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Production, Manufacture, and Trade.

MAREL TOTAL MARKED TRINGS

BY

J. E. O'CONOR.

REVISED EDITION.

CALCUTTA:

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In preparing the third edition of this compilation, a considerable portion of the work has been re-written in the light of information received since the issue of the last edition, and much matter of importance has been added.

O'C.

September 18, 1876.

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LAC:

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PRODUCTION, MANUFACTURE, AND TRADE.

L AC is a resinous incrustation formed on the Coccus bark of the twigs and branches of various lacca, (the trees by an insect, commonly called the lac insect and known to entomologists as the Coccus lacca, appertaining to the natural order Hemiptera, family Gallinsecta. The species of the order known in Asia are, according to Dr. Balfour, three in number,—viz., the Coccus cacti (the cochineal insect), the Coccus lacca, and the Coccus maniparus, of Arabia, which latter, according to Royle,* quoting Ehrenberg, punctures a variety of the Tamarix gallica growing near Mount Sinai and causes the exudation of Arabian manna.

2. The incrustation formed by the insect is cellu-*Its natural* lar, of a more or less deep red or orange colour, *history*. semi-transparent and hard, breaking with a crystal-line fracture. The substance is mainly formed by the female insects, which generally largely outnumber the males. Each of the females inhabits a cell and the incrustation seems intended to serve as a nidus or protection for the ovum and for the larva after it has been hatched. As soon as she is com-

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* Illustrations of Himalayan Botany.



pletely covered by the resinous secretion which she forms, the female lays her eggs and dies. The young on being hatched work their way out through the body of the mother, eating the red substance with which the body is filled, pierce the resinous incrustation, and swarm on to the bark, to which they fix themselves by insertion of the beak or proboscis, and at once commence the secretion of lac. The insects are produced in such vast quantities that the branch looks when the young are swarming as if it were covered with red powder; but great numbers perish, either for want of nutriment or killed by birds.

3. The red colour of the insects is due to the substance contained in the body of the mother, on which the young feed while they are working their way out after being hatched. This substance produces the dyeing material called in commerce lacdye. The process of manufacture of this article, its constituents and uses, will be described further on in this paper.

Dr. Carter's account.

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4. A careful and competent observer, Dr. H. J. Carter, F.R.S., had a very favourable opportunity in 1860 of observing the processes of impregnation and evolution of the young, and the development of the insect through the several stages of its existence. The insects swarmed over a custard-apple tree (Anona squamosa) in the grounds attached to the Bombay Mint,* and were minutely watched by

* This is not the only instance of the lac insect, which is ordinarily an inhabitant of remote wilds, having been found in the midst of the busy haunts of man. Some years ago the insect was found swarming over the twigs of a litchi tree (*Nephelium litchi*) in the heart of Calcutta, and not long ago it was observed in full work on a *Ficus* in the centre of Rangoon and on an *Anona squamosa* growing in front of a house in a street of Thayet-myo.

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Dr. Carter from about the 5th July, when the young or larvæ, about the fortieth of an inch long, began to issue, to the time (20th September) when, impregnation having been completed, the males died out, and the females were completely buried under the incrustation. He watched them again through a second evolution in the same year. Dr. Carter's account of his observations is reprinted in full for ready reference at the end of this paper. It will be observed that he denies the accuracy of the frequently repeated statements that there is only one male to five thousand females, that the resinous incrustation is formed from the juices of the bark punctured by the insect, and that the male insect is furnished with four wings. Dr. Carter asserts, as the result of his personal observations, that in some cases the males are very nearly as numerous as the females; that they begin to secrete the resinous substance even before they have fixed themselves to the bark; and that the male insect is provided with only two wings, and that even these were not observed on all, and on none at all in the first of the two evolutions which take place in the year. Special observation has proved that Dr. Carter was right and that the notions previously entertained regarding the generation of the insect and the formation of the excretion were quite wrong; but in connection with the notion that the incrustation is formed from the exudation from the tree on which the insect exists, it has been pointed out in the Journal of the Agricultural and Horticultural Society of India for 1868 that the trees on which it chiefly occurs all yield more or less a gummy, resinous, or saponaceous fluid. From the Butea frondosa exudes in October and November a bright blood-red fluid, which hardens quickly and

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assumes a brilliant polish;* the three species of Ficus particularly affected by the insect (religiosa, indica, and infectoria), when tapped in the cold weather yield a viscid fluid, of which fowlers make birdlime; from the Zizyphus jujuba is obtained a gum; and the Croton lacciferum abounds in April, May, and June with a fluid from which cowboys blow off large and strong air-bubbles. The writer of the paper in the Journal therefore thinks it "is natural to conclude that the insect requires some such juices to exist upon, and that its functions are to form lac and lac-dye according to the quantity and quality it draws from each description of tree. For instance, it secretes when on the koosum (Schleichera trijuga) the most seed-lac of a light colour which makes the best shell-lac, and on the palas (Butea frondosa) a redder stuff from which is obtained a garnet-coloured shell-lac and a larger quantity of the deepest lac-dye, just in the same manner as bees produce the best-tasted honey and the deepest-coloured wax from orange-flowers, and the poorest honey and light-coloured wax from the flowers of orchids." Mr. Baden-Powell also sayst-

"If at this stage," [i. e., after the insect has completed the formation of lac,] "a little piece of the lac incrustation is broken off, the insect is perceived as a little bag of red liquid (which yields the dye), and the place where the wood of the twig has been punctured bears a snow-white mark, as if the place had been touched with a point of chalk.

^{*} This fluid becomes a ruby-coloured, brittle, astringent gum, similar to Kino, and sold as Bengal Kino. In the Pharmacopœia of India it is said to issue from natural fissures and from incisions in the bark during the hot season.

[†] Punjab Products, vol. i, page 191.

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Thave removed an entire piece of lac incrustation from the twig, and observed the bark underneath covered with these little white dots, one in every cell, and one under every insect. Under the microscope they clearly appear to be specks of a semi-crystalline saline efflorescence, at the place punctured by the insect." Further and detailed investigation into the question might with advantage be made in the lac-plantations which have been established by the State in British Burma and the Central Provinces.

5. As the insect never wanders from the branch Natural of the tree to which it first attaches itself, and as propagation. the branch in course of time, after having afforded nourishment to millions of the insect, dries up and dies, it would seem at first sight that the ultimate extinction of the species is inevitable. But nature has provided a remedy, the insect being carried to great distances by birds and larger insects to which, when they alight on a branch, the *Coccus lacca* frequently attaches itself. In this manner it is propagated through a vast extent of country. Artificial propagation by man is also, as will be seen further on, an easy and now well-known process.

6. Lac is found in most of the provinces of *Trees on* India, and in some (Bengal, Assam, and the Cen-*which lac* tral Provinces) it occurs very extensively. It is found on various trees, of which I attach a list, as far as they are yet known to me :—

Natural order Leguminosæ: Acacia arabica. Butea frondosa. " superba. Dalbergia sp. (? robusta). " latifolia. Erythrina indica.



Erythrina monosperma. Inga dulcis. Mimosa cinerea. Prosopis spicigera.

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Natural order *Euphorbiaceæ*: Aleurites (or Croton) laceiferum. (From this a very superior kind of lac is obtained.) Croton draco.

" sanguiferum.

Natural order Ternströmiaceæ : Gordonia floribunda.

Natural order *Sapindaceæ* : Nephelium litchi. Schleichera trijuga.

Natural order Anonaceæ : Anona squamosa.

Natural order Apocyneæ: Carissa spinarum.

Natural order Urticaceæ : Celtis (Roxburghii ?). Ficus elastica.

> " indica. " infectoria.

" religiosa. v

, villosa.

Natural order Rutaceæ : Feronia elephantum.

Natural order Anacardiaceæ: Mangifera indica.

Natural order Dipterocarpaceæ : Vatica laccifera, Shorea laccifera, ,, robusta,

Natural order Hypericaceæ : Vismia laccifera. ,, micrantha.



Natural order *Rhamnaceæ* : Zizyphus jujuba. ,, xylopyra. Natural order *Amyridaceæ* : Garruga pinnata. Natural order *Bignoniaceæ* : Spathodea Rheedii.

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Some years ago Mr. W. S. Halsey found lac on a carob tree (*Ceratonia siliqua*) in the Punjab; Dr. Bonavia has found it occur in abundance on the same tree, much to its detriment, at Lucknow; and it has also been remarked on the tree in the Bombay Presidency, where indeed the tree has been given by the natives the name of "the lac tree." No doubt the foregoing list is susceptible of expansion after further enquiry. Mr. McKee indeed mentions several other trees on which, it has been proved by experiment, lac forms. Their names will be found in paragraph 22 of this paper.

The best lac is generally found on the Butea frondosa (palas, prass, or dhak), Ficus religiosa (peepul), and Schleichera trijuga (koosum). Of the last mentioned tree, Dr. Brandis in his Forest Flora of North-West and Central India says that at Mirzapore it is stated that the lac is the best and keeps good for ten years, while the lac of other trees is said to last two years only. In the Central Provinces the natives say that lac from this tree is capable of being propagated on other trees, but that the koosum tree itself will not admit of the propagation of lac from trees of other kinds.* It is also said to produce two crops annually at intervals of six months, while the other lac-producing trees in

* This idea is perhaps founded on fact. The koosum is a very hard-wooded tree and propagation from this to softer wooded trees is as easy as the reverse is difficult.



the Central Provinces give only one crop. The first crop from the koosum is produced between April and June, and the second between October and December.

Derivation of name.

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7. The vernacular names for lac are: Sanskrit. Laksha; Hindi, Lakh; Tamil, Komburruki; Telugu, Kommolaka; Cingalese, Lakada. The names derive their origin from the Sanskrit word laksha, meaning a hundred thousand (a lakh), in allusion to the multitude of insects. Sir William Iones, as quoted by Dr. Birdwood, says: "The Hindus have six names for lac, but they generally call it laksha 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."

8. Lac does not appear to have been known to Knowledge 8. Lac does not appear to have been known to of lacin an- the ancients beyond India. Dr. Birdwood states cient times. that amount Washington that amongst Western writers it is first mentioned by Abu Hanifa. Dr. Balfour, on the other hand, says, on the authority of Tomlinson's Cyclopædia, that, previous to the discovery of cochineal, the colouring matter of the lac insect was universally employed as a red dye by the ancients, and that the crimsons of Greece and Rome "and the imperishable reds of the Brussels and Flemish schools" were derived from this source. The accuracy of this statement seems open to question. It is affirmed by Dr. Birdwood and other authors, that the dyes used before the introduction of cochineal were obtained from kermes, being insects of different varieties of the species Coccus ilicis, which live upon the Quercus ilex and Quercus coccifera. This word kermes is Arabic in its origin,-viz., kirmij, meaning a little worm, whence the dye obtained in the Middle Ages the Latin name vermiculus, whence again vermeil and vermilion.

9. Y extract the following account of the chemi- Chemical cal constituents of lac from Ure's Dictionary of of lac. Arts, Manufactures, and Mines, 6th ed., 1872:-

"According to the analysis of Dr. John, stick-lac consists in 120 parts of-

A resin insoluble in ether 2000 Colouring matter analogous to that of cochineal 4'50 Bitter balsamic matter 3'00 Dun yellow extract 0'50 Acid of the stick-lac (laccic acid) 0'75 Fatty matter like wax 3'00 Skins of insects and colouring matter 2'50 Salts 1'25 Earths 0'75 Loss 3'75	An odd	orou	s	com	m	on	resi	in.	•						•	80.00
Colouring matter analogous to that of cochineal4'50Bitter balsamic matter3'00Dun yellow extract0'50Acid of the stick-lac (laccic acid)0'75Fatty matter like wax3'00Skins of insects and colouring matter2'50Salts1'25Earths0'75Loss3'75	A resin	ins	sol	ubl	e iı	ı e	the	r								20.00
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Skins of insects and colouring matter 2*50 Salts 1*25 Earths 0*75 Loss 3*75	Fatty n	natt	er	like	e w	ax					1					2.00
Salts	Skins o	f in	ise	cts	an	d c	colo	uri	ng	ma	tte	r .			1	2.20
Earths	Salts .															1.52
Loss	Earths															0.75
575	Loss .						1				1	8.64				2.75
							1 P								•	575

TOTAL . 120'00

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"According to Franke, the constituents of stick-lac are, resin 65.7, substance of the lac 28.3, colouring matter 0.6."

10. An analysis by Mr. Hatchett, quoted by Mr. Hatchett's G. W. Strettell, Deputy Conservator of Forests in Analyses. British Burma, gives for stick-lac in 100 parts-

Resin	•	•						•					68.00
Colouri	ng	ma	itte	er		•	1.		1.				10.00
Wax.													6.00
Gluten					•	•				•			5.50
Foreign	bo	die	s	•									6.50
Loss.											12	111	1'00

Analyses of seed-lac and shell-lac differ from the foregoing in the exhibition of an increase in the percentage of resin corresponding to a diminution in the amount of colouring matter, wax, and foreign bodies, which are eliminated during the processes of manufacture into shell-lac. The colouring matter, which amounts to 10 per cent. in stick-lac, is reduced to 0.5 per cent. in shell-lac, the dye being

carefully extracted, as will be shewn in the section treating of manufacture.

Other Analyses. TO

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11. I quote again from Ure's Dictionary :--

""The resin may be obtained pure by treating shell-lac with cold alcohol, and filtering the solution in order to separate a yellow-grey pulverulent matter. When the alcohol is again distilled off, a brown, translucent, hard and brittle resin of specific gravity 1.139 remains. It melts into a viscid mass with heat, and diffuses an aromatic odour. Anhydrous alcohol dissolves it in all proportions. According to John it consists of two resins, one of which dissolves readily in alcohol, ether, the volatile and fat oils, while the other is little soluble in ether and the volatile oils. Unverdorben, however, has detected no less than four different resins and some other substances in shell-lac. Shell-lac dissolves with ease in dilute muriatic and acetic acids, but not in concentrated sulphuric acid. The resin of shell-lac has a great tendency to combine with salifiable bases, as with caustic potash, which it deprives of its alkaline taste. This solution, which is of a dark-red colour, dries into a brilliant, transparent, reddish-brown mass, which may be re-dissolved in both water and alcohol. By passing chlorine in excess through the dark-coloured alkaline solution, the lac-resin is precipitated in a colourless state. When this precipitate is washed and dried, it forms, with alcohol, an excellent pale-yellow varnish, especially with the addition of a little turpentine and mastic. With the aid of heat, shell-lac dissolves readily in a solution of borax. The substances which Unverdorben found in shell-lac are the following :---I, a resin soluble in alcohol and ether; 2, a resin soluble in alcohol, insoluble in ether; 3, a resinous body, little soluble in cold alcohol; 4, a crystallisable resin; 5, a resin soluble in alcohol and ether, but insoluble in petroleum, and uncrystallisable; 6, the unsaponified fat of the coccus insect, as well as oleic and margaric acids; 7, wax; 8, the laccine of Dr. John; 9, an extractive colouring matter,"

Commercial test of good lac, 12. The goodness of lac in commercial estimation depends upon the brightness of the colour and the thickness of the incrustation; this is sometimes

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nearly half an inch thick, completely encircling the twig. To obtain lac in its best condition, it should be gathered before the young have eaten their way out. If the lac-gatherer delays until they have effected their exit, the colouring matter is much diminished, and the resin is pierced through at the top. There is but little dye to be obtained from the lac in this condition. As there are two evolutions of the insect in the year, so there are generally also two gatherings, the first being in March and the second in October.

13. The earliest detailed account I can find of lac Sleeman's production and collection in India is the following $lac: 18_{38}$ note by Colonel Sleeman, dated May 7th, 1838:—

"When at Mirzapore on my way down from the hills in November last, I visited Mr. Barlow's manufactory of lacdye at that place, and was much surprised to find that none of the gentlemen who superintended it were aware of the fact that lac is as much *cultivated* as any other raw material for manufacture; that is, that the insect is *put* upon the trees upon which it is found to thrive best, and that the quality, and consequently, price in the market, varies with the kind of the tree from which it is taken.

"The lac is gathered twice a year, the best crop is in April from seed applied to the trees in October, the second, which is inferior, in November.

"The tree that yields the best lac is one common to the jungles in this part of India, and called—

- 1st.—Koosum or asun.* The produce from this tree is said to be much superior in quality to that from any other tree.
- 2nd.—The dhak, the Butea frondosa of botanists, common to all parts of India.
- 3rd.—The tinsa.

* Schleichera trijuga of Willd, Roxburgh's Flora Indica, vol. ii, p. 277, Wight and Arnott's Prodr., vol., p. 114. Cassumbium of Rumph and Hamilton belongs to this genus, the Malayan name of one of the species being, according to the former, Cassamit.—(Note by Dr. Wallich.) 12

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4th .- The gothur or ghunt.

- 5th.—The peepul, Ficus religiosa, common to all parts of India.
- 6th.-The beree or beer, Zizyphus jujuba of botanists.

7th.—Also the ramna.

"The people leave sufficient seed for the next crop upon the trees from which they gather; and they do not consider the produce to deteriorate from the same seed being left long upon the same tree.

"They apply the seed to the fresh tree either in June, for the November crop; or in October for the April crop. Their mode of doing it is to cut off the branch of an old tree with the insects upon it, and to place this branch upon a branch of the fresh tree, over all the branches of which the little insects soon spread themselves.

"I have asked the people whether the trees ever require a fallow or not, and have been told that they do not.

"A Gond cultivator of the lac from the pergunna of Schora tells me that they begin to cut on the 18th of Bysack (on the 28th of April) and continue to cut through the two succeeding months Jeth and Asar (May and June). In the beginning of Sawun (July) the insects begin to quit their combs; and it is useless any longer to cut, as the substance yields no longer any colouring matter for the merchants, or seed for the cultivator.

"They begin to cut again in October, eight days before the dewallee, or new moon of Kattick; and continue to cut for sixteen days, till eight days after the dewallee. After this time the insects come out of the comb, and make off; and before the commencement of these sixteen days the substance is not considered to be ripe.

"They place the small twig containing the seed between two branches of the fresh tree, thus V, so that each end of it may be flat upon the branch on which it rests; if either, of the ends of the twig projects beyond the branch V the insects will not quit it to ascend upon the branch, but after walking forward and back a few times die: about one-half of the insects upon the twig would in this way be lost. If both ends projected, the whole would perish upon those parts that projected, though the twig should touch both branches. MINISTRE OC

They cannot tie the twig on to the branches with cords, for when they do so the insects walk round and round upon the cord till they die; great care is, in consequence, necessary to replace the twigs whenever they get deranged by the wind or rain.

"This Gond tells me that, though they cut twice a year, they sow only once; and that in Kattick (October), during sixteen days of this month half the cultivator's family is employed in gathering the produce, and half in applying seed to other trees. They must always leave a small portion of every branch they cut off for seed; and when they do not do so the people to whom the trees belong complain of injury. Commonly the proprietor of the trees and the cultivators are one and the same, but sometimes they are different, those who plant and gather renting the trees from the proprietor at so much the tree, the score, or the hundred : or so much the acre for the lands on which they grow. They again contract with the merchants who make advances to them. This season (April 1838) the merchants of Jubbulpore have contracted at seven rupees the maund; three or even two years ago they contracted at the rate of fourteen the maund for lac of the same quality. The produce gathered in Kattick is called 'Kattickee;' and that gathered in Bysak is called 'Bysakee.' This Gond, and another equally learned whom I have consulted, tell me that the same seed is left on the tree, and the produce never deteriorates as long as the tree retains its vigour, which it does for a man's life almost. They never allow any person to touch the roots of the trees from which they take lac, as it would injure them. The roots of the dhak trees that are not required for lac are dug up and used for ropes.

"One tree is, they say, enough to supply a whole forest when the trees are near to each other without the necessity of cutting branches from one to apply to another; as the insects, as they fall from the branches of one tree, are taken up by the lower branches of its neighbour.

"The koosum tree, on which the best lac is produced, has never yet, I am told, been cultivated, or, if I may use the term, domesticated; though it abounds in the forests of this part of India. The insects of the produce from this tree



vield colouring matters superior to those of the produce from any other tree; but the great superiority of the produce from this tree over that from any other is in the matrix or gum, in which the insects lie imbedded, as bees in their comb. This gum is of much finer quality for manufacture than that from any other tree; and what is of great importance to merchants and manufacturers, it will not only remain itself unimpaired in store-rooms for ten years, but retain the insects or colouring matter uninjured for that time, while the gum from the best of the other trees cannot be kept with safety for more than two years. The produce from the other trees is so very brittle that it is broken up and separated from the wood even the first season, before being exported from the district in which it grows; but the produce from the koosum is so firm and compact that the comb or nidus could not be separated from the wood without destroying the insects or colouring matter; and the whole of the wood covered with the substance must be exported with it. A maund of this produce may sell in the market at the same rate as that from any other tree, merely because there may be a much greater . portion of wood, which is of no value.

"There are immense groves of dhak trees, within a few miles from Jubbulpore, appropriated exclusively to the production of lac. In some cases the proprietor of the land cultivates the lac and sells it to the merchant exporter himself, while in others he lets his trees at so much a hundred to others who earn a livelihood by the cultivation.

"The natives remark as a peculiarity which distinguishes the koosum from every other tree that every twig has six leaves, neither more nor less. It is certainly the case with the koosum, but whether it is with any other tree I know not. I do not think it is with any other tree that I have seen. I enclose a specimen of the twig from the Jubbulpore jungles.

"I think that in the produce from the koosum tree, the gum or nidus bears a larger proportion to the insects, or colouring matter, than in that from any other tree; another reason why the raw produce from this tree may not fetch a higher rate of price in the market, though each of the two component parts is admitted to be of a quality so much superior,

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is, because the gum is an article of much less value, compared with its weight, than the insects."

14. In India lac occurs in Bengal and Assam Distribution (abundantly), the North-Western Provinces and of lac. Oudh (sparingly), the Central Provinces (abundantly), the Punjab, Bombay, Sind and Madras (more or less sparingly), and Burma (abundantly in some places). Lac is also found in some other countries of Southern Asia, viz., Siam, Ceylon, some of the islands of the Eastern Archipelago, and China, Siamese lac being held in high estimation. In India the best lac is obtained from Assam and Burma.

In 1862 samples of lac were sent to the International Exhibition of London from Shahabad in Bengal, from Vizagapatam, Cuttack, Raipur, Amritsar, Ahmedabad, Poona, Salem, Durrung, Burma, and Mysore.

15. The quantities produced and utilised vary Production. greatly in different provinces according to circumstances, certain forests being rich in lac, which has hardly been touched owing to difficulty of access and the cost of carriage to the place of manufacture and port of shipment. In Bengal lac is produced abundantly in the jungle tracts of Beerbhoom, Chota Nagpore, and Orissa. In various places in the forests of Assam it is also found in large quantities and forms a regular article of trade, a portion of the production being manufactured at Dacca, and the rest sent to Calcutta. A lac factory was established many years ago at Gowhatty, but the speculation failed, and has not been renewed, the European sellers in the province having devoted their energies to tea. In this province all lac-producing tracts of any importance in the reserved Government forests have recently been leased to traders.



Bengal and Assam.

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16. In July 1867, 'the Deputy Commissioner of Pooroolia in Chota Nagpore reported that the lowest average yearly supply from the district was 15,000 maunds, though the actual yield was, he believed, considerably more, while it was capable of great extension. From Singhboom at the same period about 1,250 maunds of lac were exported. In the Gya district the supply was estimated at 12,000 maunds; in Kamroop (Assam), about 5,000 maunds, with great capacity for development; in Hazaribaugh, 2,000 maunds. These figures probably do not by any means approximate to the actual yield of the districts named, in most of which there are very extensive tracts of the koosum and palas trees on which the insect thrives. But the comparative poverty of statistical information connected with production and distribution in Bengal, and indeed in India generally, will not permit of even an approximately correct estimate of the production of lac being formed.

In Bengal lac is gathered twice a year, viz., from about the middle of October to the end of January, and from the middle of May to the middle of July.

Some people, it is said, dip the lac-covered twigs in hot water to kill the young insects, it being supposed that a large amount of dye is thus secured.

North-Western Provinces.

17. In the North-Western Provinces, lac is obtained in some quantities from the Garhwal forests; and Mr. Thomson, Deputy Conservator of Forests, reported some years ago that it was largely exported to the plains. There is no recent information on the subject. But it is probable that most of the lac which is brought down from Garhwal is consumed in the local manufacture of toys and ornaments, and that very little if any is taken up for exportation from Calcutta.

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18. In the Punjab Mr. Baden-Powell says that Punjab and the production of lac is universal. I understand. Sind. however, that it is much inferior in quality to the lac of Central India or Bengal. In Sind, lac is only found in the forests about Hyderabad, twelve miles north and south, but in these abundantly. In the other forests of the province it either does not exist at all, or in such small quantities that its collection does not pay. The cause of its formation near Hyderabad is to be sought according to Dr. Schlich, formerly Conservator of Forests in that Province, in some peculiarity either in the soil or air. and he thinks the subject worthy of investigation. It is found on the Acacia arabica (babool), and is gathered from October till April or May. This tree seems while in full vigour to be exempt from the attacks of the insect; it is chiefly infested when in the semi-dry state, and is not unfrequently killed outright. The lac produced in Sind is largely used in the manufacture of the well-known lacquered ware of Hyderabad.

19. In Oudh, lac is gathered in the more wooded Oudh. parts of the south-eastern districts (Roy Bareilly and Partabgurh) from various species of Ficus, especially religiosa. It is exported to the Mirzapore factories and elsewhere. The Chief Commissioner thinks that large supplies would also be procurable from the northern forests, but that the collection would be unprofitable owing to the want of manufactories within a reasonable distance. Government obtains half the produce in quantity or value from the gatherers.

20. All the districts of the Central Provinces Central produce lac, but it is particularly abundant in the Provinces. eastern districts. Large quantities are consumed in the towns in the manufacture of bracelets and

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other articles, but most districts also export it to a greater or less extent. These provinces, at a rough guess, could readily supply some 25,000 tons of stick-lac annually. Most of the lac produced in the district of Jubbulpore is consumed in a European factory in that town. It also comes to Jubbulpore and Mirzapore in large quantities from Raipore, Bilaspore, Saugor, and Mundla. In Mundla the right of collecting lac from the Government jungles has been leased to the owners of the Jubbulpore factory for Rs. 950 a year. In Sumbulpore, a Mirzapore firm (European) has for a long time practically held the monopoly of lac collection. Boorhanpore and Bombay receive supplies, though in small quantities, from the Nerbudda and Nagpore divisions.

In the Hoshungabad district of the Central Provinces the chief mart for lac is at Sobhapore, the two other most important marts being Hoshungabad and Babai. Into Sobhapore lac is imported largely from Bankheri, Futtehpore and some of the hills on the other side of the Nerbudda and from some of the jungles of the Nursinghpore district. Hoshungabad and Babai receive lac from the malgoozaree jungles and the hills beyond the Nerbudda, while it comes to Hurda and Seonee from the jungles of the Hoshungabad and Betul districts. Traders from Bombay and Mirzapore come twice a year to purchase lac in the Hoshungabad district, leaving agents to make purchases at other times of all the produce that can be obtained. The lac-collectors are mostly jungle tribes who sell the produce in small quantities to Patwas, who again sell it in larger quantities to the regular dealers. The tribes in question are mostly Bahelyas, Rajhors, Bhirijas, Kurkus, Dhanuks, Nahils, Bhois, and some classes of Ma-

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homedans. Jains and Gonds will have nothing to say to lac.

21. According to Major Lucie Smith, the Gonds believe that the lac insect is born of the morning mist. These rude people accordingly make no effort to propagate it artificially; but if there were a large demand, the rearing of the insect would be systematically carried on, and result in a very great increase of the product. Mr. Grant, Commissioner of the Jubbulpore division, says that "in two places only is the production of lac assisted by human agency in propagating the insect from tree to tree. The great bulk of the lac is produced without any artificial assistance, and left entirely to the unaided exertions of the insect and its migration from tree to tree. The question whether it would pay the Government to undertake the establishment of lac-producing tracts of forests is one which naturally suggests itself in any discussion of an increased supply of resins." (Letter from Chief Commissioner, dated 12th July 1872.) Mr. Michea, a French gentleman possessing an intimate knowledge of the Jubbulpore and Mundla forests, and the owner of a large tract of productive forest land in the latter district, thinks that the supply would be enormously increased if the Government were to establish lac nurseries in the wilds of Balaghat and Mundla, where the two trees particularly favoured by the insect, Butea frondosa (palas) and Schleichera triguja (koosum), are found in great abundance.

22. Since the first edition of this note was print-Efforts made ed, considerable attention has been given by the Central Central Provinces Forest Department, under the Provinces to orders of the Chief Commissioner, to the develop-lac. ment of the production of lac and the formation of

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lac preserves. At the Forest Conference held at Simla in the autumn of 1875, an interesting paper was read by Mr. J. McKee, Assistant Conservator, describing the operations and the method of propagation. This paper was subsequently published in the *Indian Forester* for January 1876, and I reproduce its substance here:

* * * " The increase in the trade of shell and stick-lac has been so remarkably rapid, and the prices obtained in Europe for the manufactured article so large, that the attention of Government has lately been attracted to a scheme for developing the production of the raw material by introducing colonies of the insects into parts of the reserves under the Forest Department, and encouraging their propagation. At present nearly all the lac is collected by private individuals from the unreserved and private forests; in the former the right being sold annually to the highest bidder, while in the latter most of the large firms interested in its manufacture have obtained leases ranging in periods from 8 to 10 years, a tenure which gives them the opportunity of increasing by cultivation the ordinary natural yield. It is well known that large sums of money, amounting latterly to about 15 lacs annually, are circulated throughout the Province in the collection and manufacture of this material, much of which as before stated is obtained from the Government forests, but strange to say, in spite of its being usually classed as one of the most valuable minor forest products, the State has never up to this time reaped any considerable gain by its sale, probably not more than Rs. 15,000 per annum; the reason given for so small a revenue being realized from this source is, that up to the present the leases of Government forests have never exceeded a year's duration, in which time it would not be possible for the purchaser to do more than gather the lac which had established itself in the natural course of events, a process, compared with that of artificial propagation, causing much delay and an excessive expenditure in the collection of a necessarily uncertain yield. By a late order of the Chief Commissioner, however, the periods of these leases have been extended to eight years, a concession no doubt calculated to increase this item of revenue in the future. The reserved tracts under the im-

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mediate superintendence of the Forest Department present so many facilities and appliances for the production of lac, which do not exist in the less strictly protected private and unreserved forests, that in spite of their comparatively small areas they may be looked on as the future medium for supplying the greater portion of the demand. The private individual must keep up a large establishment to search for and collect this product over an indefinite extent of country, or should he propagate it artificially, a method resorted to at present in only a few places, a still larger staff will become necessary for the formation of the plantations and their protection, while many failures and disappointments must result from the destruction of the nurseries or deterioration in the value of their produce, caused by the almost annual occurrence of forest fires. In the reserves, however, extensive areas have been protected successfully from fire for years past, while the establishments which will eventually be necessary for their management will be nearly adequate to superintend the additional work, and be the means of lessening the cost of producing the article; and this may be further reduced by the fact that the State could at less expense fully stock the land with trees up to the point at which it would yield a maximum outturn of lac per acre and could better afford to spare the time necessary for this result. In short, there is every probability that owing to the advantages possessed by the reserves lac may be produced by the Forest Department far cheaper and of better quality than it could be raised by other agencies, and that, should the demand for the article continue of sufficient magnitude to induce Government to produce it on a large scale, the time must come when it will be to the advantage of the manufacturer to purchase his supplies from our depôts.

"If the above reasons appear sufficiently stable to justify the State in these expectations, then the only other points which seem necessary to be determined are, *first*, whether the State can afford to put aside areas of forest land adequate for this special work without affecting the needful timber supply; and *secondly*, whether it can reasonably hope to realize from it a fair pecuniary advantage. On the first point there can be no doubt as regards the provinces where the areas of the present reserves could, if desirable, be extended without difficulty; and on the second, the figures at our command tend to demon-



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strate that the undertaking would be highly profitable. To prove this it will be essential, first, to shew the cost of preparing a given number of trees, or as I have termed them lac standards; secondly, to shew the yield that may be expected from them; and thirdly, the money value of same.

"With regard to the cost, this will necessarily vary with the description of the trees employed for the purpose, and the proportion they bear to one another in numbers on a given area. Such trees as pallas (B. frondosa) and bér (Z. jujuba). which are of comparatively small size, and which are found in many places in a state of almost pure forest, will necessarily cost less to bring under cultivation than larger species, such as koosum (S. trijuga), gooler (F. glomerata), and peepul (F. religiosa), which are generally found either scattered about the forest or fringing the slopes of ravines and the banks of the rivers, for less brood lac will be required for their treatment and less trouble and time employed in searching for them; but on the other hand, the larger outturn obtained from the latter species will more than repay the extra money expended in preparing them. Our experiments extend at present to having operated on 7,467 trees of the Pallas and smaller species, and 1,903 trees of Koosum ; these numbers represent the standards on which the insects are doing well and do not include a large percentage which turned out failures. The total cost of bringing the above under cultivation, including all charges, such as collecting brood lac, attaching it to the trees, &c., average Rs. 3-5-11 per 100 trees of Pallas and Rs. 15 per 100 trees of Koosum. Owing to the dryness of our summer and the great damage to the lac caused by the hot winds, it does not seem probable that we can look forward to even two good crops in the year; the summer one will probably in almost all places, except those very favourably situated, be of poor quality and the quantity of lac developed not more than sufficient to leave on the trees for producing the crop which matures during the cold season. This latter will generally be good and must be the one we depend on for a return. Reckoning then on only one crop a year, and estimating the yield per tree at the moderate quantities of 3 seers for Pallas and 15 seers for Koosum or trees of like size, we obtain a net outturn, after deducting 25 per cent. for wastage in drying and packing, from the Pallas and small

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trees of maunds 5.25 per 100 trees, and from the larger species of maunds 27.32, which, if valued at Rs. 15 and 20 per maund respectively will be worth Rs. 84-6 for the former, and Rs. 541 for the latter. Take from these sums the cost of producing the article, which in future will be, if anything, less then heretofore, owing to the lac being obtained in one spot, and the net profit on 100 trees of Pallas will equal Rs. 81 and on the same number of Koosum Rs. 526. Large areas of forest are now available on which the number of Pallas and other suitable trees per acre quite equal or even excel the above unit, and the expediency of forming plantations of Koosum, which area for area would yield a more valuable crop, is under consideration.

"Now with regard to the cultivation of the product. In forming preserves for the production of lac the first point to be considered is the species which it will be desirable to utilize as nurseries; the most favourable will be, first, those which are found in largest numbers on a given area, always provided they are suitable for the purpose; secondly, that species from which the finest lac is obtained.

"In the Central Provinces, lac is generally found on the following :---

	Schleichera trijuga	ι.						Koosum.
	Butea frondosa .							Pallas.
	Zizuphus jujuba			•				Bér.
	Zizuphus xulopuru	s	-					Ghontee.
	Ficus religiosa							Peepul.
	Ficus indica					101		Barghat.
	Frome alomerata				-174	- 60		Gooler.
1	Filles giomerate	<u> </u>		÷.	12	10		Pakhar.
-	Ficus venosu .	1	• •				.:11	also form on
Sut	experiments have]	prov	red	tha	at	IL W	m	also form on
	Tectona grandis							Sagon.
	Acacia catechu .					4		Khair.
	Pterocarbus marsh	ipiu	m					Bija.
	Terminalia toment	osa						Saj.
	Dalhangia paniculi	ata						Dhobeyne.
	Duttergia punicai	* 0						T
	Lagerstræmia par	vift	ora	Part	•		•	Lenaya.
	Ougeinia dalbergi	oide	5					Tinsa.
	Vadia calucina							Barranga.

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Kydia calycina . . .

Eriolana Hookeriana . .



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"Of the above trees the light golden resin obtained from the Koosum is the finest, as from it the most valuable orange shell-lac is manufactured, and next in quality is that obtained from the Pallas, which yields the garnet lac of commerce. Wherever possible therefore the Koosum tree should be chosen for standards; but as the Pallas is generally found in much greater numbers, area for area, its produce will nearly compensate in quantity for the reduction in its value. Having selected the forest for experiment, the next point to fix on is the local date on which the insects leave the parent cells, a step of great importance, and one on which the first success of the plantation will very greatly depend ; as, should the work of gathering brood lac be delaved until visual proof of the exit of larvæ is obtained, a vast quantity will be killed in the operations of collection, transport, and of tying the encrusted twigs on the standards selected for nurseries. The date of evolution having been fixed on with some certainty, twigs of that season's lac should be gathered about 15 days before, wrapped up in a few straws of grass and attached to the trees selected for production, with threads of Pallas root fibre or something else as easily obtained ; each twig should be from 9" to I' in length, and be attached to the upper and middle branches of the tree. The grass tied round the twigs acts as a means of communication from the lac to the branches and leaf petioles, by which many insects are saved that would otherwise die from want of nourishment; as owing to the crookedness and irregularities of the encrustations contact between them and the branches is seldom complete. It is also of importance to tie the brood lac to the upper and middle branches, as many of the lower ones, by this arrangement, become covered with insects, which are shaken or fall from above : whereas if the lac be attached to the lower portion of the tree, many larvæ must fall to the ground and be lost. When attaching the twigs it appears necessary to take care that the wood of the standard is not of denser composition than the wood of the tree from which the brood lac is gathered, as it is believed that the larvæ reared on soft-wooded trees are comparatively weaker than those which are found on species of harder texture. There is an idea prevalent among the Gonds that nursery

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condatds must be prepared with brood lac taken from the same species as themselves; but this has been proved to be incorrect. The brood lac yielded by the Koosum, a very hard wooded tree, appears best suited for propagating purposes, as it succeeds on trees of all other species. When several trees of the selected species grow together, it does not appear necessary at first to artificially cultivate more than three-fourths of them, as during the succeeding evolution the remaining fourth will almost certainly be brought under preparation by natural means,* but as the success of the crop depends principally on the supply of juices obtained by the female insects during the period they continue to deposit the resin, it is necessary to place the brood lac on the youngest and most sappy branches.

"Lac preserves may be formed by carrying out the above simple operations; but it is not probable that success will be attained at once or until experience has drawn attention to several peculiarities in the habits of the insect and the manner in which it is influenced by situation and atmospheric conditions. Our first attempts were made in the cold weather of 1874, but owing to the want of knowledge that prevailed on several essential points, both among the superintending staff and the labourers employed on the work, the extent of these was naturally limited and of small result. It was not known with any certainty when the exit of young larvæ commenced, or what was the best method of applying them to the trees; thus a large number were lost, and this destruction of insect life was greatly increased . by the rough handling they were exposed to by the workmen. In one instance a plantation which had been prepared and was progressing well was nearly destroyed by mistaking an evolution of male insects for one of larvæ.an error into which it would be impossible to fall except

* In 1874 1,300 trees were prepared at Kosai in the Satpura Reserve, in 429 of which the lac was destroyed during the hot weather of 1875, leaving 871, from the encrustations of which a new brood of larvæ swarmed in July 1875. The lac on these trees was not touched owing to its being a bad crop, but was left for further propagating purposes. On the 19th August, however, an enumeration of the trees on this spot proved that new lac was then being formed on 1,380 trees; thus 509 trees must have been affected by their proximity to the old standards.

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through want of knowledge of the insect's habits; in another, the colonies were greatly damaged by a fire which broke out and destroyed the lac—on all but the highest trees; while in a third frost and hot winds killed the females and stopped the formation of lac on nearly half the number of trees prepared. But although we had to contend with so many mishaps, partly through ignorance and partly from physical causes, each experience in its way taught valuable information which will render more certain our future undertakings.

"Of the points to be noted in making these preserves the one of greatest importance perhaps is the fact that the lac encrustations may be plucked several days before the larvæ appear,-a knowledge of which will enable a larger number of trees to be prepared during one working season than if it was necessary to delay the operations until the evolution actually took place, as owing to this latter being nearly simultaneous in and about one locality, the period for forming the plantation would be necessarily limited to the number of days it took for the cells to become empty ; besides which, by attaching the lac twigs before the birth of the larvæ great numbers are saved, which would otherwise perish during the process of being attached to the trees. In support of this fact it will be interesting to give the following observations : Mr. Thomson, Deputy Conservator, in order to fix on a safe date for gathering the brood lac, caused twigs, covered with the encrustation, to be brought in from the surrounding forests every two days for examination. These he labelled, dated and hung up in the verandah of his forest bungalow ; the first twig was gathered on the 10th June, and the others on every succeeding alternate day until the 12th July. These twigs were the produce of several trees, and were brought from various parts of the forest within a radius of 10 miles; some were plucked from the Gooler, others from the Peepul, but the majority from the Pallas. On the morning of the 13th July, according to custom, Mr. Thompson examined the twigs, but found no sign that the larvæ had vacated their cells, although microscopic observations had proved them to be fully developed. On the 14th however an inspection shewed that on all the twigs, without exception, the young were

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pouring out of the cells through the anal apertures; thus the twig gathered on the 10th June hatched exactly on the same date as the one gathered on the 12th July, or more than a month later. The same fact was accidentally discovered on quite a different plantation in the following manner: A large basket of stick lac collected from the Koosum tree was brought to the forest bungalow on the 7th June, being then two days old, and put aside in a storeroom as being unripe and unfit for use. On the 28th of the same month however, on being casually examined, this lac was found covered with young larvæ, which must have made their appearance about 24 hours before : in this case the stick-lac had been plucked from the trees and thrown aside for 23 days and turned out useful for propagation after all. These two facts prove that the encrustations may be gathered from two to three weeks before the exit of the young, by which, as before explained, much better results will be obtained than if it was necessary to delay the work until this event took place. The date of exit varies considerably in forests separated one from another by comparatively short distances. For instance, the brood hatched last season is reported to have made its first appearance at Korai on the Satpuras on the 28th June; in the forests of the Western Division situated on the same range of hills, but about 50 miles to the south of the first-named place, during the first week of August; at Mohurli, in the Chanda District, about two degrees of latitude further south, on the 14th July; and at Ahei, still further south in the same district, a few days earlier. These dates do not point to a difference in the latitude of forests being the origin of the variation noticed, and it is more probable that in these provinces. which are situated in the centre of the insect habitat, the disagreement in the dates of birth are caused by certain local conditions. The above dates refer to the summer evolution : the winter one issues from the end of October to nearly as late as the middle of December, but the exact dates of this last in the different plantations have not yet been definitely fixed. While on this subject it is necessary to draw attention to the reported variation in the number of evolutions and consequently in the number of crops which are obtained in different countries. In Mysore and Burma it would



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appear that three evolutions of the insects take place during the year. At paragraph No. 22 of Mr. O'Conor's report he states that in the former place 'the insects are applied to the trees three times in the year, the old branches with the insects on them being lopped off, made into small bundles and tied up to fresh branches ;' and in an addendum* to his note it is stated by a late Burma Forest Officer that 'every four months, or thrice a year, the lac is collected, and thrice is the lac with the ova put on.' As in the Central Provinces only one good crop a year can be hoped for at present, it would be interesting if the Forest Departments in Burma and Mysore would give some details of the method employed in cultivating the insect in those countries, as possibly by attention and careful treatment the crops might be increased in these Provinces, a matter of much importance, as thereby a larger revenue would be realized, or the same quantity of lac obtained from asmaller area.

"After the larvæ appear, they crawl about the stems of the plant in search of young juicy spots, from which, when once fixed by their probosces, they cannot be removed without fatal injury. The male and female are identical in size and shape, and both commence at once the formation of their cocoons by excreting a substance resembling lac, those of the male being ovoid or elliptic in form, while those of the females are more circular and exhibit three distinct apertures arranged in triangular fashion in their roofs,one being the anal aperture through which impregnation is accomplished, and the larvæ eventually swarm; the other two, those by means of which the insect obtains a supply of air. About 10 weeks after birth an important change has taken place in the larvæ, the female cocoons are completed, and the insects have assumed the final or imago state; but as the female never shifts her place but remains fixed in the position she first of all took up on the twig, the male is obliged to seek her, which he does by leaving his cell in a backward manner to the ventral aperture and crawling on to the female cells, where he fulfils his office and almost immediately after dies. This exit of male insects is a fact well to know, as owing to the smallness of

* Paragraph 31 of the present edition.

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the animal and, to the naked eye, his similarity to the original larva form, it is possible for a novice to mistake such an evolution for one of young larvæ and to commence gathering the twigs under the impression that a new birth of these latter had taken place. In fact, as above mentioned, such a mistake actually happened in one of our experimental plantations, causing its almost entire destruction ; for it is obvious that if the lac is plucked before or immediately after impregnation has been accomplished, the females must perish from being cut off from their sap supplies, and as a natural consequence the young brood must be destroyed with them. This mistake however may easily be avoided, for the lac at this period is so little developed compared with its after-growth that no one at all acquainted with its final appearance could imagine it to be fully formed at the date when the male evolution takes place; besides which, the filamentous processes which give to the lac the downy appearance so familiar to it, only increases rapidly after this period. Impregnation having been accomplished, the female busies herself in sucking up large quantities of vegetable juices, increases greatly in size and begins the excretion of the true lac.

"The females must be attached to young twigs by which bountiful supplies of fluid will be supplied them, otherwise they will die or never become fully developed, the lac cells will be small in consequence, and the eggs badly effected both with regard to number and condition.

"This no doubt is the reason why in districts where the seasons are dry and where showers are of unfrequent occurrence during the hot weather, the summer crop is invariably poor and scarcely worth collecting. Moisture is one of the great essentials for a fine crop of lac, and many disappointments, if not total failure, will result by fixing on dry arid spots for the formation of the plantations. The females cannot obtain sufficient nourishment at this period from the sapless stems, and their death will be recognized by the pitted appearance assumed by the cells, the crowns of which fall in as the insect contracts within them, and by the cessation of the growth or disappearance of the white filaments which obtrude from the spiracular orifices. Spe-

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cies such as Koosum and Gooler, which most frequently are found growing along the banks of rivers, where the atmosphere is humid and moist, are, for these reasons, especially adapted for yielding good crops of lac; while the Pallas offers advantages, as its sap-producing functions are actively employed during the hottest season of the year when it forms both new wood and leaves.

"Besides the damage brought about by fires, drought, and frost, which to some extent can be guarded against, there are other enemies to the crop which are still more difficult to contend with. Mr. Thompson writes: The ant, both large and small, attends the female cells for the purpose of licking up the sweet excrement; they do not appear to hurt the insect beyond biting off the ends of the white filaments, and thus bringing many an occupant of the cells to a premature end by cutting off the supplies of breathing air which the filaments serve to convey through the holes in the lac. Where ants are seen about the lac it never appears healthy, and many cells are found with the insect dead inside them. The lac whilst on the tree is also attacked by the larva of a moth, which appears to be a species of Galleria belonging to the ninth section of the Nocturna named Tineites by Latreille, one of which is famous for eating into the honeycomb of bees, living on their larvæ and destroying their wax. Our insect eats the juicy females of the coccus and bores through the lac cells ; it is found both in the field and the store-room. A second species was also detected, which appears to belong to the genus 'Tinea.' The ravages of these insects destroy the colouring matter contained in the females, and also all hope of a brood of young from the cells visited by them. At present there seems to be no way of protecting the lac from their depredations. The ants however may be circumvented in two ways,-either by surrounding the trees with wood ashes, or something sufficiently attractive to draw their attention away from the encrustations.

"It seems possible, owing to the great drain made on the sap of the young branches by the insects, that considerable damage will be found to result to the trees on which they are propagated, and that it will be necessary at some future

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time to fix a limit to the continuous cultivation of lac on the same tree; at any rate it will probably be found beneficial to both lac and tree if a regular system of pruning be carried out to encourage the new formation of young twig or branch wood." * *

23. In Mysore, lac is produced in all the three Mysore. divisions of the province, but chiefly in Nundidroog, and is found most commonly on the Vatica laccifera. The insect thrives well in Mysore, and it might by cultivation be raised to any extent on trees growing on barren soil which would otherwise yield no return. The carob tree, which is about to be introduced into Mysore, will probably, if it will succeed in the province, be found well adapted to this purpose. It will flourish in dry and stony soil and the lac insect seems to be much attached to it. The price of lac in Bangalore varies from Rs. 7 to Rs. 8-8 per maund of 24 lbs. No data exist on which to estimate the quantity procurable annually, the produce being collected in many places by several petty contractors. But the supply in the province is large, and, in the event of a good demand arising, would no doubt be considerably increased. (Note by Colonel R. H. Sankey, R. E., dated 5th November 1872.) Apparently the lac produced in Madras and Mysore is consumed locally, for the exports from Madras are next to nothing.

24. The mode of propagation of the insect in Propagation Mysore is as follows: The insects are applied to af the insect in Mysore, the branches of the trees (Vatica laccifera, a tree easy of culture and propagation) three times in the year, the old branches with the insects on them being lopped off, made into small bundles, and tied up to fresh branches. The insects then begin to build their cells on the branches, and



continue occupied for about three months. When this period has expired, the young leave their abode. This opportunity is carefully watched, the insects are secured for further use, and the laccovered branches are gathered, each tree producing on an average $2\frac{1}{2}$ seers. The insects are invariably applied to immature trees or saplings, as the old trees do not contain sufficient sap for their nourishment.

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25. In a note published in the Agricultural den's descrip- Gazette of India, January 31st, 1874, Mr. A. H. Blechynden states that "the lac insect is as much artificially propagated or as much cultivated as any other raw material for manufacturing purposes. If it takes to a tree not considered so suitable for elaborating the colouring matter and gum, it is removed from thence and placed upon others on which it is known to thrive better. In Central India the application of seed to a new tree takes place in June for the November crop, and in October for the April crop. The operation is most simple, consisting merely of cutting off the branch of an old tree with the insects on it, and placing it on the branch of a fresh tree, over which and the other branches the insects soon spread themselves. The cultivators are careful, in placing the old branch between the two branches of the fresh tree, not to allow the ends to project on either side, otherwise many of the insects would be lost. If the seed is placed on a congenial tree, the produce does not deteriorate from the same seed being left any time on the same tree, so long as the tree retains its vigour. The insects are sometimes, when quite in a state of nature, transplanted to other trees by the feet of birds to which they attach themselves."

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26. Mr. Elliot Angelo, of Cossipore, informs Protection me that it is necessary to protect the insects, when from ants thus transplanted, against the attacks of ants, and that lac-gatherers in Oudh, and perhaps elsewhere, are in the habit, for this purpose, of keeping the ants occupied in another direction by placing things of which they are fond at the foot of the tree and replenishing the supply until the insects have completely shielded themselves under their resinous coverings. Mr. McKee, in the Central Provinces, apparently finds that wood ashes placed on the soil round the tree answer the same purpose, and the same plan is practised by the Karens in Burma.

27. Mr. Crichton, of Ranchee, says that "who-*Propagation* ever wishes to grow lac should break off a twig, *Nagpore*. about three inches long, well covered with lac, at the proper time, and tie it with string to a young branch of the tree just below or close to the green juicy twig." In Chota Nagpore the insect swarms in January and February, and again in June and July, in any of which months the lac may be fixed as described. Mr. Crichton has known the insect taken forty miles and then attached to trees with great success. But it is very capricious and easily affected by atmospheric influences.

28. In 1860, the propagation of the insect was Successful successfully effected in the territory of Kapurthala propagation of lac distance of some hundreds of miles. About three long distance, maunds of lac containing the insect were sent up from Oudh, by the Rajah's agent there, to Phagwara. The lac was taken from the vessel in which it was received, and tied up in detached portions in little bundles of grass. These bundles were tied to the larger branches of the dhak tree, and, as the
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insect worked its way through the lac, it found its way out from the bundle on to the branch, and soon made its way up the smaller branches, where it commenced its operations.

Propagation in Burma: by the State.

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29. The vast forests of British Burma are capable of producing an almost unlimited quantity tions formed of lac; but hitherto the largest portion of the quantity available for shipment has been brought from Upper Burma and the Shan States, and the principal market is found in Calcutta, where the rough stick-lac is manufactured into shell-lac for export. The product is, to a small extent, procurable in the hill tracts of Arakan, and with encouragement it is susceptible of development. Prizes have been offered to the people to encourage the propagation of the insect. The Chief Commissioner in 1874 gave orders for the execution in the Forest Department of a plan for the development of the production of lac in British Burma, and experiments were made with the object of introducing a better supply of the lac insect, through the agency of Shans and Karens, into the Toungoo district. Mr. Eden also ordered the Forest Department to select sites on which a considerable number of trees suited to the production of lac exist. These were demarcated and improved by the removal of all unsuitable trees, and the substitution of quick-growing trees adapted to the purpose, such as the Zizyphus jujuba, Butea frondosa, Ficus indica, Mimosas, Erythrinas, and others. Insects were procured from the Shan States and Karennee through the agency of Karens, who volunteered assistance at Toungoo, and from the border districts of Siam. The insects on trees in Rangoon were carefully removed to the new plantations. Mr. Eden also ordered the establishment of a lac MINISTRE

preserve at Toungoo under the Deputy Conservator of Forests there.

According to the Forest Report for 1874-75, the lac plantation formed in the Rangoon division at Magayee, appears to be progressing satisfactorily. The breeding nurseries extend over three acres, containing two varieties of Ficus, Butea frondosa and B. superba, Zizyphus jujuba, and Erythrina indica. Another nursery of eighteen acres in extent has been similarly prepared. The Conservator of Forests says that there is every reason to believe that lac cultivation will turn out a valuable branch of forest administration; and in a recent Resolution (dated the 7th September 1876) the Chief Commissioner states that the experimental culture of lac in the nurseries near Rangoon may be declared a success. The insect has been naturally reproduced, and there is now no ground for apprehending a failure. In Sittang, however, for reasons which are not explained, the cultivation has failed altogether.

30. Among the Padoung Karens beyond the Lac in the North-East frontier of Burma the production of lac *Karen* is said to be carried on upon a large scale and in a systematic manner. The following information on the subject is furnished in a communication from the Reverend A. Bunker (Missionary), dated Toungoo, the 23rd September 1874:

Lac among the Padoung Karens is gathered twice a year, in September and October, and again in January and February. It requires from five to six weeks to complete the harvesting of a crop. The best quality of lac is gathered in September and October. It is then large and full of the insect and the colouring matter, that of the dry season is small and deficient in colouring matter. At the time of harvesting, seedlings are cut off and tied on anew at base of the limbs of the lac trees, or certain branches are left untouched. I am told

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Methods of

propagation among the

Karens.

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that the lac insects will leave their cells, and spread over the trees, even though the branch is not cut off, when the season for breeding anew comes on.

These natives take the lac after the insects have left it for the branches of the tree, and mix it with the lac prepared for sale, but natives acquainted with the article readily discover the fraud, and will not buy it, even at a discount.

The insect being the colouring matter, great care is taken to prevent it from leaving its cell; hence, immediately on being severed from the tree, the lac is spread on mats and mixed with wood ashes in order to kill the insect in its cell. After mixing with ashes for a season the lac is exposed to the sun and packed away for sale.

Only a part of the tree is usually covered with the insect, sometimes one side or only a few branches. These are cut off when the lac is harvested and grown anew for future crops.

The natives have many superstitious rites which they observe during harvesting and preparing for a new season, but they are unworthy of mention. They are also unwilling to part with the live insect, being fearful lest their neighbours ruin their trade, yet money will prevail with them.

Lac is found also among the Sankoo Karens and Koonoung Karens in small quantities. It is reported to have been plentiful formerly in some parts of the Koonoung district.

31. The following notes by Moung Poh, Forest Overseer, give some information (in quaint diction) regarding the method of propagation of lac in the Karen Country:--

Propagation of Lac in the Karennee States.

They commence putting the lac on the Gyo (Schleichera trijuga) trees from the 4th or 5th of the new moon of Watso (July).

The lac matures by the new moon of *Tasoungmong* (November), when the branches are broken off and collected. In the same month they again put lac with eggs in it on the trees. Every four months, or thrice a year, the lac is collected, and thrice is the lac with the ova put on.

If not collected in four months, the lac deteriorates.

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> On a Pouk tree (Butea frondosa), of a girth of three cubits, as much as three viss (10.95 lbs.) of lac can be placed either on the stem or branches. In putting on the stem it must be not less than four cubits from the ground, above which point the bark has to be removed and the green lac fastened on with bamboo wisps and covered finally with split bamboo plaited to a width of three fingers, and fastened securely on with bamboo wisps.

> The bamboo wisps used for securing the lac must not be more than three fingers in width.

> In tying on the lac the bark must not be altogether removed, but being cut with a *dah* (knife) on two sides at a distance one cubit apart, it is, together with other bark obtained from the same tree, placed over the lac like a pad. According to the breadth of the bamboo wisps will be the yield of lac, *viz.*, one inch width of bamboo wisp will allow of one collection; two inches width two collections; three inches width three collections.

> When mature at the end of four months, the lac-bearing branches are broken off with a betel-nut cutter and assorted into good, middling, and bad quality. To destroy the insects in the lac, it is exposed to the sun and sprinkled three times with ashes. The drying process occupies about 20 days.

> On a Gyo tree from three to four cubits in girth, and having numerous branches, a yield of 1,430 viss (5,110°lbs.) may be expected if properly looked after.

> On the Yendike tree (Dalbergia caltrata).—The lac is put on in quantities of 70 tickals (2.55 lbs.) wrapped around with cloth not wider than three inches, both ends being left open and the whole secured with bamboo wisps and suspended about one cubit below the branch.

> The ground below to be kept clear of rubbish and spread with ashes to keep off insects.

On the Nyoungben or Ficus.—The bark is removed to the width of one span, and the stick-lac fastened on in pieces of three inches in length.

It is customary to bury a piece also in the ground at the foot of the tree to prevent the tree from swallowing up the lac. (!)

Lac obtained from the Ficus can only be propagated on Ficus trees; if attempted on other trees, there will be no yield.

On the Pouk tree (Butea frondosa).—It can be done either on the stem or branches. In the case of the branches care must be taken not to injure the bark in ascending the tree; and the extremities of the branches for one cubit in length should be left untouched, and a similar space left untouched at the lower portion of each branch.

The lac is covered with a thick fold of cloth, but not more than three inches in width, and the cloth itself kept on by means of strips of cloth.

This being completed, the bark is placed over the whole and tied with bamboo wisp or bark. This latter operation is intended to prevent the insects when formed from descending the tree. Furthermore, at the distance of one cubit from the lower end of the branch, other branches are tied round the bark with the additional object of forcing the insects upwards.

On the Zee tree (Zizyphus jujuba).—The bark is removed where required to the extent of one cubit, and the lac put on in any quantity covered with indigo-dyed cloth secured with bamboo wisps.

The indigo-dyed cloth must not exceed three inches in width, and the lac must be left open at both ends, above and below the cloth.

Before putting up the lac it is usual to warm both ends before the fire.

The bark that has been removed is also to be tied round the middle of the tree and also the branches; but in the case of the latter, the lac enclosed in bamboo wicker work is suspended above one cubit below the branch.

It is necessary to keep the base of the tree perfectly clear of rubbish, and to place ashes round it to keep off insects.

32. Mr. Strettell says that it is generally believed that there are three swarming seasons in British Burma. He adds that "Mr. Nepean, who has devoted much attention to the subject, has ascertained that the insects emerge from their cells about the end of November or early part of December."

Trade: Exports of shell-lac to foreign countries.

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33. The following table shews the exports from British India to foreign countries of shell-lac for the ten official years ending with the 31st March 1876: Ending with 1875-76.

		COUNTRIES WHITHER EXPORTED.											
¥ears.	Whence exported,	United Kingdom	Fra	France.		rica,	Other countries.		Total.				
1866-67 (eleven months)	Bengal	Cwts. Rs. 28,210 11,43,85 	Cwts. 3 2,441 2 	Rs. 1,00,693 	Cwts. 5,43 ⁸ 	Rs. 2,18,573 	Cwts, 443 	Rs. 18,276 	Cwts. 36,532 121 	Rs. 14,81,375 5,082			
	TOTAL INDIA .	28,331 11,48,91	5 2,441	1,00;693	5,438	2,18,573	443	18,276	36,653	14,86,457			
1867-68	Bengal	27,791 7,74,2-	9 \$,434 19 	67,805 535 	5,194 	1,45,449 	1,501 17 1	41,987 515 23 	36,920 36 1	10,29,490 1,050 23 			
	TOTAL INDIA	27,791 7,74,2	9 2,453	68,340	5,194	1,45,449	1,519	42,525	36,957	10,30,563			
1868-69	Bengal Bombay Sind Madras. British Burma.	33,577 8,81,1 31 8 	15 871 15 	24,390 	9,164 	2,56,609 	96 	2,670 21 29 	43,708 31 1	11,64,814 896 *** 29 			
	TOTAL INDIA	33,608 8,82,0	871	24,390	9,164	2,56,609	97	2,720	43,740	11,65,739			

Note on Lac.

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Quantities and value of Shell-lac exported from British India to Foreign Countries during the ten years ending with 1875-76-(continued).

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						Coun	TRIES WHIT	THER EXPOR	TED.	The state	-21	
Years,	Whence exported.		United Kingdom.		France.		America,		Other countries,		Total,	
	Bengal		Cwts. 32,233	Rs. 9,02,552	Cwts. 2,691	Rs. 75,382	Cwts. 9,648	Rs. 2,70,160	Cwts. 888	Rs. 24,836	Cwts, 45,460	Rs.
1869-70	Bombay		58	1,624 			 			 		
	TOTAL INDIA .		32,291	9,04,176	2,691	75,382	9,648	2,70,160	918	25,683	45,548	12,75,401
1870-21	Bengal	• • •	24,464 	6,85,039 	693 	19,415 	13,913 	3,89,514	1,144 ¹ 63	31,988 7 	40,214	11,25,956
	Madras	•										
	TOTAL INDIA .	•	24,464	6,85,039		19,415	13,913	3,89,514	1,1513	32,108	40,2213	11,20,130
1871-72	Bengal Bombay		39,362 195 	11,02,139 5,457 	504 20 	14,045 550 	15,662 	4.38,557	2,032 43 2	56,970 1,170 	57,560 258 2	16,11,711 7,183 48
l	Total India	•	39,557	11,07,596	524	14,601	15,662	4,38,557	2,077	58,188	57,820	16,18,942

Note on Lac.

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(IT)	URE . GOVER		A STATE OF	a indi										
IISTRY OF		Bengal Bombay	::::::	29,652 176	8,30,275 4,933	169	4,727	17,655	4,94,329	2,948 41	85,400 1,180	50,424 217	14,14,731 0,115	A
	Marce Mart	Madras British Burma				1	1.1				14		14	31
The second	राजय . भाग्स सार्थ		TOTAL INDIA	29,828	8,35,208	169	4,727	17,655	4,94,329	2,9891	86,394	50,641	4,20,858	
	1873-74	Bengal Bombay Sind	:::::::	45,909 5	12,85,367 152 	405 	11,294 	16,551 	4,63,438 	2,897 23 	80,603 629	65,762 28 	18,40,701 781	
	l	British Burma .								H. H.				
	1	「生活」	TOTAL INDIA	45,914	12,85,519	405	11,294	16,551	4,63,438	2,920]	81,240	65,790}	18,41,491	No
•	1874-75	Bengal Bombay Sind Madras British Burma .		45,576 36 	12,75,938 1,000 	793 	22,193 	18,502 	5,17,858 	2,773 21 	77,678 614 	67,644 57 	18,93,667 1,614 	ote on Lac.
			TOTAL INDIA	45,612	12,76,938	793	22,193	18,502	5,17,858	2,794	78,292	67,701	18,95,281	
	1875-76	Bengal Bombay Sind Madras British Burma .		58,443 4 752	46,04,007 134 26,295	3,544	2,31,452 2 	13,615 	13,83,210 	3,774 23 489	2,46,495 1,500 85 13,688	79,376 27 1,241	64,65,164 1,696 85 39,9 ⁸ 3	
F			Total India	59,199	46,30,436	3,544	2,31,454	13,615	13,83,210	4,287	2,61,828	80,645	65,06,928	41

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34. During these ten years therefore the quantity of shell-lac exported to foreign countries rose from 36,653 cwt. to 80,645 cwt., being an increase of more than 120 per cent, the last year of the decade shewing a specially large increase. This year also shews a vast increase in value, but to some extent the increase over the value recorded in 1874-75 is more apparent than real. In that year (1874-75) on the other hand a very large increase ought to have been shewn in the recorded values, prices having reached nearly their highest point during the twelvemonth, and being in many cases more than double what they were in 1873-74. The explanation is that until the commencement of the official year 1875-76, the values declared at the custom-houses by exporters and recorded there were the values fixed by the tariff of 1871, and these were far below the real value in 1874-75 and for some time previously. Thus until 1875-76 the values in the foregoing tables must not be taken. to represent the market values ruling for the period to which they relate.

35. The effect of the great demand for shell-lac and the excessive speculation in the article during the last two years are shewn in the figures representing the exports for the official year 1875-76. Since then, however, there has been a corresponding reaction and depression in the trade, and prices have fallen, as will be seen from the table printed elsewhere, (page 55) from a maximum of Rs. 97 per maund, and a minimum of Rs. 53 per maund in 1874 to a maximum of Rs. 57 and a minimum of Rs. 22 per maund in 1876. It is not probable that this depression will be of long continuance ; but those who are interested in the trade might do well to take warning by the fall which has occurred, and to bear in mind

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not only that it is possible to overstock the market in a period of feverish excitement, but that unreasonable prices may cause consumers to turn to other sources of supply than India for their lac. It is an error to suppose that India alone produces lac. No doubt practically she may be said to possess the monopoly of the trade at present, but some quantities are also exported from Siam and the Straits Settlements,* and a development in the trade of these countries would assuredly follow upon a continued unreasonable valuation of Indian lac, and carelessness in its preparation for the market. A considerable silk trade has gradually slipped out of our hands and a once flourishing industry is in a state of decay because unreasonably high prices have persistently been combined with an inferior article.

36. The exports of stick-lac for the same period Exports of are exhibited in the table appended. They are stick-lac. quite insignificant as compared with those of shelllac.

Quantities and value of Stick-lac exported from British India to Foreign Countries during the ten years ending with 1875-76.

Years.			Whe	ence	exp	orted.					Quantity.	Value.
1	A ME IN	14		1		1	1			1	Cwts.	Rs.
1865.67	Bengal .			•				•	•		139	3,076
(eleven { months)	Sind . Madras . British Burn		÷	•••		••••	:			•	 50 1,523	1,050 31,895
						Тотл	L IN	DIA.	•		1,712	36,021

* The imports into the United Kingdom from the Straits and "other countries" in 1874 (the latest year for which I have the figures) were 10,824 cwts. valued at \pounds 81,635 as compared with 60,495 cwts., valued at \pounds 579,999, imported from British India. These are imports of all different states and dya. of all descriptions of lac: seed, shell, stick, and dye. A large pro-portion of these imports is Siamese lac.

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Note on Lac.



Quantities and value of Stick-lac exported from British India to Foreign Countries during the ten years ending with 1875-76—(continued).

Years,	Whence exported.	Quantity.	Value.
1867-68	Bengal	97 30 356 419	1,548 502 5,729 8,312
and a	TOTAL INDIA	902	16,091
1868-69	Bengal	6123 739 	11,010 11,833 15,147 28,668
	British Burma	4,075	66,558
-950 400	Bengal	1,136 63	18,176 1,025
1809-70	Sina Madras, British Burma	430 460	6,886 8,747
and the second	TOTAL INDIA	2,089	34,834
1870-71	Bengal	41 37 	73 590 1,339 6,672
	TOTAL INDIA .	. 692	8,663
1871-72	Bengal	35	550
	Total India	. 446	5,499

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Quantities and value of Stick-lac exported from British India to Foreign Countries during the ten years ending with 1875-76—(continued).

Years.	Whence exported,	Quantity.	Yalue,
1872-73	Bengal	Cwts. 50 65	Rs. 800 1,040
	Total India	115	1,840
1873-74	Bombay Sind Madras British Burma		
	Total India	127	2,036
1874-75	Bengal ,	386 20 164	6,180 320 3,881
	Total India	570	10,381
1875-76	Bengal ,	58 41 108	1,817 1,300 3,775
	TOTAL INDIA	207	6,958

37. The foreign trade in lac-dye is exhibited in the following table:

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Exports of Lac-Dye from each Presidency or Province in India to Foreign Countries during the ten years ending with 1875-76.

CULTURE . GOVE

Years,	Presidency or Province,	United Kin	ngdom,	Fra	nce,	Am	terica.	Other o	Other countries,		otal.
1866-67. (Eleven months).	Bengal Bombay Sind Madras British Burma .	Cwt. 8,921 <u>2</u> 	Rs. 3,73,317 	Cwt. 126½ 	Rs. 3,632 	Cwt. 2,644 ¹ / ₂ 	Rs. 1,11,071 	Cwt. 23 25 	Rs, 982 522 	Cwt. 11,692 ¹ / ₂ 23 25 	Rs. 4,88,020 982 522
	TOTAL .	8,921 ¹ /2	3,73,317	126 <u>1</u>	3,632	2,64412	1,11,071	48	1,504	11,7402	4,89,524
1869-68,	Bengal Bombay Sind Madras British Burma . Total .	11,829 11,829	5,29,117 5,29,117	288 288	12,995 12,995	2,131 · · · · · · · · · · · · · · · · · ·	95,880 95,880	25 25		14,273 14,273	6,38,736 6,38,736

Note on Lac.

Contract of the second	Bengal Bombay . Sind Madras British Burma		12,433 	5,56,879	280 	12,595 	5,022 	2,26,080 	 	 	17,735 13 	7,95,554 	SI
	TOTAL	•	12,433	5,56,879	280	12,595	5,022	2,26,080	13	101	17,748	7,95,655	
·04-6981	Bengal . , Bombay Sind Madras British Burma					 	 		20,518 346 	9,23,963 2,109 	20,518 346 	9,23,963 2,109 	Note on .
	TOTAL				3				20,864	9,26,072	20,864	9,26,072	Lac
1870-71.	Bengal Bombay . Sind Madras British Burma		10,564 	4,75,385 	136 	6,133 	1,553 	69,885 	30 218* 	1,359 1,671 	12,283 218 	5,52,762 1,671 	
	TOTAL	•	10,564	4,75,385	136	6,133	1,553	69,885	248	3,030	12,501	5,54,433	

* Countries not distinguished.

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Experts of Lac-Dye from each Presidency or Province in India to Foreign Countries during the ten years ending with 1875-76—(continued).

CULTURE . GOVE

Years.	Presidency or Province,	lency or vince, United Kin		ingdom. France,		An	nerica.	Other c	ountries.	Total.	
1-73.	Bengal Bombay	Cwt. 14,862	Rs. 6,68,832	Cwt. 257	Rs. 11,577	Cwt. 1,601	Rs. 71,998 	Cwt. 622 121	Rs. 27,987 795	Cwt. 17,342	Rs. 7,80,394
187	Madras British Burma								;		
.(Total .	9,010	6,68,832	²⁵⁷ — 148	6,695	1,601	71,998 		28,782	17,463	4,67,106
1872-73	Bombay Sind Madras British Burma	···· ··· ···		 	 	 	··· ··· ···	19* 109 	861 600 	19 128 	861 688
	TOTAL	9,029	4,09,988	148	6,695	1,122	50,511	128	1,461	10,427	4 68,655

Note on Lac.

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CONTRACTOR OF THE STATE	COVERNME	Bengal Bombay Sind Madras British Burma	•••••	8,891 8 5 	4,00,068 360 125 	37	1,650 	959 	(43,174 	5 2	204 31	9,892 8 7 	4,45,096 360 156	SL
5	And a state	TOTAL		8,904	4,00,553	37	1,650	959	43,174	7	235	9,907	4,45,612	
	1874-75.	Bengal Bombay . Sind Madras British Burma		{ 3,229 4,273 	1,44,331 1,92,295 	130 	5,850 	529 210 	23,818 9:453 	6 8	 	3,888 4,489 8	1,73,999 2,02,003 338	Note on
		TOTAL		7,502	3,36,626	130	5,850	739	33,271	14	. 593	8,385	3,76,340	La
ç.	1875-76.	Bengal Bombay . Sind Madras British Burma	••••	9,655 . 72	2,47,123	256 	5,37 ¹ 	680 	10,275 	5 	100 	10,596 72	2,62,869 2,854	
		TOTAL	•	9,727	2,49,977	256	5,371	680	10,275	5	100	10,668	2,65,723	
		- Burner							Service of the	A STATE OF THE PARTY OF THE PAR	the second second		the state of the s	Contract of the second se

Countries not distinguished.

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The coasting trade in this article is insignificant in its proportions, both as regards quantity and value, the total value in 1875-76 not having reached Rs. 62,000, this being much the highest value attained at any time during the last five years: 38. The great bulk of the export trade in lac is

Export trade. 50

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confined to Calcutta, which is the entrepôt for all the shell-lac (except that which is locally used up) manufactured from the raw material supplied from the forests of Bengal as well as from those of Assam, Oudh, the Central Provinces, and Burma. The following figures represent the exports of shell-lac, stick-lac, and lac-dye from Calcutta, for the period comprised in the foregoing tables :

Exports of Shell-lac, Stick-lac, and Lac-dye, from Calcutta to ports beyond India during the ten years ending with 1875-76.

Years,	Shel	I-lac,	Stick	-lac.	Lac-dye,		
	Cwts,	Rs.	Cwts.	Rs.	Cwts,	Rs.	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	36,532 36,920 43,708 45,460 57:559 50,421 65,760 67,642 79,376	14,81,375 10,20,490 11,64,814 12,72,930 11,25,885 16,11,660 14,14,656 18,40,641 18,93,607 64,65,055	139 ¹ / ₂ 97 612 ⁴ / ₄ 1,136 4 ⁴ / ₄ 35 50 386 58	3,076 1,548 11,010 18,176 72 550 500 6,186 1,817	11,692 14,274 17,735 20,518 12,283 17,342 10,280 9,892 8,377 10,595	4,88,020 6,38,736 7,95,554 9,23,963 5,52,762 7,80,394 4,67,106 4,45,096 3,76,002 2,62,869	

Calcutta consequently still practically possesses the monopoly of the export trade. Burma, however, has entered the field as a direct exporter to foreign countries, and the trade of that province will undoubtedly increase. The two largest customers for Indian lac are the United Kingdom and the United States.

Calcutta Trade.

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39. There is also a small coasting trade in lac as will be seen from the tables appended.

Quantities and value of Shell-lac exported from each Province to all other Provinces in India, during the five years ending with 1875-76.

Years.	Whenc	e exported.	To all other	Provinces.
1871-72	Bengal . Bombay . Sind . Madras . British Burma		Cwts. 545 2 	Rs. 16,241 56
		TOTAL	547	16,297
1872-73	Bengal Bombay Sind Madras British Burma		243 	6,911
Collect of A	and the second	TOTAL	243	6,911
1873-74	Bengal Bombay Sind Madras British Burma		135 2 72 1 1 1 2	4,054 75 2,700 6
and the second second	The state of the	TOTAL	209 ¹ / ₄	6,835
1874-75	Bengal Bombay Sind Madras British Burma		77 	2,156
State States	12-94 St. 1	TOTAL	77	2,156
1875-76	Bengal Bombay Sind Madras British Burma		455 ¹ / ₃ 50 331 19 2,472	28,027 2,574 8,700 838 74,340
Margare		TOTAL	3,327	1,14,479
	A CONTRACTOR OF		Contraction of the local division of the	

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Note on Lac.

Quantities and value of Stick-lac exported from each Province to all other Provinces in India, during the five years ending with 1875-76.

Years.	Whence	e exported.		To all other	Provinces.
	Bengal Bombay			Cwts. 323	Rs. 5,363
1871-72	Madras British Burma	: :		 198 9,925	3,159 1,62,913
	Bengal	TOTAL		10,446	1,71,435
1872-73	Bombay Sind Madras British Burma			 13,906	 300 2,93,558
***		TOTAL		14,026	2,95,464
1873-74	Bengal Bombay Sind Madras British Burma			524 258 21,483	8,382 2,925 4,120 7,90,928
······································		TOTAL		22,348	8,06,355
1874-75	Bengal Bombay Sind Madras British Burma			132 370 14,893	2,120 11,342 4,07,744
ATRA AND		TOTAL	• •	15,395	4,21,206
1875-76	Bengal Bombay Sind Madras British Burma	• • • • • •	• • • •	1,061 7 39 1,524 7,668 ¹ / ₄	31,551 208 840 51,051 2,09,667
er biring	and the	TOTAL	• •	10,2994	2,93,317

40. The import and export trade in stick-lac in *Central* the Central Provinces for the last five years for *Provinces*. which statistics are available, is represented by the following figures :--

the first with	1870-71		Mds.	8,505		Value Rs.	1,29,882
(MALE INTO	1871-72		,	4,5782		,,	71,510
IMPORTS	1872-73		, ,,	1,217			14,164
	1873-74		53	3,328	•	"	54,473
SEL LEVEL	1874-75		"	10,245	•	"	2,67,738
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1870-71		,,	16,423	. 2	37	2,17,957
2 - 1 - 1	1871-72 .		,,	36,8801		"	5,47,436
EXPORTS . «	1872-73 .	• •	1 32	25,581	•	"	6,45,457
And I want	1873-74 .	• •	""	58,069	•	"	12,57,376
A TRANSPORT	1874-75	. "	"	82,521	• •		26,22,915

Of the imports a large proportion is brought to Hoshungabad from Rewah and the adjoining native states of Central India, and most of the balance comes to Jubbulpore from Northern India $vi\hat{a}$ Mirzapore to feed the local factory of shelllac; of the exports the great bulk is sent to Calcutta $vi\hat{a}$ Jubbulpore. The remainder is taken up in small parcels in various directions.

41. Small quantities of lac are exported from *sind*. Sind chiefly to Bombay, and from the latter port to Europe.

42. The imports into British Burma from Upper Burma: Burma and the Shan States have considerably in-land trade. creased of late years, as will be seen from the following statement :--

	and the stand						Quantity.		Value.
							Mds.		Rs.
	1867-68		5	•			6,550		54,594
	1868-69 .		7.				- 5,815		57,409
	1869-70 .						9,942		94,703
1.	1870-71 .		11.			• •	12,004		1,44,353
IMPORTS	×1871-72 .	14		(d.)		*	13,115		1,73,349
	1872-73 .					0	14,474		1,91,759
	1873-74 .		•			•	25,582		4,41,944
	1874-75 .				*		14,980		2,23,683
	1875-76		72 -	Carl		8	Figures	not a	vailable

This is all stick-lac, and the traders in the article are mostly Shans, who sell their produce on arrival across the frontier to Chinese and other dealers, by whom most of it is brought down to Rangoon, where it is sold either for local manufacture or for shipment. Hitherto most of the lac produced in Burma has been exported in the form of stick-lac to Calcutta for manufacture there, but as has been seen by the tables printed in the preceding pages, British Burma is now commencing a distinct export trade in manufactured lac.

The decrease in the import of lac into British Burma in 1874-75 is explained by the interference of the officers of the King of Burma, who imposed a prohibitive duty in order to make this article a royal monopoly. The Chief Commissioner in his report on the trade of the province for 1874-75, says that "the falling off in imports by the Irrawaddy was no doubt due to the King having a lac factory of his own at work."

Valuations of shel-lac and lac-dye in the Calcutta market. 43. The table appended shews the average prices of shell-lac in the Calcutta market from 1865 to the middle of 1876. From this table, which has been compiled from the quotations given in the Price Current of the Bengal Chamber of Commerce, it appears that the highest prices realised were obtained in 1874, these being indeed "fancy" prices. Such an unprecedentedly high range of prices could not be expected to last, and 1875 saw a reduction which became more and more marked, until in the current year prices are little more than half what they were in 1874.

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Statement shewing the prices of shell-lac in the Calcutta market for the years 1865 to 1876.

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MAN	•		3						PRICES PER BAZAR	MAUND OF 82lbs.		
गयपंच जयते							1865.	1866.	1867.	1868.	1869.	1870.
shell-lac (fine orange) .						5	Rs. As. P. 30 3 0 to 31 11 8	Rs. As. P. 23 14 0 to 24 14 8	Rs. As. P. 24 10 0 to 26 13 8	Rs. As. P. 26 13 4 to 27 13 4	Rs. As. P. 27 I 4 to 28 9 4	Rs. As. P. 36 10 8 to 37 14 8
" (middling orange)	•	•		•	• •	· · ·	25 14 7 to 27 8 8 22 0 0	20 0 8 to 20 I 4 I4 I0 0	$ \begin{array}{r} 22 & 7 & 4 \\ to \\ 23 & 5 & 4 \\ 14 & 4 & 4 \end{array} $	23 12 0 to 25 4 8 10 1 4	23 6 8 to 24 9 4 18 10 0	28 13 4 to 33 6 0 26 12 8
" (garnet)		•	•	•	•••	in	to 23 I 4 20 IO 8 to	15 6 0 17 3 0 to	16 9 8 15 1 4 to	16 14 0 16 4 0 to	19 9 4 19 12 0 to	28 II 4 27 I3 4 to
" (native)	1.1	•	•	•			24 13 4 Not quoted. {	10 8 9 12 3 0 to 16 4 0	10 2 8 13 13 4 to 19 2 8	14 14 8 to 20 12 0	16 14 8 to 20 4 0	21 9 4 to 27 10 8
AND STREET	1					199		dura en est	PRICES PER BAZAR	MAUND OF 82lbs		
							1871,	1872.	1873.	1874.	1875.	6 months of 1876, January to June.
						(Rs. As, P. 45 12 0	Rs. As. P. 54 5 4	Rs. As. P. 66 11 4	Rs. As. P. 94 10 0	Rs. As. P. 89 11 6	Rs. As. P. 51 1 2

							the second se	the second second second second		the second se		
ell-lac (fine orange) .		1					Rs. As. P. 45 12 0 to 47 15 4	Rs. As. P. 54 5 4 to 55 11 4	Rs. As. P. 66 11 4 to 67 15 5	Rs. As. P. 94 10 0 to 97 0 0	Rs. As. P. 89 11 6 to 93 13 5	Rs. As. P. 51 I 2 to 57 0 0 32 2 5
", (middling orange)	•	1.1.1	•	•	•	• •	$ \left\{\begin{array}{ccccc} 40 & 2 & 0 \\ to \\ 42 & 7 & 4 \\ (32 & 14 & 0 \\ \end{array}\right. $	49 6 8 to \$1 10 8 37 14 8	02 0 0 to 64 1 4 40 13 0	03 3 0 to 01 1 6 64 7 3	to 82 10 3 51 13 5	to 43 11 9 31 2 5
s, (garnet)		•	•	•	•	•	to 33 13 4 35 6 0	to 38 4 0 44 15 4	to 56 4 0 60 6 8	66 14 7 73 1 4	53 0 0 70 9 7	32 2 5 32 7 5
» (liver) • •		•	•	•	•	• •	to 36 14 8 30 2 8	to 46 5 4 34 12 0	to 61 14 8 40 4 0	to 80 13 1 53 10 2	77 0 0 37 3 2	$\begin{array}{c} 10 \\ 34 & 4 & 9 \\ 22 & 4 & 11 \\ \end{array}$
in (native)	•	+	3	0		• •	to 36 I 4	to 44 I 4	60 8 0	75 4 4	70 3 2	42 11 0

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Statement shewing the prices of lac-dye in the Calcutta market for the years 1865 to 1876.

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		PRICES PER BAZAR MAUND OF 82lbs.						
· ·		1865.	1866.	1867.	1868.	1869.	1870.	
		Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P. 85 10 0	Rs. As. P. 78 12 8	
Lac-dye (fine)	· · · · · · · · · · · · · · · · · · ·	to 60 12 0	to 61 8 0	to 71 13 4	to 83 11 6	to 86 4 0	to 82 10 8	
" (middling)		33 5 4 to 48 0 0	45 I 4 to 56 I 4	45 2 0 to 60 6 6	54 10 8 to 70 4 8	59 6 6 to 74 9 4	48 13 4 to 64 2 8	
" (inferior)	· · · · · {	25 0 0 to 28 5 4	19 9 4 to 29 8 0	19 0 0 to 26 8 0	16 12 0 to 36 9 4	18 13 4 to 32 1 4	20 0 0 to 34 9 4	
The weather		PAR NA	Pr	ICES PER BAZAI	MAUND OF 82	lbs.	12.172	
		1871.	1872.	1873.	1874.	1875.	6 months of 1876 Jan. to June.	
Lac-dye (fine)		Rs. As. P. 70 12 8 to	Rs. As. P. 60 0 8 to	Rs. As. P. 46 4 0 to	Rs. As. P. 28 4 8 to	Rs. As. P. 20 9 7 to	Rs. As. P. 15 0 0 to	
		· 73 12 8 34 2 8	63 14 0 29 10 8	52 6 0 18 5 4	31 11 2 11 0 0	35 9 7 7 12 9	27 11 0 5 9 10	
" (middling)	• • • •	to 43 14 8	to 40 0 0	to 35 12 0	to 19 0 0	to 15 9 7	to 11 8 7	
0.0.1.)		14 15 4	12 12 0	6 2 8	2 13 0	270	300	

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45. Commencing in 1865 with a valuation twice Decline in as high as that of shell-lac, we see lac-dye fall trade in lacgradually from 1872, until during the last two years the market value has been for the better sorts barely half the price of shell-lac, while the inferior kinds are hardly saleable at any price. Lac-dye in fact is now of very minor importance, both in the eyes of manufacturers and shippers, as compared with shelllac. It has always had competitors in cochineal and other dyes, but lately the competition of mineral dyes has become very formidable. These aniline dves are produced so cheaply and are worked so easily, that they threaten to supersede the use of most vegetable dyes, and it is probable that the prospects of Indian dyes will before long require much consideration from the State and all interested in them.

46. When in 1871 a tariff value of Rs. 45 per cwt. was placed on lac-dye, the article occupied a place relatively to shell-lac which it no longer occupies and to which it will probably never again attain. The tariff valuation was far above the real value of the inferior kinds and the duty therefore. pressed heavily on them, representing indeed a real levy of six times 4 per cent. and more. Taking these facts into consideration, and having regard to the small importance of the revenue derived from the duty (about Rs. 28,000 a year on the average) the Government of India by Notification dated 27th November 1874 removed lac-dye altogether from the list of dutiable exports. The remission of duty has no doubt so far been a relief to manufacturers, but it has not had any substantial effect ir reviving the trade.

47. Under the Indian Tariff Act of 1875 a duty Tariff of 4 per cent. on the tariff value of the different valuations.



kinds of lac is levied on exports of the article. The tariff values up to the revision of the tariff in August 1875 were:—

Button-lac . Rs. 28 per cwt. Shell-lac . . Rs. 28 per cwt. Lac-dye . . ,, 45 ,, Seed-lac . . ,, 20 ,, Other sorts, ad valorem.

They are now :---

Button . . Rs. 65 per cwt. | Stick . . . Rs. 35 per cwt. Seed . . . , 45 ,, Shell . . . , 80 ,,

Lac-dye is free of duty on export.

The revision of the valuations was made at a time when the prices of shell-lac had reached an exceptionally high point, but the tariff rates are now nearly as much above the actual market values as they were formerly below them.

Manufacture of lac.

48. In its raw condition, incrusted round the twigs of the tree on which the insect feeds, lac is called technically stick-lac. The twigs are generally, for convenience of transport, brought to market cut up in lengths of two or three inches, and it is probable that a great deal of material is wasted in this process. The objects of the manufacturer are first, to separate the resinous incrustation from the wood ; second, to free the resin from the colouring matter; third, to convert the resin into what is known as shell-lac; and, fourth, to form from the colouring matter cakes of dye known as lac-dye. As generally practised, these processes are conducted in a primitive manner. A good account of the manufacture in accordance with the ordinary processes is given in the following extract from a paper by Mr. H. A. Crichton, of Ranchee.

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which was published in the Supplement to the British Burma Gazette for 11th April 1874 :---

"The first thing to be done is to strip the twig of its Common covering of lac, and for this purpose the coated twigs may be processes, placed under a roller on a platform. The roller being rapidly passed over the twigs (called stick-lac), the coating comes off, leaving only a small part adhering to the twig, which last must be separated by hand-picking. The wood of course is rejected. The coating, when separated (which I call. dall) must then be reduced by rolling or other means until it will pass through a moderately coarse sieve,—for instance, one whose squares should measure a quarter of an inch.

"The result of this will naturally be the collection of a quantity of grains of matter partly resinous and partly gummy, impregnated with scarlet colouring matter.

"Dye.—The grain is first placed under dekis, or triturated in some other manner and water is poured or flows over it at the time of trituration, the result being that the colouring matter passes from the grain, which remains of a golden colour, into the water.

"The grain is then dried and stored for making shell-lac. The dye containing water is run off into a vat, and allowed to remain there till the dye is precipitated, looking like dark mud at the bottom of the vat. The surface water is then run off, and the precipitate removed from the vat. The water is first expressed by placing the precipitate in cloths and allowing the water to pass away through the cloth. Frames should be prepared, about 18 inches square, having compartments about 11 inch square; the frames to be fitted with loose tops and bottoms, the whole susceptible of compression. When the muddy matter is tolerably consistent, the compartments should be filled with it and put into a screw press. The water will then be expressed, and when the cake is firm, it may be thrown on a clean floor to dry thoroughly, and will be a cake of lac-dye and fit for the market.

"Shell-lac.—I call the golden-coloured grain after the dye has been washed out "seed-lac." It is placed in long bags about 2 inches in diameter, of American drill or other cloth,



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and is then ready for roasting; chulas being prepared with a good draft, a bag is placed horizontally in front of the chula and over a narrow shallow trough projecting from the chula. The bag is held in one hand by the roaster, the other end of the bag being held by his mate. The two cause the bag to revolve slowly in front of the fire, and the result is that a matter something like golden-coloured sealing-wax exudes from the bag and drops into the trough. Close to the roaster is a cylinder of porcelain or other smooth hard substance, hollow and filled with some heat-absorbing matter. The roaster twists the bag with his left hand, while with his right he wields a wooden ladle with which he mixes the melted lac in the trough, and then lifts a spoonful on to the cylinder, which should be inclined at a slight angle to the ground; a third person stands ready over the cylinder, holding in both hands a piece of bark or other substance which may appear necessary or well adapted to the purpose, and with this draws down the melted substance in a thin coating over the cylinder. He then detaches the coating from the cylinder with both hands, and lays the sheet on one side, and recovering his bark is ready to repeat his operation. The coating or leaf is golden-coloured and called shell-lac, and is now ready for the market.

"Button-lac.—The only difference between this and shelllac is in form. Instead of being drawn over a cylinder, the melted lac is allowed to drop on to a plane, and is in shape like a large-sized flat gingerbread nut, about 3 inches in diameter, and the of an ineh thick. I have thus described the details of the manufacture, omitting in some cases to say what materials I consider best suited for particular purposes. But these materials, or some equally efficient ones, will no doubt suggest themselves, after a few trials have been made, to any intelligent handicraftsman. The processes are mentioned in order, and the purpose thereof plainly stated.

"If, however, it should be considered desirable to try the manufacture, two long godowns with pucka floors should be constructed side by side.



Cleanliness in all the processes is essential."

49. Mr. Erskine, of Elambazaar, says that "many native manufacturers dispense with vats and filtering tables. Earthenware pots, straining cloths, charcoal, and manual labour constitute a lac-factory—a cheap and primitive stock-in-trade."

50. Mr. Elliott Angelo, of Cossipore, was kind Improved enough, when I was writing the first edition of processes. this paper, to permit me to see his extensive lac-factory, where the manufacture is conducted on an improved and civilised system by the aid of machinery worked by steam power. The lac is first separated from the twigs by the action of rollers, worked by steam. Of these rollers there are three sets, each consisting of an upper and under roller with a sieve attached. Between these the stick-lac passes from a feeder, and the lac is, by the turn of the roller, separated from the wood and broken up, falling on to a sieve, while the twigs are thrown off aside in a heap. If the lac has not been sufficiently broken up by the first roller to pass through the sieve, some of the twigs not having been separated, it passes on to the second roller, and

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goes through the same process, passing again if still not fine enough to the third, whence the lac is dropped, as the sieve is filled, into a series of small troughs arranged on an endless chain working with the machine, and is projected thence as the chain moves into a heap on the floor. The twigs are thrown off on to a platform on the other side. These are afterwards again examined by women, and all the remaining lac separated by hand, and, as far as it may be worth while, used in manufacture. The refuse is bought by natives for the manufacture of *choories* and other articles made of lac. The sticks are used for fuel in the furnace of the steam-engine.

51. The lac is now placed in a horizontal cylinder furnished internally with arms, arranged on a bar passing through the cylinder from end to end. These arms are worked by steam power, and their action, combined with water with which the cylinder is filled, breaks up the lac into very small pieces, and separates the colouring matter which forms lac-dye. Lime is frequently employed to assist in the precipitation of the dye when the water is not naturally impregnated with lime. In the liquid thus obtained the lac is left to soak for twenty-four hours in a large vat, the liquid being then drawn off, by the removal of plugs, into a vat on a lower level, and there left to settle in the same way as indigo, the colouring matter being precipitated to the bottom. The clear water at top is drawn off, and the sediment, after having been passed through a strainer, much of the same nature as that used by papermakers for the straining of pulp, is finally allowed to settle and consolidate, when it is pressed in frames into cakes, which are afterwards dried

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in the sun. These cakes are the lac-dye of commerce.*

52. The lac, now called "seed-lac," after maceration, is thoroughly melted in a close vessel heated by steam, and thence conducted into open shallow troughs, also heated by steam, where the melting continues. Some resin is here mixed with the lac, to act as a flux and to prevent the lac from burning and adhering to the vessel. The resin, which is probably useful for this purpose, flies off, at least in great part, during the process of ebullition. But I may remark here that great complaints have been made in Calcutta of the adulteration of shell-lac with resin by some unscrupulous native manufacturers. Undoubtedly the high prices offered in 1874 encouraged adulteration. It is said that what was then offered as lac often consisted of resin to the extent of 50 and even 60 per cent. and it may be that the practice still exists. Lac thus adulterated may be detected by its smell when broken.

53. Ranged round the troughs are a series of zinc columns, inclined outwards at an angle of 45°. These columns are hollow, and being supplied by pipes with tepid water, are maintained at a certain temperature. They must never become too hot, or the fluid lac would not consolidate; nor must they become too cool, for then the lac would harden at once, and break up into small fragments which would adhere to the surface of the column. A quantity of the melted lac is now taken up by a workman in the concavity of a piece of plantainbark, this being the material best adapted to the purpose, and dexterously flung on to one of the

^{*} The smell in a shell-lac factory, while the colouring matter, which is in fact the dead insect and its contents, is being separated from the lac, is intolerably offensive.

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columns. Here the liquid mass 'is spread evenly and thinly over the surface by a man who makes use for the purpose of a leaf of the pine-apple plant or some other tough fibrous material. The leaf being held in both hands, its edge is drawn over the liquid until the mass is properly spread over the surface of the column to the required degree of fineness. It begins to consolidate at once, and becomes of a pliable, leathery texture. As soon as the lac is thoroughly consolidated, it is taken off by a workman, while still so hot that it would burn the fingers of any person not accustomed to the work, a considerable section of the upper portion of the sheet of lac being torn off, because it is thicker there than in the rest of the sheet, and thrown back into the trough to be melted again. The sheet is placed on a rod held in readiness by a woman, each extremity of the sheet hanging down like a towel on a rack, and the whole is hung up to dry in a large drying-shed, the rods supporting the lac being ranged on supports running across the shed from side to side, just like a. tobacco drying-house. The next day it is fit for despatch, and it is then packed in boxes and sent away.

54. The points in which Messrs. Angelo's machinery differs from the ordinary processes are—(I)the triple system of rollers and sieves, and the endless chain of receivers; (2) the strainer for lacdye, which is made of metal; (3) the system of melting the seed-lac by the action of steam; and (4) the hollow zinc columns with the arrangement for keeping them at an equable temperature. The natives use stems of plantain-trees, which do not last of course for more than a day, and the European improvement of porcelain and stone columns is inferior to Mr. Angelo's invention. This factory

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turns out an average of 100 maunds of shell-lac a day, from 200 maunds of stick-lac, for six months in the year, working from October to April; and with a sufficiency of raw material it could turn out 150 maunds a day during the whole year.

55. The various qualities of shell-lac are known Commercial by different names and marks, and there is a condifferent siderable range in prices from "Fine Orange DC," sorts of lac. to "Livery," "Garnet," "Native Leaf," and "Button." The last quality is so named from the lac not being made in sheets, but dropped from a height, and solidifying into masses.

Trisulphide of arsenic (orpiment) is frequently used in the manufacture of lac to impart a fine yellow colour to the resin. Dr. Chevers says that the use of this poison gives rise to miliary eruptions on the bodies of the workmen.

56. In India lac is used chiefly for the manufac- Uses to ture of bracelets (choories), rings, beads, and other which lac is trinkets were explicit in trinkets, worn as ornaments by women of the poor- India; er classes. The lac is bought in the bazar and after having been melted it is mixed with vermilion, arsenic, and lamp-black for colouring purposes. It is also used as a varnish, in many cases the dye being left in the lac to produce a coloured varnish; by the turners of wooden toys which are coated neatly with coloured compositions in which lac predominates; in lacquered ware; and by goldsmiths for the colouring of the metal. In Burma it is also employed to fix the blades of knives and similar instruments in their handles. In the Bombay Presidency and elsewhere lac is also used in manufacturing grindstones, for which purpose three parts of river sand and one part of clean seed-lac are mixed over a fire, the mass being formed into the shape of a grindstone, having a square hole in the centre. This is then cemented



on to the axis with melted lac, and the stone having been moderately heated it is caused to revolve rapidly when it can easily be formed into a circle. The sand should be finer and the proportion of lac greater when the stone is only required for polishing.

Japanese lacquered ware is made of an entirely different material, being a varnish obtained from the gum exuding from certain trees, among which are the *Melanorrhæa usitata*, *Rhus vernix*, *Elæococcus vernicia*, and others.

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57. In Europe lac is chiefly used in the preparation of varnishes and by hatters. The body of all the silk hats in common use is rendered stiff and waterproof by the liberal application of a composition of shell-lac, sandarach, mastic, and other resins, dissolved in alcohol or naphtha. The brim is always imbued more thickly than the body with this varnish. Lac is also extensively used in the manufacture of sealing-wax, which is formed of an amalgam of shell-lac, Venice turpentine, colophony, and colouring matter, the quantity of lac used being equal to that of all the other articles put together. Lac also enters largely into the composition of lithographic ink, and in the preparation of lake (the name is derived from "lac"), the colouring matter being precipitated by means of alum or oxide of tin. Lake, however, is also made with madder and cochineal. I am aware as yet of only one attempt to make lake from lac in India. The manufacturer, Mr. Flynn, exhibited the product at the Madras Exhibition of 1857 and was awarded honourable mention by the jury. The process was thus described : Coarsely powdered Rangoon stick-lac was boiled in several portions of water until it ceased to yield any colouring matter. A small

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quantity of alum was then added to the filtered solution, and a few minutes later a little liquor potassæ was employed to precipitate the alumina with the colouring matter, the fluid at the same time being constantly agitated. The precipitate was allowed to settle for a day, the fluid then drawn off, and the sediment pressed into cakes and dried in the shade. In the present depressed condition of the trade it might be of some advantage to manufacturers of lac-dye to turn their attention to this matter and make experiments which might perhaps result in the profitable disposal of portion of their unsaleable stock of material. The experiment would involve very little expense.

Lacquer is based on a solution of shell-lac in alcohol, coloured with gamboge, saffron, &c. It is used to give a golden colour to brass and other metals and to preserve their lustre.

58. In India lac-dye is mostly used to dye silk, Uses of lacand to some extent it is also employed in the dyeing of leather. It is not much used as a dye for cotton, on account of the expense. The following extract from Ure's Dictionary, already quoted, gives a good account of the manner of employment of lac-dye in Europe :—

"Dr. Maeleod of Madras states that he prepared a very superior lac-dye from stick-lac by digesting it int he cold in a slightly alkaline decoction of the dried leaves of the *Memecylon tinctorium* (perhaps the *M. capitellatum*, from which the natives of Malabar and Ceylon obtain a saffron yellow dye). This solution, being used along with a mordant consisting of a saturated solution of tin in muriatic acid, was found to dye woollen cloth of a very brilliant scarlet hue.

"The cakes of lac-dye imported from India, stamped with peculiar marks to designate their different manufacturers, are now employed in England for dyeing scarlet cloth, and are



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found to yield an equally brilliant colour, and one less easily affected by perspiration than that produced by cochineal. When the lac-dye was first introduced, sulphuric acid was the solvent applied to the pulverised cakes, but as muriatic (hydrochloric) acid has been found to answer, it has to a great extent supplanted it. A good solvent (No. 1) for this dve-stuff may be prepared by dissolving 3 pounds of tin in 60 pounds of muriatic acid of specific gravity 1'19. The proper mordant for the cloth is made by mixing 27 pounds of muriatic acid of specific gravity 1.17 with 11 pound of nitric acid of 1.19 putting this mixture into a salt-glazed stone bottle, and adding to it in small bits at a time grain tin, till 4 pounds be dissolved. This solution (No. 2) may be used within 12 hours after it is made, provided it has become cold and clear. For dyeing, three-quarters of a pint of the solvent No. I is to be poured upon each pound of the pulverised lac-dye, and allowed to digest upon it for six hours. The cloth before being subjected to the dye-bath must be scoured in the mill with fuller's earth. To dye 100 pounds of pelisse cloth, a tin boiler of 300 gallons capacity should be filled nearly brimful with water and a fire kindled under it. Whenever the temperature rises to 150° Fahr., a handful of bran and half a pint of the solution of tin (No. 2) are to be introduced. The froth, which rises as it approaches ebullition, must be skimmed off, and when the liquor boils, 101 pounds of lac-dye, previously mixed with 7 pints of the solvent No. I and 31 pounds of solution of tin No. 2 must be poured in. An instant afterwards, 101 pounds of tartar and 4 pounds of ground sumach, both tied up in a linen bag, are to be suspended in the boiling bath for five minutes. The fire being now withdrawn, 20 gallons of cold water with 10} pints of solution of tin being poured into the bath, the cloth is to be immersed into it, moved about rapidly during ten minutes, the fire is to be then re-kindled, and the cloth winced more slowly through the bath, which must be made to boil as quickly as possible, and maintained at that pitch for an hour. The cloth is to be next washed in the river, and lastly with water only in the fulling mill. The above proportions of the ingredients produce a brilliant scarlet tint with a slightly purple cast. If a more orange hue be wanted, white florence argal may be used instead of tartar, and some MINISTRY OF



more sumach lac-dye may be substituted for cochineal in the orange scarlets.

"To determine the tinctorial power of lac-dye by comparison with proved samples, a dye-bath is prepared as follows:—5 grains of argal, 20 grains of flannel or white cloth, 5 grains of lac-dye, 5 grains of chloride of tin, I quart of water. Heat the water to the boiling point in a tin or china vessel; add thereto the argal, and then the piece of cloth or flannel. Weigh off 5 grains of the lac-dye and pulverise it in a wedgewood mortar, with the 5 grains by measure of chloride of tin, and pour the whole into the hot liquor containing the cloth, taking care to rinse the mortar with a little of the hot liquor; keep the whole boiling for about half an hour, stirring the cloth or flannel about with a glass rod; then withdraw the cloth, wash and dry it for comparison."


ON THE NATURAL HISTORY OF THE LAC-INSECT (COCCUS LACCA).

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BY H. J. CARTER, Esc., F.R.S.

(From the Annals and Magazine of Natural History, 1861.)

HAVING had an opportunity of examining the lac-insect just previous to the evolution of its young, and of watching the latter from this period up to the time at which they become incarcerated in the resinous substance which they secrete around themselves, known in commerce by the name of "lac," and finding that a description of the changes which the insect undergoes still remains unpublished, so far as I am aware, while that which has been stated on the subject is more or less incorrect, I am not without hope that the following observations may prove both new and acceptable.

Thus much is known: that the substance called "lac" consists of a resinous incrustation partly encircling or scattered over the small branches of several trees and shrubs of different kinds in India; that the incrustation is cellular, and that each cell indicates the position of one of the insects which secreted it; that the insect contains a red colouring matter called "lac-dye," which is also an article of commerce, and is allied to cochineal; and that, at a certain period of the year, vast numbers of young animals leave these cells, and, spreading themselves over the neighbouring branches, fix themselves to the bark, which they pierce with their beaks, and then begin to pour forth from their bodies the resinous substance above mentioned.

On the 25th of June last (1860), my attention was drawn to the subject more particularly by a fresh branch of the custard-apple tree (Anona squamosa) bearing portions of the lac having been presented to me by my friend Major Burke. The branch was taken from a tree growing in the enclosure of the Bombay Mint, within a few yards of the sea, and in

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the midst of the smoke of steam engines, smelting furnaces, and the atmosphere of a crowded population; while the resinous incrustation and the red colouring matter, both in quality and quantity, did not appear to me to be less than that which is produced by the insect in localities widely spread as well from the sea as from all human habitations.

On receiving this branch and observing that it was fresh and that the insects in the incrustation were also living, my curiosity was directed to ascertaining the form and organology of the latter. Meanwhile the young began to pour forth—that is, on or about the 1st of July; and by the middle of that month the whole branch had become covered with them; but for want of nourishment, as they became stationary, so they died without apparently secreting any of the resinous substance around them; and thus I was obliged to visit the custard-apple tree itself for the purpose of examining the subsequent changes which the insect undergoes, which changes, together with a description of the form and organology of the full-grown insect, so far as I have been able to ascertain them, will now be related.

The first feature that strikes the eye on looking at the surface of the incrustation, when the insects which are within it are alive, is the presence of a kind of white powder like that observed about the cochineal insects; this is concentrated here and there into little spots, and on being examined more closely will be seen to be chiefly confined to three bunches of curly hair-like filaments, which radiate from three small holes in each spot. The holes are situated triangularly with respect to each other, two being closer together than the third, which is the largest, and which, by-and-by, will be found to be the anal, while the other two will be found to be spiracular apertures; all three are continuous with corresponding apertures in the insect, from which the white insects originally proceed, which filaments we shall hereafter observe to be the attenuated extremities of the tracheæ.

If we now examine the contents of the interior, which we may easily obtain entire by dissolving off the lac in spirit of wine (for, from their tenderness, they can hardly ever be extricated without rupture by simply breaking the incrustation), it will be observed that each cell is filled with a single insect,

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which is now almost as much unlike one as any object can well be unlike another,—consisting of a pyriform sac of a dark-red colour, smooth, shining, and presenting at its elongated end one, and at its obtuse end three papillary processes; the former, which is a continuation of the elongated end, is fixed to the bark; and the three latter, which project from the middle of the obtuse end, are respectively continuous with the three holes in the sac above noticed. As with these holes, so with the three processes: one is much larger and longer than the other two, which latter are of the same size; the former is also further distinguished by having several hairs round the margin of the aperture which exists at its extremity,—a point which it is desirable to remember, as it will serve by-and-by to identify it with the anal extremity of the animal when in its insect form.

So far the spirit of wine assists; but when we come to the contents of the body, it is not only necessary to avoid using spirit of wine, from the disfiguration which it occasions by causing the tissues to contract, but also to extricate the body by fracturing the lac, and to dissect the contents as quickly as possible, on account of the rapidity with which they pass into dissolution after death; this is probably the reason why this part of the history of the insect has remained unpublished up to the present time.

Directing our attention to the interior, after the rupture of the insect, which takes place more or less with that of the lac, we are at once struck with the voluminousness of the organ containing the red colouring matter, which organ thus obscures everything else; and it is not before a quantity of it is removed by gentle edulcoration that we can (still under water, for the anatomy of this insect can be studied in no other way) arrive at a view of the other organs of the body, when it will be observed that there is an alimentary canal, liver, tracheæ, and, last of all, the organ containing the red colouring matter, which we shall presently find to be the ovary. To each of these organs, then, separately and briefly, we will now give our attention.

The alimentary canal commences with an attenuated, shapeless æsophagus at the elongated end of the body, which is thus seen to be the oral extremity, and after passing up-

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wards for about two-thirds of the length of the abdominal cavity, where it becomes enlarged and convoluted, turns back to make a single revolution, in the course of which it soon becomes diminished in calibre, and receiving the hepatic duct at this point, terminates at length in the rectum, which opens at the great papillary process. The liver consists of a single straight sacculated, beaded tube of the same size throughout, presenting a yellow colour, and giving off the hepatic duct a little nearer one end than the other; while the tracheæ are amassed into bundles, apparently without order, and send forth many of their extremities through the two small, as well as through the large, anal apertures, to terminate on the surface of the lac in the way above mentioned.

Lastly, we come to the ovary, which consists of a voluminous tree of tubes apparently branched dichotomously with each branch, large and small, bearing long elliptical pouches, in each of which, again, is a correspondingly shaped ovum, -the whole nearly filling the body, and terminating in a single oviduct, which opens (probably through the rectum) at the anal apertures. The ovum, on the other hand, consists of an elliptical transparent envelope filled with little cells, each of which contains oil (?)-globules and globules filled with the red-colouring matter. The oil-globules are spherical, uniform in size, and much larger than the red globules, which are also spherical, but distinctly separated from the oilglobules and from each other. Whether these bodies respectively have delicate cell-walls or not, I am ignorant; but while they are both distinctly defined in the ovum when the insect is first opened under water, both soon burst by imbibition and become lost to view by dispersion of their contents. Thus the red-colouring matter exists originally in the form of distinct globules or in cells in the ovum.

The further changes in the ovum preparatory to the full development of the embryo, I have not followed; but about the beginning of July the young ones are perfectly formed, and issuing through the anal aperture in the incrustation, they creep to the neighbouring parts of the branch, and soon fixing themselves by inserting their beaks into the bark as before stated, commence secreting the lac or resinous substance, in which they soon become incarcerated. Myriads issue in this

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way, as may be well conceived, when, at a guess, I should think each insect contained a thousand; but by far the greater number die; for although the branches become quite red with them, it is only here and there that a few, scattered or in groups, live; the rest still remain attached to the bark, but dried up and dead, which may arise, perhaps, from not having been sufficiently developed, or not being strong enough at their delivery to pierce the bark for subsistence.

On leaving the parent, the young *Coccus* is of a minium red colour, about 1-40th of an inch long, elliptical, obtuse anteriorly, without any division between the head and body, possessing six legs, two antennæ, two small eyes, marginal and lateral, and two long hairs, growing from the penultimate segment of the abdomen; the body segmented regularly; the oral aperture ventral and placed at some distance from the anterior extremity; two tufts of white, powdery, hair-like filaments budding from the sides of the thorax respectively, in the place of wings, and a tuft of the same kind, bifurcated, and curling outwards on each side, projecting from the anal orifice. Anal orifice surrounded by a row of short, strong hairs.

At this period the insect is almost too small for examination organologically; but after it has crept off the incrustation and on to the bark of the branch, it soon becomes stationary, and enlarging, as the resinous secretion exudes from the surface of the body so as to surround all parts except the oral orifice and the three apertures from which the three white tufts issue, at the expiration of a month (that is, by the middle of August) it measures in length almost the eighteenth part of an inch.

If we now examine it minutely, it will be observed that the legs, antennæ, and the whole of the chitinous part of the body have become almost undistinguishably incorporated with the resinous secretion, which, when dissolved from the insect by spirit of wine, leaves the body almost in a larval or caterpillar form, but without eyes or any other appendages save the three white tufts of hair-like filaments and the proboscis which is now fully developed. The proboscis consists of a fleshy projection situated at a little distance from the head ventrally, presenting a depression in the centre, from which issue four long hairs or setæ, based internally



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upon as many pyramidal inflations situated almost at right angles to each other, and supported by other horny elements, which also appear to belong to the machinery of the proboscis. These hairs together form the penetrating organ through which the juice of the tree is extracted; but whether they are hollow and do this individually, or from a single tube by combination for this purpose, I have not been able to determine.

On the other hand, the three apertures from which the white tufts proceed, and which are now seen to open through the incrustation, are observed to be situated in the thorax and at the tail respectively, thus identifying the latter, which still presents the circle of hairs round the anal orifice, with the large papilla or anal orifice of the full-grown insect, and the former, or thoracic apertures, with the two other papillæ, which appear to replace the wings. The white tufts projecting from all these we have already found to consist of the extremities of the tracheæ covered with a white powder.

Thus we see that the increase of size which takes place in the female insect, from its locomotive form to its, ultimate development in the fixed state, is chiefly effected by an enlargement and elongation of the body between the mouth, on the one hand, and the parts from which the three white tufts project, on the other; for the oral extremity simply becomes elongated, and the three other openings of the body remain as near together, in the resinous incrustation, at the end as they were at the commencement.

Of what the white powder on the tracheæ consists, I am ignorant, further than that it does not dissolve in spirit of wine like the lac, which, on the other hand, appears to be a secretion from the skin generally, analogous to the chitinous one which would be required under other circumstances.

MALE INSECT.

On the 8th of September I visited the custard-apple tree again, to see how the incrusted young were progressing; and, on close examination of the parts where they were most congregated, observed, here and there, little red insects actively crawling over them, which insects appeared so like originally young ones that I thought they must be a few

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stragglers of a later evolution; but on inspecting them more particularly, they were observed to possess much larger antennæ, and therefore it was concluded that they were males, which afterwards proved to be the case. Several of them were collected for description, and a small portion of one of the branches, more or less covered by the incrusted young, brought away, to shew how the secretion of the lac was progressing.

The male is a little larger than the young ones at their exit from the parent; it has larger antennæ, which are hairyplumose and consist of seven articulations, not including the two basal ones; four eyes, two lateral and two underneath the head; two long hair-like appendages, covered with white powder, proceeding from the penultimate segment above; and a beak-like horny extension from the last segment, which is curved a little downwards and composed of two members, an upper and a lower one, both grooved, and forming together a cylindrical channel, through which the semen is conveyed into the female.

Thus the changes which the larva undergoes during incarceration, to produce the male, consist in an enlargement and alteration in form of the antennæ; in the differentiation of the head, and the addition of two larger eyes underneath it, which appear to be for the purpose of enabling the male, as he crawls over the lac covering the females, to find out the apertures in it that lead to the valvæ; in the addition, of the male organ, and in the replacing of the two hairs growing from the penultimate segment on either side of the tail by two delicate, white twisted cords, composed of the attenuated extremities of the tracheæ. There are further differences between the sexes at this period, in the female having lost all traces of eyes, antennæ, and legs, whilst no differentiation having taken place between the head and body, the female is reduced to a mere elliptical sac, with but faint traces of the original segmentation. From the thorax, however, project the two white tufts of the tracheæ, which are absent in the male, and also a tuft from the anal extremity, the two hairs before alluded to having disappeared altogether; but the row of hairs round the anus, which are now absent in the male, still remain in the female, and appear to serve the purpose

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chiefly of preventing the secretion of lac from covering up the anal aperture.

At this period only, the bodies of both male and female are about the same size (viz., about 1-27th of an inch long); but while the former has become more highly developed and eliminated, for the performance of his special function, the latter has become retrograde and permanently incarcerated for hers. So unsparingly does Nature deal with her forms for the development of the new being !

Impregnation.—After having taken home the small portion of the branch above mentioned, which was covered more or less by the newly incrusted brood, on which there were no free males, I was astonished, on taking it up an hour or two afterwards, to observe that two had made their appearance, and were actively engaged in impregnating the females. This they do by drawing the organ before described downwards and a little forwards just over the hole in the lac which leads to the anal orifice of the female, and inserting it; after which the male sits on the hole, as it were, for a few moments, and then, withdrawing the penis, goes to another female, and so on until his office is fulfilled.

I now watched the process for some time, and having sufficiently satisfied myself of the fact as just stated, the two males were removed for microscopical examination, and the branch left, as before, without any. Next morning, to my astonishment, I again found two more males on it, actively engaged in performing their duty like the former ones; and then it struck me that they must come from some of the incrustations; so I examined the latter, and soon saw that there were two distinct kinds of incrustations on the bark, one circular, slightly larger than the other, and when *isolated* from the rest (which for the most part are agglomerated), presenting twelve notches or teeth symmetrically arranged round the base, six on each side, with the three holes above, and the white tufts projecting from them as before described; this, of course, was the female.

The other form of incrustation was narrower and elliptical, like that of the young insect at evolution, but without serrated base holes, or white hair-like appendages. Finally

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was observed that the latter were frequently empty, and open at their unfixed and elevated end, while from others the tail of the male insect itself was projecting.

Thus the origin of the male and the process of impregnation as to time and act were easily determined, while it was also observed that in some parts there were almost, if not quite, as many male as female incrustations present, in others not so many.

On the evolution of the young, therefore, all at first would appear to attach themselves to the bark and pierce it for nutriment—at least all that live—preparatory to undergoing further general and generative development (for all are alike, apparently, when first hatched), and then they respectively become changed for the fulfilment of their ultimate functions,—the males for impregnating the females, and the females for secreting the lac and developing the new brood; but the latter, as before shewn, does not appear until the month of July of the following year. Thus we see that the young *Coccus*, as we have termed it, merits rather the term of "larva" (from the metamorphosis which it subsequently undergoes to pass into the matured forms of male and female respectively) than that of "young insect."

Again, all begin to secrete from their bodies the resinous substance even before they have fixed themselves to the bark, for those had it which were hatched from the lac on the branch that was first presented to me, after the latter was dry and dead; so that no doubt can exist of the lac being produced by the insect itself, and that it is not a mere exudation from the tree, which follows the insertion of its proboscis into the bark, as has been stated.

But while those which are to become males are entirely, though but temporarily, shut in by the lac which they subsequently elaborate from the juices of the tree on which they may be located, those which are to become females preserve thoughout the three apertures before mentioned, from which project the white tufts of tracheæ.

These tufts, which previous to impregnation consisted of but a few filaments from each aperture, and thus in no way impeded the functions of the male, had so increased imme-

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diately after impregnation (that is, by the 30th September) that every part of the branch covered with the new lac was rendered white by it; and although there were still a few females which were not enveloped by it (and possibly, therefore, were not impregnated), yet for the most part they were thickly covered by this cottony substance; and the few remaining males were so inextricably entangled in it, that, together with the presence of dead ones also entangled in the mass, it may be inferred that this rapid evolution of the cotton-like substance at önce indicates the death season of the males, and that impregnation has been fully performed.

One other observation I would add, which is more practical than scientific, viz., that to obtain as much resin and as much colouring matter as possible, the gathering of lac should take place towards the end of May or the beginning of June, just before the evolution of the young, which, as will have been seen above, carry away with them the greater part of the colouring matter. In Ure's Dictionary of Arts and Manufactures, which contains by far the best, and least incorrect, account of this insect that I have met with, it is stated that the evolution of the young takes place in "November or December," and afterwards in "October or November," while the lac is gathered twice a year in "March and October." It is also stated in the same article that the male insect has "four wings," and that there is "one to every 5,000 females," whilst we are not a little surprised to see in P. Gervais and Van Beneden's Zoologie Médicale (1859), page 374, that lac "exudes from certain trees through the punctures which have been made by the females."

It was this and sundry other statements, together with seeing that the insect could be examined successfully only in the country where it lives, which induced me to avail myself of the opportunities presented to me of obtaining as much of its history as I could, for publication.

On the 25th June I received the branch of the custardapple tree with the living matured lac-insect on it in its incrustation. About the 5th July the young or larvæ, about 1-40th of an inch long, began to issue. On the 14th of August all were fixed to, and progressively enlarging, in incrustation, on the custard-apple tree. On the 8th September

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the males were leaving their incrustations and impregnating the females, each sex being now about 1-27th inch long, and on the 20th of September the females were almost all concealed under an exuberant evolution of the white cottony substance (which we now know to be the attenuated extremities of the tracheæ covered with a white powder) with a single male insect here and there alive, and many dead ones, entangled in it.

Further observations by Dr. Carter.

AFTER my observations on the evolution of the larvæ of the lac insect, which took place at Bombay about the 1st of July, and their succeeding changes, were made, I continued my visits to the colony on the custard-apple tree in order to ascertain the truth of the statement that a second evolution took place during the year, and was fortunate enough to witness this also, as well as the succeeding changes in the larvæ, which, being somewhat different from those that took place after the first evolution, I will now relate, with the modification in the practical deductions that the second evolution necessitates.

On the 13th of December I visited the custard-apple tree, and found the larvæ issuing from the lac formed by the evoluion of July, besides many which had become fixed to the bark; so that we must date the commencement of this evolution a few days earlier, say the 7th of December. After this, the same changes took place in the incrustations that were observed in the evolution of July. On the 27th of February the males were coming out of their cocons or incrustations; and on the 4th of March I found some of them creeping over the cocoons of the females, with others dead and entangled, as before, in the cotton-like substance, which, during the last few days, had become so exuberant from the females as to whiten all those parts of the branches covered with the new lac.

But the remarkable point here was, that this time all but a few of the males were provided respectively with two membranous, whitish, transparent, diploneurose wings, which, being a little longer than the whole length of the body, extended, when closed, considerably beyond the last segment



of the body, and made the insect look very much like the male of *Coccus cacti* or the cochineal insect.

Thus, on comparing the dates of evolution and metamorphosis, we find that the first evolution of the larvæ takes place about the 1st of July, and the second about the 7th of December. Hence the summer brood requires about five months and seven days, and the winter brood six months and twenty-one days, to prepare their young respectively for independent existence. But the metamorphosis of the larvæ into the males and the impregnation of the females take place about the same time after each evolution. Thus, in the evolution of July it took place about the 20th of September, and in that of December about the 1st of March, giving eighty-two days to the former and eighty-five for the latter ; but in the latter instance almost all the males were provided with wings, as before stated, while in the former not a single winged male was observed.

The resinous secretion goes on more rapidly in the first than in the second evolution, owing probably to the greater quantity of sap which is present in the trees in the summer than in the winter or cool season; but the greatest amount of resin, comparing that produced by the brood of December 1859 with that of the brood of July 1860, appears to me to be produced by the December brood. In each instance the lac-insect perishes, whether it gives forth a new brood or not; so that the old lac thus becomes entirely lifeless.

Having previously assumed that only one evolution takes place during the year, it is necessary to modify the practical deductions which I have made. Thus, I have stated that, as the colouring-matter or "lac-dye" is contained in the young ones, the lac should be gathered just before their issue, that is, "towards the end of May or the beginning of June," so that at once the greatest amount of "lac" and "lac-dye" might be obtained; and now it is necessary to add that a second gathering should be made, *viz.*, in the month of November.

Then, as regards the propagation, branches of the tree bearing the lac with the insect in it should be gathered just previous to the evolution of the young, and tied to the trees on which it is desired to grow it, it being understood that,

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the name of "lac," according to Sir W. Jones, would appear to be derived, the trees must be thus sacrificed. And as regards self-propagation, it would be difficult to conceive how this could take place with the early incarceration of the females, did we not know that the larvæ are so light and so numerous that they might be conveyed from tree to tree in a hundred ways; and as to impregnation the females may be able to produce even more than one brood without this, as is notorious with the *Aphides*, which belong to the same order, and afford the oldest authenticated instance of parthenogenesis.

In the second volume of the *Asiatic Researches*, page 261 (ed. Lond.), there is a paper on the lac-insect by Roxburgh, to which my attention has been directed; and it is interesting to find that his description was written from an evolution of the larvæ which was taking place in Bengal on the 4th of December. His figure of the male, and its appearance at the same time with the larvæ, is of course erroneous.

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