's ability to make steel marked a further advancement in Iron Age technology. The change from the Bronze Age to Iron Age was again not confined to one geographical area, but was experienced by many regions in several continents. Since the initial phase of copper-bronze and iron, other elemental metals as well as different alloys came to be discovered throughout the progression of history. Man's dexterity in transubstantiating elemental metals into new alloys offered wide choice of metals useful for varying purposes.<sup>3</sup>

Scholarly interest in the study of metals and metal use in antiquity commenced in Europe sometime in the eighteenth century A.D., and it soon grew into a distinctive discipline. But in the South Asian region it was only very recently that scholars began to show any serious interest in this very important area of study.<sup>4</sup> As far as Sri Lanka is

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<sup>1</sup> V. Gordon Childe, *What Happened in History*, Harmondsworth, 1964, p. 86.

<sup>2</sup> *ibid.*, p. 83.

<sup>3</sup> R. J. Forbes, *Metallurgy in Antiquity*, Leiden, 1950, p. 4 ff.

<sup>4</sup> H. C. Bharadvaj, *Aspects of Ancient Indian Technology*, Delhi, 1979. pp. 3 ff.

concerned, except for the pioneering attempts made by Ananda K. Coomaraswamy, Wilhelm Geiger and a few others to understand the technological achievements and skills in metal use, it is only now that attempts are being made to investigate into these aspects in a more scientific manner if at least on a very limited scale.

Ananda Coomaraswamy, in his epoch-making study *Medieval Sinhalese Art*, draws attention to the ability and skills of the Sinhalese craftsmen in the Kandyan kingdom to extract metals from ores and making alloys and their dexterity in working on various metals. Coomaraswamy argues that such an advanced stage of technological abilities and skills must have been the result of a long-standing tradition that had taken shape over the ages, but unfortunately he has not attempted to trace the development of the tradition prior to the Kandyan period.<sup>5</sup> However, Geiger in his *Culture of Ceylon in Medieval Times* cites a few but useful references in the *Culavamsa* to metal crafts and metals used in the early medieval times and highlights the fact that Sri Lankans possessed an admirable tradition of metal crafting.<sup>6</sup>

Several archaeological excavations at ancient historical sites have brought to light evidence of metal smelting as well as some metal objects such as implements and weapons. Though the finding of such items have been noted in the early archaeological reports and a few attempts have been made to carry out chemical analysis of some of those objects<sup>7</sup>, there has hardly been any attempt until recently to study the historical significance of metal use in ancient Sri Lanka.<sup>8</sup>

It has been suggested that the techniques of iron smelting and production of implements were known to the pre-historic people of Sri Lanka, and that iron-using cultures directly superseded the mesolithic culture, thus implying that the island did not

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<sup>5</sup> A.K. Coomaraswamy, *Medieval Sinhalese Art*, New York, 1956, pp. 191 ff.

<sup>6</sup> W. Geiger, *Culture of Ceylon in Medieval Times*, Wiesbaden, 1960, p. 103.

<sup>7</sup> H. Parker, 'Report on Archaeological Discoveries at Tissamaharama in the Southern Province of Ceylon' *Journal of the Royal Asiatic Society, Ceylon Branch*, Vol. VII, no. 27, pp. 95 ff.

<sup>8</sup> A commendable effort in this direction was made by the Sri Lanka Institute of Fundamental Studies in 1987 by convening a symposium on Archaeo-metallurgy of Sri Lanka, but unfortunately, the proceedings of the symposium are yet to be published.

experience a copper-bronze age.<sup>9</sup> Whatever the pre-historic developments were, the earliest references to metal use can be found in some early Brahmi inscriptions which may broadly be assigned to the pre-Christian era. Two inscriptions from Periyapuliyankulama in the Vauniya district refer to two persons who are described as *tabakara*.<sup>10</sup> Paranavitana equates this term with the Pali *tambakāra* and the Sanskrit *tāmrakāra* which means a worker in copper or a 'copper-smith'.<sup>11</sup> Another inscription from the same place refers to a certain Sumana, who is described as a *topasā*.<sup>12</sup> This term has been interpreted as 'tin-smith', as *topa* appears to be the early Sinhalese equivalent of the Pali term *tipu* and the Sanskrit *trapu* which mean tin.<sup>13</sup> The term *tulādara* found in several of the Brahmi inscriptions has been taken to mean a goldsmith'.<sup>14</sup> the term *kabara* prefixed to proper names as found in two inscriptions from Mutugalla in the Polonnaruva district and the Ganekanda Vihara in the Kurunegala district, has been equated with the Pali term *kammāra* and the later Sinhalese *kamburu*, and accordingly been rendered as 'ironsmith'.<sup>15</sup> The *Sihalavatthupakarāṇa* refers to a smith who worked on both copper and gold.<sup>16</sup>

All this evidence points to the presence in early Sri Lanka of artisans specializing in different branches of metal crafting. It is also evident that some of the workers enjoyed a fairly high economic and social standing. For instance, a *kabara* or an iron-smith mentioned in the Ganekanda vihara record was an *anu-jeṭṭa* or a vice-president of a

<sup>9</sup> S.Seneviratne, 'Iron Technology in Sri Lanka: A Preliminary study of Resource use and production technique during the Early Iron Age,' *The Sri Lanka Journal of the Humanities*, Peradeniya, Vol.XI, nos. 1 & 2, 1985 (published in 1987), pp. 129 ff.

<sup>10</sup> S.Paranavitana, *Inscriptions of Ceylon* (Early Brahmi Inscriptions), Vol. I, Colombo, 1970, p.28, ins. 351 and 352.

<sup>11</sup> *ibid.*, p. xcvi.

<sup>12</sup> *ibid.*, p.29, ins no.370.

<sup>13</sup> *ibid.*, p. xcvi.

<sup>14</sup> *ibid.*

<sup>15</sup> *ibid.*

<sup>16</sup> *Sihalavatthupakarāṇa* (ed. P.Buddhadatta), Colombo, 1959, p. 107.

of the island's civilization. In this respect a commentarial passage<sup>20</sup> found in the *Kaṅkhāvitaraṇī* or the *Matikaṭṭhakathā* by Buddhaghosa, the illustrious Buddhist scholar and commentator, deserves special attention. The *Kaṅkhāvitaraṇī* while commenting on the word *pācittiya* (minor offence) and attempting to explain how a *pācittiya* can occur, refers to five categories of *garubhaṅgas* or important items of property belonging to the community of monks as a whole. In this discussion, a long list of metal objects belonging to Buddhist monasteries is found along with several other details which are of use for our purpose.

The *Mātikaṭṭhakathā*, along with several other commentaries, was edited and rendered into Pali by Buddhaghosa in the fifth century A.D. In making use of the data found in the commentaries, one has to keep in mind that, although the commentaries were translated in the fifth century, their content as found today need not be considered as representing conditions exclusive of that century. It is evident that the compilation of the commentarial works was begun at the time of Thera Mahinda in the third century B.C., and that the literature kept on growing ever since, until it was translated into Pali by several scholars including Buddhaghosa. However, as Adikaram has pointed out,<sup>21</sup> the compilation of much of the main body of the original Sinhalese commentaries must have been completed sometime around the first century A.D. In fact, some internal evidence of the Pali commentaries themselves does not seem to warrant an earlier date than the first century A.D. for the content of this body of literature.<sup>22</sup> Hence, although there is no difficulty in considering the data found in the *Kaṅkhāvitaraṇī* as belonging to the pre-fifth century period, it is possible to place it within the broad chronological bracket of the first century A.D. and the fifth century.

The data found in the commentaries for the subject under study is of special significance. Firstly, the Buddhaghosa's commentaries are definitely earlier than the *Mahāvamsa* and thus become one of the earliest groups of sources for Sri Lankan history, and secondly, the historical information found in them is not a result of deliberate

<sup>20</sup> *Kaṅkhāvitaraṇī nāma Mātikaṭṭhakathā*, (Buddhaghosa's commentary on The Patimokkha) Pali Text Society, edited by D. Maskell Stede), London, 1956, pp. 135-137. (Hereinafter *Kaṅkhāvitaraṇī*).

<sup>21</sup> E.W. Adikaram, *Early History of Buddhism in Ceylon*, Colombo, 1949. pp. 33 ff.

<sup>22</sup> See, P.V.B. Karunatilaka, 'Caste and Social change in Ancient Sri Lanka; The Growth of the Caste System in the Early Anuradhapura Period: A Study Based on the Buddhist Commentaries', *Social Science Review, Journal of the Social Scientists' Association of Sri Lanka*, no. IV, Colombo, 1988, pp. 1-30.

insertion, but appears as casual references and parts of commentarial discussions. Thus, there cannot be any doubt about the trustworthiness and the value of the commentarial data for the writing of Sri Lankan history, once their relevance to the island has been ascertained.

The *Kaṅkhāvitarāṇī*<sup>23</sup> passage in question is given below together with my translation.

Ekādasame "samaggena saṅghena" ti samānasamvāsakena samānasīmayaṃ ṭhitena saṅghena saddhiṃ cīvaraṃ datvā; "yathāsanthutan" ti yo mittasandiṭṭhasambhattavasena santhuto tassā ti attho. Pācittiyān ti evaṃ saṅghena saddhiṃ sayameva senā-sanapaññāpakādivasena sammatassa bhikkhuno cīvaraṃ datvā pacchā khīyantassa vācāya pācittiyaṃ.

Rājagahe chabbaggiye ārabha cīvaraṃ datvā pacchā khīyanavatthusmiṃ paññattaṃ. Sādhāraṇapaññatti. Anānattikaṃ. Dhammakamme tikapācittiyaṃ. Cīvaraṃ ṭhapetvā aññaṃ vissajjiyaṃ vebhaṅgiyaṃ parikkhāraṃ datvā pacchā khīyantassa dukkaṭaṃ. Vissajjiyavebhaṅgiya nāma ṭhapetvā pañca garubhaṇḍāni avasesā. Rāsivasena hi pañca garubhaṇḍāni vuttāni. Tattha āraṃ āramavatthu ti ekaṃ. Vihāro vihāravatthu ti dutiyaṃ. Mañco pīṭhaṃ bhisibimbohanan ti tatiyaṃ. Lohakumbhi lohahānakaṃ lohavarako lohakaṭāhaṃ vāsi pharasu kuthāri kuddalo nikhādanan ti catutthaṃ. Valli velu muñjababbajaṃ tiṇapaṇṇaṃ dārubhaṇḍaṃ mattikābhaṇḍan ti pañcamaṃ. Etāni hi pañca saṅghasantakāni neva-Saṅghassa na gaṇapuggalānaṃ vissajjetoṃ vā vibhajitoṃ vā vaṭṭanti. Vissajjitavibhattānipi saṅghikāneva honti. Thāvarena pana thāvaram, itarena ca akappiyena vā mahagghakappiyena vā itaram, saṅghassa upakāraṃ sallakkhetvā kappiyaparivattanena parivattetoṃ vaṭṭati. Varasenāsanādīnaṃ samrakkhaṇatthaṃ lāmakādīni vissajjetoṃ vissajjetvā paribhuñjituñca vaṭṭanti. Ettha ca purimesu tisu rāsīsu agarubhaṇḍaṃ nāma kiñci natthi. Catutthe lohakumbhi araṇjarasaṅghānaṃ lohahānakaṃ lohakaṭāhan ti imāni tīni antamaso pasatamattaṃ udakagaṇhanakānipi garubhaṇḍāni. Lohavarako pana kālaloḥa - tambaloḥa - = kaṃsaloha - vaṭṭalohānaṃ yena kenaci kato Sīhaladīpe pādagaṇhanako bhājetabbo. Pādo nāma Magadhañāliya pañcanaḷimattaṃ gaṇhāti. Tato atireko garubhaṇḍaṃ. Imāni tāva paḷiyāgatāni lohahājanāni. Paḷiyaṃ pana na āgatānipi bhīṅkārapaṭiggaha uluṅkadabbikaṭacchupatitattakasarakasamuggaṅgārapal-lakādhumaṭacchu - ādīni khuddakānipi garubhaṇḍaneva. Ayapatto ayathālakam tambalohathālakān ti imāni pana bhājanīyani. Kaṃsalohavaṭṭalohabhājanavikati saṅghikaparibhogena vā gihivikatāni vā vaṭṭanti. Puggalikaparibhogena na vaṭṭanti. Ṭhapetva pana taṃ bhājanavikatim aññasmimpi kappiyalohabhaṇḍe añjanā añjanīsalākā natthudānaṃ kannamalaharaṇi sūci khuddako pipphaliko khuddankaṃ āraṇṭakam muddikā kuñcīkā tālaṃ kattarayatthivethako bhendivāloko yathā tathā vā ghanakatalohaṃ

<sup>23</sup> *Kankhavitarani*, pp. 135-137.

vippakatalohabhaṇḍaṅca sabbam bhājanīyaṃ. Dhūmanetta - phalāka - dīparukkha - dīpakapallikā - olambakadīpa - ithhipurisatiracchānarūpakāni pana aññāni vā bhitticchadanakavātādisu upanetabbāni. Antamaso lohakhilajaṃ upādāya sabbāni lohahhaṇḍāni garubhaṇḍāni yeva. Attanā laddhānīpi pariharitvā puggalikaparibhogena na paribhuñjitabbāni. Saṅghikaparibhogena ca gihivikaṭāni vā vaṭṭanti. Tipubhaṇḍepi eseva nayo. Khirapāsānamayāni tattikasarakādīni garubhaṇḍāni yeva. Ghaṭako pana telabhājanam vā pādagaṇhanakato atirekameva garubhaṇḍam. Suvannarajata - ārakūtajātīphalikhājanāni gihivikaṭānīpi na vaṭṭanti. Senāsānāparibhoge pana āmāsampi anāmāsampi sabbam vattati. Vāsi-ādisu yāya vāsiyā dantakatthacchedana-ucchutacchanamattato aññam mahākammaṃ kātuṃ na sakkā, ayaṃ pana bhājanīya. Sesā yena kenaci ākārena katā garubhaṇḍā. Pharasu pana antamaso vejjānam sirāvedhako pi garubhaṇḍameva. Tatha kuthāri. Yā pana āvudhasaṅkhepena katā ayaṃ anāmāsā. Kuddālo daṇḍabaddhanikhādanam vā agarubhaṇḍam nāma natthi. Sammuñjāni daṇḍakhaṇanākampana - adaṇḍikaṃ phalamattameva, yaṃ sakkā sipātikāya pakkhipitvā pariharitum tam bhājanīyaṃ. Sikharampi nikhādane neva saṅgahitam. Yehi manussehi vihāre vāsi-ādīni dinnāni honti, te ce ghare daḍḍhe vā vilutte vā detha no bhante upakkhare puna āharitvā demā ti vadanti, dātābbāni. Sace haranti, na vāretabbā. Anāharantāpi na codetabbā. Kammāra - rathakāra - tacchakāra - cundakāra - nalakāra - maṇḍikāra - pattabandhanakānam adhikarāṇī muṭṭhisāṇḍāsātulādīni sabbāni lohamayaupakaraṇāni saṅghe dinnakālato paṭṭhāya garubhaṇḍāni. Tipukottaka - suvaṇṇakāra - cammakāropakaraṇesupi eseva nayo. Ayaṃ pana viseso: tipukottaka - upakaraṇesu tipucchedanakasatthakam, suvaṇṇakāraka - upakaraṇesu suvaṇṇacchedanakasatthakam, cammakāra - upakaraṇesukataparikkammacammachindanakā khuddakā satthī ti imāni bhājanīyāni. Nahāpītatunnakāra upakaraṇesupi ṭhapetvā mahākattarim mahāsāṇḍāsam mahāpīpphalakaṅca sabbam vaṭṭati.

"In Rājagaha this was enacted with reference to the group of six monks on the point of finding faults after giving over the robes. It is a common notion, not an injunction. Keeping aside the robe, having given the other requisites which can be distributed, if one finds faults with, (then) it is a minor offence. What is meant by *vissajjiyavebhaṅga*? The rest (of the items) excluding *garubhaṇḍa*.<sup>24</sup> The *garubhaṇḍas* are of five categories. In this context, *ārāma* means the entire park-land; and that is one (group). *Vihāra* and the *vihāra* land are the second (group). Beds, stools, rugs and pillows are the third (group). Metal pot, metal cauldron, metal pots (small?), metal barrel, adze, axe, small hand-axe, mamoty, digging-rod (or spade) are the fourth (group). Things made of

<sup>24</sup> *garubhaṇḍa* literary means heavy items but in this context it may be rendered as important items or items that should remain in common possession of the *saṅgha*. Also see *Pali Text Society's Pali English Dictionary* (P.T.S.), ed. T.W.Rhys Davids and W.Stede, London, 1929, sv.

creepers, bamboo-reeds, soft grass, thin-reed, wooden items (furniture?), earthenware are the fifth (group). these five categories of items belong to the *saṅgha* (in its entirety) alone, and they should neither be given to a group or individuals (monks) nor should they be divided (or distributed). Even if such items are divided (distributed), they shall still remain in common possession.....

Of the first three groups (of property) mentioned above, no item can be considered as an item not in common possession (*agarubhaṇḍa*). In the fourth group, the metal pot, the big metal receptacle and those vessels that can hold at least three *patas* of water are considered as *garubhaṇḍa*. Metal objects mean any object made of iron (*kāla-loha*), copper (*tamba-loha*), *kaṇṣa-loha*<sup>25</sup> or *vaṭṭa-loha*<sup>26</sup>. For the purpose of measuring, the *pāda* (measurement) used in the *Sīhala-dīpa* should be used. *Pāda*, (in this instance) is taken as equal to five *maḡadha nālis*. Those that are outside the above criterion are *garubhaṇḍas*. Those are the metal objects that have come down to us in the (original) Pali texts.

Those that are not mentioned in the Pali (texts) are spout (or water-jar), water-receptacle, gruel-spoon, ladel, rice-ladel, bowl, porringer, drinking cup, basket or box, cinder-pot, smoke-ladel, though they are small (will still be) considered as *garubhaṇḍa*. Iron-bowl, iron-cauldron (small?) and copper bowl may be divided (or distributed among members). Those objects that are made of *kaṇṣa-loha* and *vaṭṭa-loha* are allowable for common use (of the community) or in accordance with the custom of *gihivikaṭana*.<sup>27</sup> They are not allowable for individual use (possession?).

In addition to the utensils referred to above, others such as collyrium-holder, collyrium-sticks, nasal-drop-sprinklers, ear-picks, needles (or small drilling needles), scissors, thorn-removers, signet-rings or seals, keys, gongs, walking-

<sup>25</sup> For the interpretation of this term, see *infra.*, pp. 114-115

<sup>26</sup> For the interpretation of this term, see *infra.*, pp. 114-115

<sup>27</sup> The term *Gihivikaṭāni* has been interpreted in the *Vinayattha-Maṅjūsā*, the sub-commentary to the *Kaṅkhāvitarāṇī* as acquisition for oneself having changed the mode of community use, see *Vinayattha-Maṅjūsānāma Kaṅkhāvitarāṇī Tīkā*, ed. U.P.Ekanayake, Colombo, 1912, p. 255.

stick covers, *bheṇḍivālakas*<sup>28</sup> and both heavy and light utensils made of metals are also allowable for division (or distribution among individual monks). Smoke-tubes,<sup>29</sup> *phālakas*,<sup>30</sup> lamp-stands, chandeliers and pictures of men and women, animals etc., wall covers should be kept in their proper places (should not be given away?). All others, inclusive of even a metal peg, may be regarded as *garubhaṇḍa*. Even those that are offered to oneself should not be used individually; they must be used collectively. Even those utensils made of tin must be used in the same manner. Those utensils such as plates and mugs made of white-stone (marble?) are regarded as *garubhaṇḍa*. Those utensils other than small pots, oil-receptacles and vessels of the volume of a single *pāda* (measure) are considered as *garubhaṇḍas*. Utensils made of gold, silver, *ārakūṭa*<sup>31</sup> and precious stones (*jāti-phalika*) or quartz are not allowable even in accordance with the custom of *gihivikaṇa*. In regard to razors (it is said) that a razor may be used for simple tasks such as cutting tooth-picks and peeling sugar-cane, but bigger tasks cannot be performed with a razor. This is the (method of) division. The rest has been made *garubhaṇḍa* somehow or other.

As regards the axe, (even the axe-like) instrument used by physicians for opening blood vessels is treated as a *garubhaṇḍa*. So is the case with the hand-axe. Indeed, whatever is made for use as a weapon may not be touched. *Sikhara*<sup>32</sup> and *nikhādana*<sup>33</sup> (chisel or digging-rod) should be taken together. If some implements such as adze had been given to the monastery by some persons and in the event of their houses being burgled or burnt by fire, in such instances, when such persons make requests to borrow implements for use, they

<sup>28</sup> The term *bheṇḍivālaka* has been interpreted as a weapon (*P. T.S. Dictionary*, sv.) but it may also be taken to mean a heavy digging-rod.

<sup>29</sup> *Dhūmanetta* has been explained as an instrument used in the medical profession, *Pali-English Dictionary*, (P.T.S.), sv

<sup>30</sup> *Phālaka* may have been an instrument used for splitting or cutting in surgical operations, *Pali-English Dictionary*, (P.T.S.), sv.

<sup>31</sup> For the interpretation of this term see *infra*. pp.114-115

<sup>32</sup> The meaning of this term is not clear, perhaps it was a digging rod or similar implement.

<sup>33</sup> This has been interpreted as scissors used by tailors, see M.Sumangala, *Pāli-Sinhala Śabdakoṣaya*, Colombo, 1965, p. 320.



should be given to them on the understanding that the implements are returned (after use) to the monastery.

Implements such as hammers, pliers (or tweezers) and scales used by blacksmiths, implements used by chariot makers, carpenters, lime-burners, workers on reed, lapidaries and makers of bowls (potters?) become *garubhaṇḍa* from the time such implements are given to the *sangha*. So is the rule regarding tools used by workers on tin, goldsmiths and leather-workers. There is, however, an exception. Of the implements used by workers on tin, the instrument for cutting tin; of the implements used by goldsmiths, the instrument used for cutting gold; and the small cutting instrument among the leather-worker's tools, are items that may be divided (or distributed among individuals). Of the implements used by barbers and weavers, all implements excepting the large scissors, the large tweezer and the scissors known as *pipphalaka* are allowable (for division)."

A few important points that emerge from the above commentarial passage deserve special attention. In the first place, the long list of metal objects and implements given in the commentary is not found in the original canonical work and this precludes the possibility that this description had any relevance to India. In fact, the commentary itself informs us that, except for the names of a few items, the rest of the details given in it is not mentioned in the canonical text. It is also noteworthy that the commentary emphasizes the need to use *pāda* measurement prevalent in Sri Lanka in calculating the volume of the vessels mentioned therein. These facts definitely point to the conclusion that the passage in question was composed in Sri Lanka, and therefore, there can be no doubt that it depicts conditions in the island at the time it was compiled. Thus the *Kankhavitāraṇi* passage provides the earliest known list of metal objects of varying use in Sri Lanka. It is also the first such list of items in the possession of the Buddhist monasteries in the country. Therefore its relevance and significance in the study of metal use in the island cannot be over-emphasized.

In addition to the list of metal objects, this commentarial passage gives the names of several kinds of metals used in turning out equipment, vessels, implements etc. They include *kāla-loha*, *Kaṃsa-loha*, *vaṭṭa-loha* and *ārakūṭa*. Of these different metals, *kāla-loha* and *tamba-loha* can be identified as iron and copper respectively, and their use in manufacturing various objects is well attested by archaeological and literary evidence. The term *kamsa-loha* is explained in the *Pali Text Society Dictionary* as brass,<sup>34</sup> but the word *ārakūṭa* is not explained in it. No reference at all is found to the term *vaṭṭaloha* in this dictionary. Neither this term nor any other term close to it is found in the *Sanskrit-*

<sup>34</sup> *Pali-English Dictionary*, (P.T.S.), sv.

*English Dictionary* either. Monier Williams explains the term *ārakūṭa* as brass.<sup>35</sup> The *Amarakoṣa* of Amarasimha, the famous Sanskrit lexicon, too, gives *ārakūṭa* as a synonym of *pittala*<sup>36</sup>, which is the common Sanskrit term for brass. However, these explanations are certainly inadequate for a proper understanding of the exact type of metals mentioned in the *Kaṅkhāvitaraṇī*.

In this regard, a passage in the *Sammohavinodanī*, another commentary by Buddhagoṣa seems to shed some welcome light. In this commentary, *kaṃsa-loha*, *vaṭṭa-loha* and *ārakūṭa* are described as *kittima-loha* or artificial metals.<sup>37</sup> Thus, the existence of *vaṭṭa-loha* as an alloyed metal, though not found in contemporary Indian sources, is confirmed again without doubt. The *Sammohavinodanī* reference also shows that the author was aware of the distinction between elementary metals and alloyed metals, and therefore it is reasonable to assume that he was also aware of the metallic composition of these different alloyed metals. Unfortunately, the commentary is silent about that aspect. Nevertheless, the sub-commentary to the *Kaṅkhāvitaraṇī*, which is also known as the *Vinayattha-mañjūsā* written by one Buddhānāga in the twelfth century A.D., obviously based on sources of much early origin, gives very useful information in an interesting explanation which is very helpful in understanding the exact nature of these three artificial metals.

The relevant sub-commentary passage is as follows:

'*Kālalōha tambaloha kaṃsaloha vaṭṭanti: Ettha kaṃsa lohaṃ vaṭṭa lohaṃca kittima lohaṃ, tīni kittima lohāni; kaṃsa vaṭṭalohaṃ ārakūṭānti. Tattha tipu tambe missevā kataṃ kaṃsa lohaṃ: sīsa tambe missevā kataṃ vaṭṭa lohaṃ; rasa tambe missevā kataṃ hārakūṭaṃ. Tena vuttaṃ kaṃsa lohaṃ vaṭṭalohaṃ kittima lohaṃ.*'<sup>38</sup>

<sup>35</sup> M. Williams, *Sanskrit-English Dictionary*, Oxford, 1899, sv.

<sup>36</sup> *Amarakoṣa of Amarasimha*, ed. R.S. Talekar, Bombay, 1907. p.234.

<sup>37</sup> *Sammohavinodanī* (P.T.S. edition) ed. P. Buddhādatta, London, 1923, p.63, *kaṃsa-lohaṃ vaṭṭa-lohaṃ ārakūṭaṃ ti tīni kittimalohāni nāma.*

<sup>38</sup> *Vinayattha-Mañjūsā nāma Kaṅkhāvitaraṇī Tīkā*, ed. U.P. Ekanayake, Colombo, 1912, p. 254.

A literal translation of the passage is given below:

There, *kaṃsa-loha* and *vaṭṭa-loha* are artificial metals; artificial metals are of three kinds; (namely) *kaṃsa-loha*, *vaṭṭa-loha* and *ārakūṭa*. In this, tin and copper are mixed to make *kaṃsa-loha* (while) *vaṭṭa-loha* is the mixture of lead and copper. *Ārakūṭa* is made by mixing copper with mercury. so it is said that *kaṃsa-loha*, *vaṭṭa-loha* and *ārakūṭa* are artificial metals.'

In this explanation the author of the sub-commentary categorizes the three metals *kaṃsa-loha*, *vaṭṭa-loha* and *ārakūṭa* as *kittima-loha* or artificial metals thereby making the distinction between elementary metals and alloys. The fact that this knowledge was available as early as the time of Buddhagoṣa or even earlier is proved by the two references in the Buddhagoṣa commentaries. It is of interest to note that, although *vaṭṭaloha* and *kaṃsa-loha* are alloys of two base metals (i.e. tin and copper = *kaṃsa-loha* lead and copper = *vaṭṭa-loha*), *ārakūṭa* cannot be considered as an alloy according to modern scientific classification. It is an amalgam, commonly known as copper-amalgam, as it is the result of a mixture of copper and mercury.<sup>39</sup> But an interesting fact that emerges of this data is that, although the term *ārakūṭa* is explained in the Sanskrit sources as a synonym of *pittala* or brass, it cannot actually be considered brass or even an alloy like brass. In fact, it has an entirely different metal composition, and is produced through a different process. Thus it belongs to a class of metal different from brass.

The *Kaṅkhāvitaranī* passage contains names of over fifty metal objects including different types of tools, implements, instruments and vessels. Some of these are obviously implements needed in agriculture while some others are simple household utensils like plates, cauldrons, pots, scissors and tweezers. Another group includes instruments used by craftsmen such as goldsmiths, coppersmiths and workers on tin. This wide variety of instruments and implements that appear to have been in the possession of at least certain monasteries is of immense interest, since they give a clear indication of the nature of the involvements of the monasteries in this period.

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<sup>39</sup> See Kunzets, *Chemical Encyclopedia*, London, 1961, pp. 39-52. The author is thankful to Professors Vijaya Kumar and O. Illeperuma of the Department of Chemistry, University of Peradeniya for drawing his attention this information.

It is a well known fact that Buddhist monasteries in ancient Sri Lanka had been well endowed with various sources of income mainly based on land and agriculture.<sup>40</sup> In some of his commentaries Buddhaghosa makes reference to such land and irrigation rights which the monasteries had come to own. Rules and regulations governing them are also enumerated in some of his works.<sup>41</sup> Accordingly, the cultivation of that land becomes the responsibility of the institution concerned. Some monastic land was cultivated on a share-cropping basis while some other land was brought under cultivation making use of the *corvée* labour available to the monasteries.<sup>42</sup> Certain north Indian Buddhist monasteries used the labour of monastic servants<sup>43</sup> for cultivating some of the land they held. It may well have been the practice in some Sri Lankan monasteries too. The larger monasteries had a fairly strong work force at their service. Moreover, they also owned slaves whose labour could have been made use of for agricultural purposes.<sup>44</sup> In such circumstances, it would have been the responsibility of the monastery to provide the labourers with the necessary equipment and implements, and this would explain the need for the monasteries to possess such items in common ownership of the *saṅgha*.

It is also evident that Sri Lankan Buddhist monasteries had several groups of artisans in their service, some of whom at least served on a permanent basis. These included carpenters, wood-carvers, potters, brick-makers, lapidaries, blacksmiths, lime-burners, weavers and possibly various other categories of workers.<sup>45</sup> As in the case of agricultural labourers, the monastery must have been expected to provide these workmen with the necessary equipment. This shows the need for the monasteries to have in possession such items like implements used by workers on tin, goldsmiths, copper-smiths,

<sup>40</sup> See R.A.L.H.Gunawardana, *Robe and Plough, Monasticism and Economic Interest in Early Medieval Sri Lanka*, Tucson, 1979, pp. 53 ff.

<sup>41</sup> See for instance, *Samantapāsādikā*, ed. J. Takakusu and M. Nagai, P.T.S.edition, Vol. III, London, 1930, pp. 678-80, *ibid.* vol. VI, 1947, pp. 1246 f.

<sup>42</sup> R.A.L.H.Gunawardana, *op.cit.*, pp. 184 ff.

<sup>43</sup> P.V.B.Karunatilaka, 'Buddhist Monasteries in North India: Their Economic Functions in Early Medieval Times', *Journal of Humanities and Social Sciences of the University of Kelaniya Vols. III & IV, 1984-85*, pp.84-103. See especially, p.99.

<sup>44</sup> R.A.L.H.Gunawardana, *op.cit.*, pp. 98 ff.

<sup>45</sup> *ibid.*, pp. 117-118 and 339-343.

leather-workers' tools such as the small cutting instrument, implements used by barbers and weavers, carpenters, lime-burners, workers on read, lapidaries and makers of bowls (potters).

In fact, recent excavations at several monastic sites have yielded furnaces, crucibles, slabs of metals and some metal implements, suggesting that those monasteries themselves were involved in smelting iron and other metals and turning out implements.<sup>46</sup> If the monasteries had the necessary resources, labour and equipment, as shown above, it would not have been difficult for them to engage themselves in this kind of endeavours. What is still more significant is the role of the monastery in promoting different crafts including iron-smelting and metal craft. It adds another dimension to the multi-faceted activities in which these institutions had been involved. However, available data is inadequate to state whether the monasteries were mass-producing metal objects for commercial purposes, but such a possibility cannot be easily discounted. The few furnaces found at some ancient monastic sites seem to indicate that iron-smelting was done on a mass-scale; and if so, their production must certainly have surpassed the monastic requirements.

Reference to instruments used by physicians also direct our attention to another area in which many monasteries played a prominent role. It is quite evident from many literary and epigraphic references that some monasteries in ancient Sri Lanka had hospitals (*vejja-sālā* or *ved-hal*) attached to them.<sup>47</sup> Epigraphic evidence is also available of physicians and other medical staff on monastic pay-rolls.<sup>48</sup> Even those monasteries that did not maintain hospitals may have employed physicians on a permanent basis to attend to the medical requirements of resident monks.

It is important to note that one of the instruments used by physicians as mentioned in the *Kaṅkhāvitaraṇī* passage was an axe-like instrument used to open blood-vessels; thus it must have been a surgical instrument. Literary evidence is available of some surgical operations performed in ancient Sri Lanka,<sup>49</sup> but the earliest known

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<sup>46</sup> See, S.U.Deraniyagala, 'The Citadel of Anuradhapura, 1969 Excavations in the Gedige area', *Ancient Ceylon*, no. 2, pp. 48-169.

<sup>47</sup> R.A.L.H.Gunawardana, *op.cit.*, pp. 19, 71 and 147. Also see S.Paranavitana, 'Medicine and Hygiene as Practiced in Ancient Ceylon,' *Ceylon Historical Journal*, Vol. III, no. 2, Oct. 1953, pp. 123-35.

<sup>48</sup> *ibid.*

<sup>49</sup> *Culavamsa*, XXXIX, 113, 128.

surgical instruments found in archaeological excavations belong to the eleventh - twelfth century period.<sup>50</sup> They are the very impressive collection of surgical instruments found at the Alāhana-parivena site at Polonnaruwa. Yet, the *Kaṅkhāvitarāṇī* reference is significant in that it is one of the earliest references to a specific surgical instrument with details of its shape.

Even the limited amount of data discussed above clearly shows that the early Sri Lankans had mastered the use of different metals, and developed skills in making various alloys and amalgams through different processes. The metallurgical techniques they have employed presuppose the ability to generate high temperatures required in melting ores and making of metals, for which ordinary charcoal would not have been sufficient. However, we know nothing definite of the different techniques, processes and methods used in metal production. But what we can say with a degree of certainty is that Sri Lankans had made major advances in metal technology at least by the fifth century A.D., if not earlier. The various references to different crafts using metals is further evidence of craft specialization, which had begun long before the conditions depicted in the commentaries. Another important aspect that has emerged from the above discussion is the crucial role that appears to have been played by the Buddhist monasteries in promoting metal craft as a part of their involvement in economic functions. By being major centres for resource concentration, at least some of these monasteries must have been well placed to play the role of promoters of technological knowledge and skills.

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<sup>50</sup>. P.L.Prematilaka, *Ālāhana Parivena, Polonnaruwa. Archaeological Excavation Report*, April-September, October, 1982, (Central Cultural Fund, Colombo.).

corporate body (*pukaṇa* = Pali *pūga*),<sup>17</sup> perhaps a guild of artisans. It is worth noting that all the artisans referred to in the above mentioned inscriptions were donors of dwelling quarters to the *saṅgha* and such benefactions could have been made only by persons who had substantial means at their disposal.

The Brahmi inscriptions reveal that guilds of artisans were among a number of corporate bodies of different occupational groups that existed at the time and this presupposes a highly organized nature of different crafts and trades.<sup>18</sup> In this context, therefore, the fact that even some artisans who were involved in metal smithy had been organized into guilds is not without significance. This not only points to craft specialization, but also to the possible high demand that existed for metal implements and other items of varying types. Apart from the requirement for weapons, ornaments, agricultural equipments and other implements, major construction work also appears to have generated a demand for the services of metal smiths. For instance, the *Mahāvamsa* informs us that king Dutthagamani had the roof of the Lohapāsāda covered with copper sheets, and that the copper was found at a village called Tambapitthigāma.<sup>19</sup>

Thus even the limited amount of information that is found in the inscriptions and the literary works clearly shows that metal use was fairly widespread and the crafts were well organized in the island during the pre-Christian centuries. Nevertheless, our knowledge on metal technology, methods and techniques of iron smelting, and the standard and quality of skills of metal-smiths can be ascertained and evaluated only by more systematic and extensive analyses of archaeological as well as literary data, but the available archaeological data is ruefully inadequate for any systematic investigation. The traditionally used literary works such as the Pali chronicles, are all but silent on this subject except for a stray reference to a metal worker or a metal object. On the other hand even some of the information found in the chronicles, particularly those pertaining to the pre-third century B.C. period, cannot be made use of for our purpose with any fair degree of reliability or authenticity.

In these circumstances, even the barest shred of information that can be extracted from any possible source is undoubtedly indispensable in the arduous task of reconstructing the history of metal use and metallurgical knowledge in the early stages

<sup>17</sup> S.Paranavitana, *op.cit.*, p. 96, inscr. no. 1198.

<sup>18</sup> *ibid.*, pp. xcvi-xcviii. Also see, H. Ellawala, *Social History of Early Ceylon*, Colombo, 1967, pp. 151 ff.

<sup>19</sup> *Mahāvamsa*, XXVII, 42.