

## Discovery of *Kerria lacca* (Insecta: Hemiptera: Coccoidea), the lac insect, in India in the late 18th century

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Close to 100 species of coccoids, grouped as 'lac' insects, produce an oleoresin, better known as the shellac. Being sap-suckers, these insects inflict damage to some plants as well<sup>1</sup>. Between 1930 and the World War-II years, shellac was the main component in the 78 rpm phonograph discs<sup>2</sup>. The ability of lac to form films on various surfaces encouraged its use as an insulating material at electrical junctions and in the manufacture of moulding, adhesive and binding materials. In recent years, lac is used in coating pharmaceutical products for absorption in the hind gut and not in the stomach of humans. Lacquer, a product derived from lac, is useful in realizing an elegant sheen to painted wooden products (Figure 1 a).

Joseph Conrad Chamberlin<sup>3,4</sup> streamlined knowledge of this complex group of insects. Lac insects are presently classed under the Kerriidae, a group of morphologically distinct coccoids, which produce a hard cover (the test) made of the oleoresin<sup>5</sup>. For the taxonomy of the lac insect complex, see Kondo and Gullan<sup>6</sup>. Among the several species that yield the resin, *Kerria lacca* is the most sought after species. Large populations of *K. lacca* occur in the Southeast Asian countries and in Yuan Province, China. Lac insects live on various tropical plants, such as *Schleichera oleosa* (Sapindaceae) and *Cajanus cajan* (Fabaceae), but their most preferred host is *Butea monoperma* (Fabaceae). Lac product has been known in India for long. The insects were recognized as *lakṣā* (Sanskrit, a hundred thousand) implying the innumerable numbers of insects in one cluster<sup>7</sup>. Diverse medicinal uses of lac are indicated in the *Atarva Védā* (estimated 2nd century BC)<sup>8</sup>. *Mahābhāratā* (estimated 6th century BC) refers to *lakṣā-grihā* (the house of lac)<sup>9</sup>.

The lac consists of a resin, a pigment, and a wax; lac also includes traces of proteinaceous materials, inorganic salts, and a few odoriferous substances. Lac wax is used in coating fresh fruits of apple and orange, so that their shelf-life can be increased<sup>10</sup>. The principal materials in the resin are the aleuritic, kerrollic,

butolic, shellolic, jalaric, epishellolic, laksholic, epilaksholic, laccishellolic, epilaccishellolic and laccijalaric acids<sup>10</sup>. Aleuritic acid is extensively used as a starter in perfumery industry<sup>10</sup>. The lac wax is the alcohol-insoluble material separated from shellac. Sealing wax is made from lac wax and coloured with vermilion, obtained from cinnabar<sup>11</sup> (note 1). The use of sealing wax has been dropping in recent years, except in certain strict requirements by the Indian Postal Service and in Indian banking industry. The water-soluble lac dye has been used in India as a cosmetic in human decoration and for dyeing wool and silk, whereas in China it has been used to stain leather<sup>12</sup>. The Chinese use lac more sophisticatedly and artistically than the Indians do<sup>13,14</sup>. The Chinese create enchanting lacquerware (Figure 1 b), although it must be noted that the Chinese lacquer is not from the lac insect, but from *Rhus verniciflua* (Anacardiaceae) that grows in eastern China. The lac dye is similar in colour to that obtained from the other coccoids, such as *Dactylopius coccus* ([the cochineal insect] Hemiptera: Coccoidea: Dactylopiidae). The bright red colourant of the lac insect (erythrolaccin) offers a lightfast tint to silk and wool. The colour of the dye can be modified from violet to red and brown by treating with an appropriate mordant. Claudius Aelianus (c. AD 250) refers to lac dye in *de Natura Animalum*<sup>15</sup>. The lac dye remained valuable, until William Perkin synthesized synthetic colouring

agents in the late 19th century<sup>16</sup>. Remarks of Bancroft<sup>17</sup> under 'Of the *Coccus Ficus*, or *Coccus Lacca*, and its Nidus, or Comb, commonly called Lac, Lacca, or *Lacshā*' are exciting:

'This substance was probably unknown in Europe until after the Portuguese had visited India by sailing round the Cape of Good Hope, ... . Cardanus (de subtilitate rerum, lib. viii.) represented lac as a natural gum, exuding from a sort of cherry-tree in India. But this was contradicted by Amatus Lusitanus, in the first book of his annotations upon Dioscorides, where he asserts, that it is the excrement of a species of winged ants in the kingdom of Pegu (note 2); which opinion was also delivered by Christopher Acosta, in his treatise de Hist. plant. Aromatumque Indiarum Orientalium (note 3).'

James Kerr, a medical officer in the India Company's Service, published the paper entitled 'Natural history of the insect which produces the gum lacca', describing the coccoid as *Coccus lacca*<sup>18</sup>. Little details are available on the life of Kerr, who is identified as 'James Kerr of Patna' (note 4). William Roxburgh published a note on the lac insect<sup>19</sup> in 1790. For details on the life and work of William Roxburgh in India, read Robinson<sup>20</sup>. The present historical note brings to light details published by Kerr<sup>18</sup> and Roxburgh<sup>19</sup> on this insect.



**Figure 1.** a, Lacquer-finished wooden whistles made in Chennapatna, Karnataka, contemporary India. b, Lacquer container inlaid with peony décor (mother-of-pearl), Ming Dynasty, 16th century (<http://en.wikipedia.org/wiki/Lacquer>).

James Kerr on *Coccus lacca* and the lac

Joseph Banks, President of the Royal Society, communicated Kerr's note on *C. lacca* to the *Philosophical Transactions of the Royal Society of London*. I will restrict my notations to what I think as the more important morphological and biological details of the insect from Kerr<sup>18</sup> (Figure 2).

Kerr refers to the production of the 'lac resin' referring to it as 'gum lacca'. As a sample, I reproduce one paragraph here from his article (note 5):

'This insect is described in that state in which it sallies forth (*shoots forth*) from the womb of the parent in the months of November and December. They traverse the branches of the trees upon which they were produced for some time, and then fix themselves upon the succulent extremities of the young branches. By the middle of January they are all fixed in their proper situations, they appear as plump as before, but shew (*show*) no other marks of life. The limbs, antennae, and the setae of the tail are no longer to be seen. Around their edges they are environed with a spissid (*of thick consistency*) sub-pellucid (*partly transparent, translucent*) liquid, which seems to glue them to the branch: it is the gradual accumulation of this liquid which forms a compleat (*complete*) cell for each insect, and what is called Gum Lacca. About the middle of March the cells are completely formed, and the insect is in appearance an oval, smooth, red bag, without life, about the size of a small cochineal insect (*cochineal insect*), emarginated at the obtuse end, full of a beautiful red liquid. In October and November we find about twenty or thirty oval eggs, or rather young grubs, within the red fluid of the mother. When this fluid is all expended, the young insects pierce a hole through the back of their mother, and walk off one by one leaving their exuviae behind, which that white membranous substance found in the empty cells of Stick lac.'

He lists *Ficus Religiosa* (*Ficus religiosa*, Moraceae), *Ficus Indica* (*Ficus benghalensis*), *Plaso Hortus Malabarici*, and *Rhamnus Jujuba* (*Ziziphus jujuba*, Rhamnaceae) as host plants of *C. lacca*.

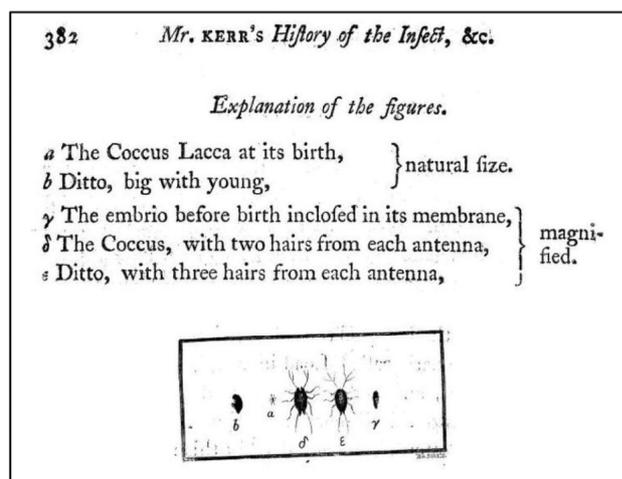


Figure 2. Drawings and legend in James Kerr<sup>18</sup>.

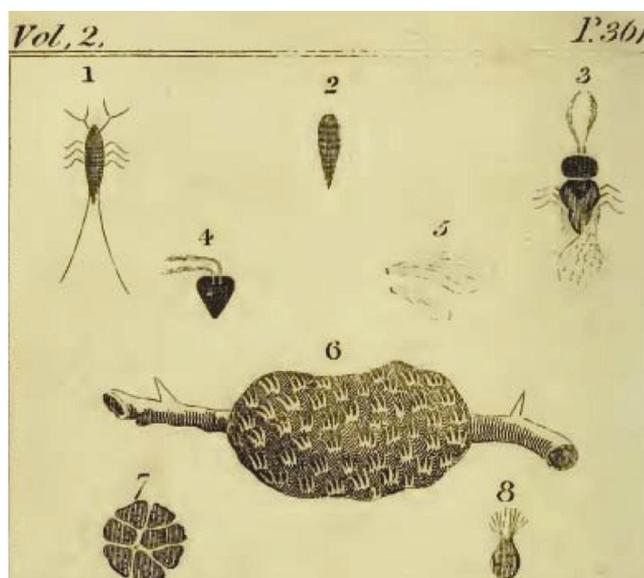


Figure 3. Drawings in William Roxburgh<sup>19</sup>: the numbers included are not cross cited in the text nor an explanatory legend available.

In the succeeding section Kerr outlines how insects occur on their host plants and what effects their populations bear on plants. The following remark of Kerr is worthwhile in the present context:

'These insects are transplanted by birds: if they perch upon these branches, they must carry off a number of the insects upon their feet to the next tree they rest upon.'

Kerr indicates that *Ziziphus jujuba* is the least preferred plant among the four he lists.

'The Gum Lacca of this country is principally found upon the uncultivated mountains on both sides of the

Ganges, where bountiful nature has produced it in such abundance, that was the consumption ten times greater the market might be supplied by this minute insect. . . . The best Lac is of a deep red colour. If it is pale, and pierced at top, the value diminishes, because the insects have left their cells and consequently they can be of no use as a dye or colour, but probably they are better for varnishes.'

He provides details of the four types of lac: stick lac, seed lac, lump lac, and shell lac. After outlining how to clarify the shell lac into a usable form, he summarizes details of lac in its use in India, in making of sealing wax, varnish, grindstones, painting, and dyeing. He

concludes this paper with remarks on the use of lac materials in Europe.

### William Roxburgh on lac insect and lac

William Roxburgh published a note on the lac insect entitled 'On the *lacsha*, or lac insect' in *Asiatick Researches*<sup>19</sup>. This note does not include a name for the insect, *sensu* Linnean system of nomenclature. But he describes male insects, about which James Anderson, M.D., of Madras mentions<sup>21</sup>, while communicating Roxburgh's note to the President of the Asiatick Society of Bengal (William Jones, note 6) in an unnumbered page preceding p. 361 in *Asiatick Researches* (vol. 2, Calcutta):

A letter from Doctor Anderson to Sir William Jones

'The male *Lac* insect having hitherto escaped the observation of naturalists, I send the enclosed description, made by Mr. *William Roxburgh*, surgeon on this establishment, and botanist to the Honourable Company, in hopes that you will give it a place in the publication of your Society, as Mr. Roxburgh's discovery will bring Lac a genus into the calls Hemiptera of Linnaeus.'

Fort St. George, January 2, 1790.

JAMES ANDERSON

At the end of Roxburgh's note<sup>19</sup>, William Jones, the President of the Asiatic Society of Bengal comments:

'The *Hindus* have six names for *Lac*; but they generally call it *Lacsha*, from the *multitude* of small insects, who, as they believe, discharge it from their stomachs, and at length destroy the tree on which they form their colonies. A fine *Pippala* (note 7) near *Crishnanagar* (note 7) is now almost wholly destroyed by them.'

In this note<sup>19</sup>, Roxburgh describes his observations, arranged chronologically: from 20 November 1789 to 7 December 1789. He refers to lac insects adhering to branches of *Mimosa cinerea* (now, *Dichrostachys cinerea*, Mimosoideae) brought to Roxburgh 'from the mountains'. In his notes (dated 4 December

1789), he offers details of the insects and how they appear on close observations. I have selectively paraphrased a few of his words, considered critical by me, from his notes of 6 December:

'The male insects I have found to-day. A few of them are constantly running among the females most actively: as yet they are scarce more, I imagine, than one to 5000 females, but twice their size. ... wings membranous, four longer than the body ...'

Roxburgh published an article shortly thereafter, entitled *Chermes Lacca*<sup>22</sup>, in which he provides supplementary notes on the biology of *C. lacca* in addition to providing brief remarks on a few experiments he trialled with this insect. Roxburgh refers to the nature of host preference of this insect as a footnote<sup>22</sup>:

'Lac, on this coast, is always found upon three following species of *Mimosa*: 1st, a new species called by the *Gen-toos* (note 8) *Conda corinda* (note 8); 2d, *Mimosa glauca* of Koenig; and 3dly, *Mimosa cinerea* of Linnaeus.'

He describes the male and female insects and offers notes on the formation of the scarlet encrustation<sup>22</sup>. Roxburgh describes the encrusted stage as the 'pupa'. He also describes his efforts to extract the dye from dry-lac material, where he refers to following Hellott's process of extracting colouring matter (note 9). He provides an explanation of the figures he included in this paper. Unfortunately, I could not see the 12 figures provided by Roxburgh referred to in Robinson<sup>23</sup>, whereas I could get hold of only the drawings Roxburgh has supplied in his 1791 paper<sup>22</sup>, which are included in this note (Figure 3).

### Remarks

Kerr's observations pertain to the insect material he collected near Patna (25°36'N, 85°8'E; northern India) and published in 1781. Roxburgh's observations pertain to the insect material he got near *Samulcottah* (17°3'N, 82°10'E; southern India) and published in 1790. Roxburgh does not refer to Kerr<sup>18</sup> in his article, although both have been published in the same journal in different years. Kerr refers to the insect as *Coccus*

*lacca*, following the Linnean system of nomenclature. Roxburgh names this insect *Chermes lacca* in his 1791 paper<sup>22</sup>. The present valid name is *Kerria lacca*.

The name *Chermes* provided by Roxburgh<sup>22</sup> provoked my interest, since the same name exists among the Aphididae (Hemiptera). Immense lack of clarity prevailed in early entomological nomenclature with *Chermes*. According to Burdon<sup>24</sup>:

'Great confusion has arisen from the fact that there are two genera of insects, both belonging to the Hemiptera, which bear the same name under different spellings. One of these is the genus *Chermes* included in the family Aphidæ, while the other belongs to the Coccidae and is spelt *Kermes*. According to Kirkaldy, there is a third genus of the Hemiptera which bears this name, namely that usually known as *Psylla*, belonging to the family Psyllidae.'

What is not clear is whether Roxburgh intended to mean *Kermes* of the Coccidae and spelt it *Chermes* or whether he thought that the lac insect was a taxon of the Aphididae (the Eriosomatinae).

The earliest formal description of a scale insect was by Linnaeus in 1761 referring to *Coccus uvae ursi* (now *Eriococcus uvaeursi*)<sup>25</sup>. Williams and Gertson<sup>25</sup> provide an English version of the Linnean description made in Latin:

'*Coccus Uvae Ursi* of the roots of *Arbutus uva ursi* (note 10). It lives on the underground stems of *Uva ursi* in rather damp places. Description: Body reddish, with a blood-red juice but covered with a small loose, white oval sack.'

Before Linnaeus, René Antoine Ferchault de Réaumur described a few European-scale insects with illustrations<sup>26</sup>.

According to Kondo *et al.*<sup>1</sup>

'Linnaeus (1758), in his *Systema Naturae*, the starting point of zoological nomenclature, drew heavily on Réaumur's work for his chapter on the genus *Coccus*.'

Johann August Ephraim Göze (1731–91, a pastor and zoologist, Quedlinburg, Germany) described the Indian lac insect

as *Coccus gummilaccae* in 1778 (Yair Ben-Dov, Bet Dagan, Israel, pers. commun., 16 June 2013). I could not access the original description by Göze, and I can offer no explanation as to how he accessed Indian lac insects. Nevertheless, I speculate that Kerr's description<sup>18</sup> of *C. lacca* is the formal description of a scale insect immediately after Linnaeus.

Kerr describes the external morphology of *C. lacca*, although he does not recognize males and females, nor he distinguishes different developmental stages. He acknowledges that the lack of appropriate optical gadgets restricts his observations on the juveniles and on mating. The two figs (*F. religiosa*, *F. benghalensis*) and jujube (*Z. jujuba*) are referred by their binomials *sensu* Linnaeus, whereas *plaso* is not. *Plaso* (*plāsā*: Sanskrit) was named *Butea frondosa* (*B. monosperma*, Fabaceae) by Roxburgh<sup>27</sup> in 1795 (note 11). Given that no binomial existed for *B. monosperma* in 1781, Kerr has naturally referred to this taxon as *Plaso Hortus Malabarici* as *plāsā* [*plaso*], following Hendrik Adriaan van Rheede in *Horti Indici Malabarici*<sup>28</sup>.

Kerr's comment that the insects are transplanted from one tree to another by birds is fascinating. Today, we know that only the males in Coccoidea are winged, whereas the females are not; we also know that the winged males enable the dispersal of their wingless sisters phoretically<sup>29,30</sup>. Although incorrect, I imagine that Kerr would have been influenced to infer so, because birds could be feeding on the hard tests of these insects and also that he may have noticed the winglessness of some of the nymphal instars and adult females, and thus imagined how they could move from one site to another.

The key component in Roxburgh's notes<sup>19,22</sup> is the 'discovery' of males. Although Roxburgh provides details of males of lac insect, the details provided do not exactly match with what we know today of the complex biology of the Coccoidea. The 'mountains' he indicates could be either Rampaçodvaram (~150 amsl, c. 75 km west of Samalkottah) or Mare-dumilli (~400 amsl, c. 100 km west-northwest of Samalkottah). Roxburgh's remarks under 'December 7' (ref. 22), evoke interest. They suggest that he may have trialled their host relations by allowing the insects to 'live' and 'feed' on *M. cinerea* and *M. intsia*. In contemporary entomological literature, we

recognize Charles Thomas Brues (note 12) as the pioneer of studies on insect-plant interactions and one who clarified host-preference patterns among plant-feeding insects. Here we see Roxburgh beating Brues hollow with his trials on host preference of *K. lacca* by testing its feeding behaviour on two species of *Mimosa*, in a remote village Samulcottah in India in the 1790s.

What is striking is that both Kerr and Roxburgh published descriptions of the lac insect in the *Philosophical Transactions of the Royal Society of London*; Kerr in 1781 and Roxburgh in 1791. Anderson while communicating Roxburgh's 1790 paper to William Jones highlights Roxburgh's 'discovery' of male insects, although Anderson does not explain why he thought that this is a key discovery. Kerr does not refer to the males or females in his 1781 paper. This could be one pertinent reason why Anderson saw a merit in highlighting the discovery of males in his letter to Jones. If this were true, then I would infer that Roxburgh (and possibly Anderson) was aware of James Kerr's 1781 paper on *C. lacca*. Then why did Roxburgh name the insect as *Chermes lacca* when the insect has previously been named *Coccus lacca* following Linnean tradition by Kerr is a throbbing question. Roxburgh does not refer to Kerr's paper in his; because the style followed in those days was not to refer to previously published papers in the same subject? I have no answers.

## Notes

1. The article 'The sealing wax'<sup>31</sup> could interest readers.
2. Pha-Kho, the capital city of Bago region, Myanmar.
3. I could not track down details of Christopher Acosta, except the following reference cited in Burdet *et al.*<sup>32</sup>, which also includes a portrait of C. Acosta. At the foot of the portrait, Acosta is referred as '*Christophorus Acosta Africanus*': This citation refers to his volume '*Tractado de las drogas, y medicinas de las Indias Orientales, con sus plantas debuxadas al bivo por Christobal Acosta medico y cirujano que las vio ocularamente. En el qual se verifica mucho de 10 que escrivio el Doctor Garcia de Orta*' (= *Treatise of drugs and medicines from the East Indies, with its plants illustrated [as they occur in nature] by Physician and Surgeon Cristobal Acosta, who has seen them; 10 of these have been verified by Dr Garcia*

*de Orta*). Garcia de Orta (1502–68) was a Portuguese physician and naturalist. He came to India in 1534 with Mariam Afonso de Sousa, who later became the Governor of Goa. de Orta settled in Goa in 1538, where he had a busy medical practice. He was physician to Burhan Nizam Shah I of Ahmadnagar and later to many Portuguese viceroys and governors at Goa. He was granted a lease of the island of Bombay, although he never lived there.

4. No details could be secured to explain why James Kerr is referred as 'James Kerr of Patna'. Watt<sup>33</sup> identifies James Kerr as the author of the paper on the lac insect<sup>18</sup> and the translator of a Persian text referring to the rise and advancement of the Mahratta State into English in 1782. According to Henry Noltie (pers. commun., 13 August 2013), 'James Kerr was a Surgeon belonging to East-India Company Service, first appointed in Bengal (1770? 1772?). He resigned in 1782 and died in Calcutta on 17 September 1782 and is buried in South-Park Street Cemetery. He was stationed in Patna for some time, but he was also in Calcutta, and Dacca. He just happened to be in Patna at the time he submitted the lac paper, the MS of which is in the British Library (MSS Eur E11).'
5. In the original passage, the long, medial character 'f' is used throughout for 's', whenever it occurred either at the start or in the middle of a word: e.g. 'infect' for 'insect'. For reader's comfort, such a usage has been modified following current writing style. Wherever necessary, some of the archaic words have been interpreted in italics in brackets.
6. William Jones (1746–94) was proficient not only in many European languages, but also in different Asian languages. Jones arrived in India in 1783 as a Judge in the Supreme Court in Calcutta. Because he realized that India had plenty to offer to the world in arts and sciences he established the Asiatick Society in 1784, which revolutionized the world of letters. His scholarship in Sanskrit was profound. He will be remembered for his monumental translations of several Indian Sanskrit classics including those by *Kālidāsā*.
7. *Pippala* – *Ficus religiosa*, Moraceae. Crishnanagar – Krishnanagar, Nadia, West Bengal (23°24'N, 88°30'E).
8. Telugu-speaking people residing in Samalcottah. Conda corinda is the Telugu name for *Acacia intsia* (now *Senegallia intsia*); Roxburgh refers to this as *Mimosa intsia*.
9. Jean Hellot (1685–1766) was a pioneer in the chemical, metallurgical and textile industry in France and Europe. He revolutionized chemical industry in the 19th century. Hellot investigated Zn and its

## HISTORICAL NOTE

- compounds, the precious metals, the preparation of P, and ethyl ether, the manufacture of porcelain and invisible inks, and dyeing. One important discovery was the photosensitivity of paper impregnated with AgNO<sub>3</sub>.
10. *Arctostaphylos uva-ursi* (Ericaceae).
  11. Jean-Baptiste Lamarck described the plant today known as *Butea monosperma* as *Erythrina monosperma* in *Encyclopédie Méthodique—Botanique* (1786) based on specimens from India and Southeast Asia.
  12. Charles Thomas Brues was an American entomologist, who developed the framework of insect-plant interactions and plant-feeding behaviour among insects in modern times. He will be remembered for his classic *Insect Dietary—An Account of the Food Habits of Insects* (Harvard University Press, Harvard, 1946, p. 466).
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