

HARD-WAX IN THE ARCHITECTURE OF THE CROWN-SHAPED CELL

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There are two generations per year of the lac insect, the major one has a tendency to produce males in a large number, some of them seem to change their sex and become abnormal females. These are distinct from the normal apple like cells and appear crown-shaped cell. The architecture of the crown-shaped cell immediately after the insect has become adult, has been studied.

The main horizontal crevice on the equatorial region of the cell shows wax fibres arising upwards and downwards. There are six such areas all round the cell. Corresponding to each area on the outside wall is a path on the skin comprising the wax pores which secrete wax as hard fibres, and is studied under polarized light.

The adult female lac insect is a delicate creature. It has a soft skin and protects itself by secreting a coat of hard resin, the ordinary lac or shellac. Lac therefore forms a cell all round the insect body. The shape of the cell is like an apple with a smooth surface. This is rather a summarised picture of a full grown normal lac cell. The cell is constructed of a resinous wall which in turn is supported by the frame-work of a hard wax as fibres embedded within the cell wall, like a skeleton. This has been reported before.¹ Besides the normal smooth-surfaced lac-cell there is another, decorated or ornamental, also dome-shaped and comparable to a crown. The architecture of the crown-shaped cell has not been studied so far. Firstly a word on the origin of such an abnormal cell. There are two generations per year of the lac insect. Mother insects growing during the humid part of the year, from July to November, give rise to a generation in which males form the majority when they are winged. A few females and wingless males are also to be found. It means that in such cases very few females are to be found to propagate the species further. The Sind lac insect has a tendency to produce males in large numbers and which is responsible for the ups and downs of lac crops from year to year. In the post-monsoon generation, some larvæ seem to change their sex² and become abnormal females. These are distinct from the normal apple-like cells and appear crown-shaped. In fact the insect producing such a cell is so different as to have been described as a new species, *L. rangoonesis* by Chamberlin³ who naturally never studied the biology of the insect he was describing. It is proposed to study the architecture of the crown-shaped cell immediately after the insect has become adult. The problem is part of the study that is being carried out on the biology of the Sind lac insect which alone is responsible for the production of lac collection from *Acacia arabica*.

The typical appearance of the abnormal cell is presented in Fig. 1. The cell is three-fourths grown and seen sideways. It was collected from Karachi, growing on *Albizia lebbek* as an avenue tree near Clifton bridge. The main rough striated area seems to comprise a terraced arrangement. The main horizontal crevice on the equatorial region of the cell shows wax-fibres arising upwards and downwards. These fibres are thinly coated with lac-resin and give rise to the sculptured or ornamental appearance. There are six such areas all round the cell. Corresponding to each area on the outside wall is a patch on the skin itself comprising the wax-pores which secrete wax as hard fibres. The arrangement of these pores, or the patch as a whole, differs between the normal and abnormal lac insects. Patches of wax-pores belonging to the normal and abnormal lac insect of the species, *L. cummunis*, have been illustrated before² as pen and ink drawings. A more objective appearance is revealed by a microphotograph, Fig. 2, belonging to *L. sindica*. The specimen comes from an insect attacked by a chalcid. The chitin got oxidized and was stained by itself thus requiring no staining for being properly photographed. Briefly Fig. 2, as a patch of wax exuding pores, shows the seat of origin of the wax fibres. The major or lower horizontal crevice, in Fig. 1, shows the external seat of exudation appearing as fibres outside the cell wall.

It is proposed now to start with the earliest adult stage of a normal and crown-shaped cell. The normal cell under polarized light is seen, in Fig. 3, which clearly reveals the wax fibres embedded with the cell wall. The same specimen, Fig. 3, is photographed under ordinary microscopic illumination as shown in Fig. 4. Polarised light selectively brings out wax which, so to say, is alone illuminated by it. In Fig. 3 wax appear in three pairs of flat ribbons on each side, thus a dozen of

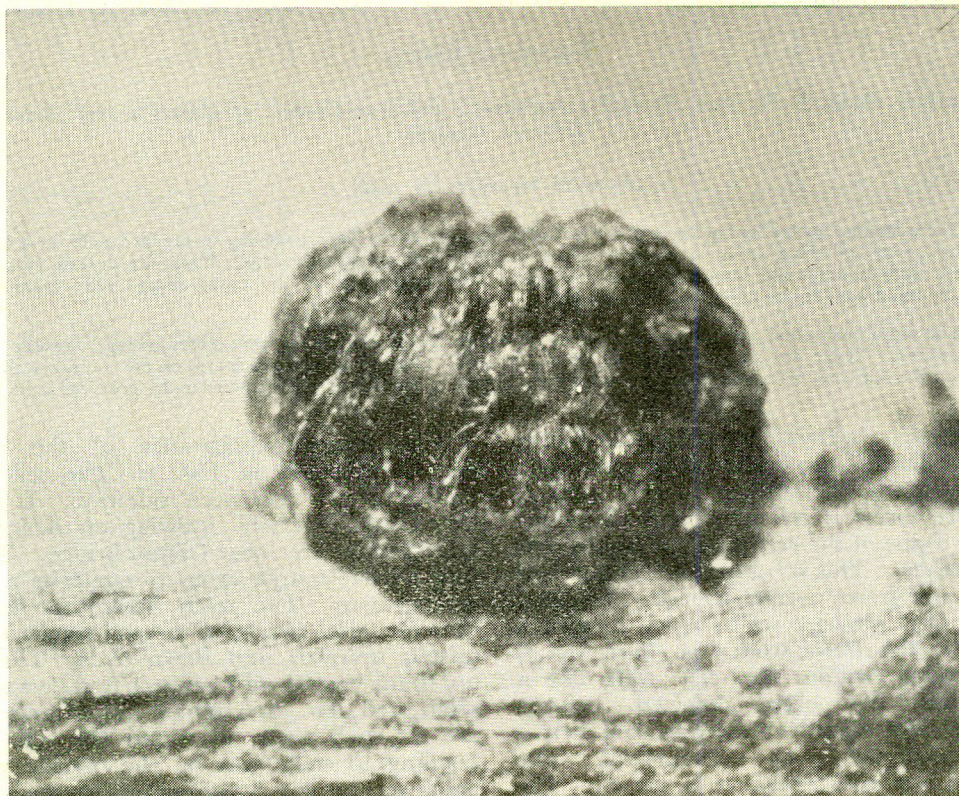


Fig. 1.—*Lakshadia sindica*. Crown-shaped cell three-fourths grown. Side-view showing a region exuding wax fibres, pointing upwards and downwards, yet growing all along the cell wall..



Fig. 2.—Exudation of wax fibres originating from a patch of pores. In the case of a crown-shaped cell the arrangement of pores is abnormal as shown here.

them all round the insect body. Each pair arises from a single patch of wax pores, shown in Fig. 2. At this stage the wax fibres appear as spokes projecting outside and on this wax is supported the dome like structure or the lac cell. Imagine a man stretching both his hands and supporting a huge basket upside down covering his head.

The head now will be free to move within the basket because the latter rests on the hands and nowhere touching the head. The twelve ribbons of hard wax fibres form the basement which supports the weight of the lac-cell. Within the cell the delicate insect thus remains free to move although the movement itself is limited. The wax

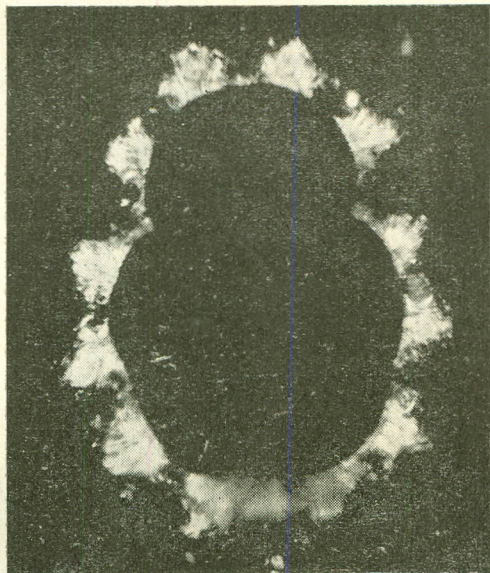


Fig. 3.—*Lakshadia sindica*. Young adult normal female, the cell being seen under polarised light revealing exudation of wax fibres from three patches on each side and each patch divisible into two ribbons of fibres.

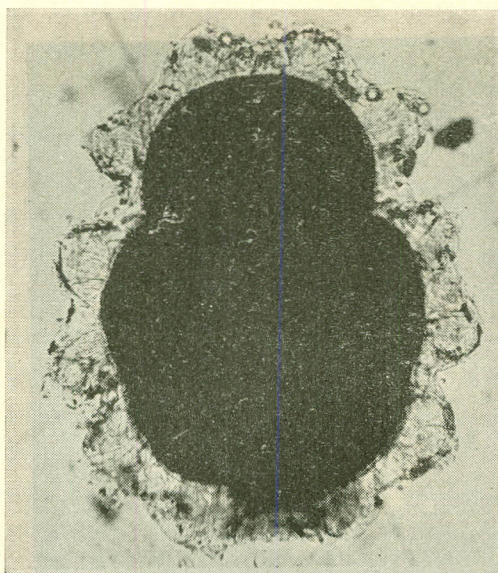


Fig. 4.—*Lakshadia sindica*. Same as fig. 3 but under normal illumination. Note the absence of wax fibres which are not thick at this stage.

in turn rests on the surface of the twig so that even indirectly the weight of the lac cell is not supported by the body of the insect. On the basement formed by the wax the future cell is enlarged. The wax fibres protrude away from the body and the cell gets enlarged gradually and as wax fibres are pushed further and further away from the centre.

The future secretion of lac rests on the lengthened wax spokes which form the framework of the cell. Taking the previous analogy if the hands are stretched gradually, and not all at once, they can serve to bear larger and larger baskets one after another, none actually covering the head which will remain free to move within. In Fig. 3 we see in front a pair of ribbons on each side or altogether four. The pairs in the opposite direction, towards the anal end, are out of focus, yet their existence can be easily confirmed. When Figs. 3 and 4 are compared all details becomes self evident. The cell margin or the cell outline is seen better in Fig. 4, while the actual basal structure consisting of wax fibres supporting the lac cell is seen in Fig. 3. The fibres are elongated and thus the basal circumference is widened and gradually the growing cell is enlarged.

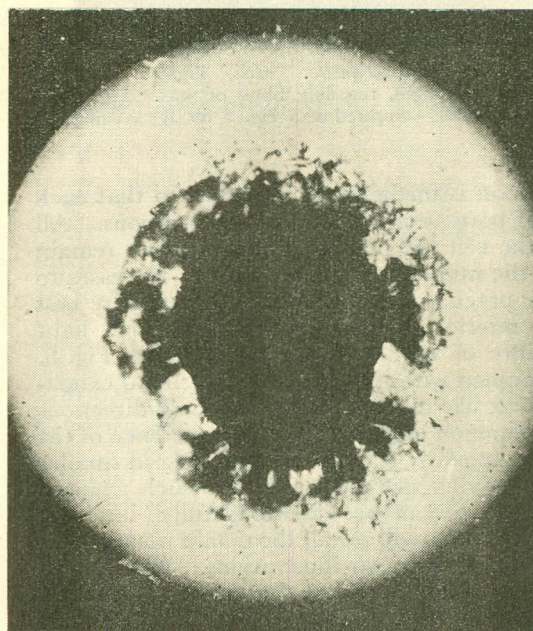


Fig. 5.—*Lakshadia sindica*. Crown-shaped cell under ordinary illumination. Wax fibres are thick and hence opaque. There are three areas of wax exudation on each side. Each region gives rise to wax as four ribbons-like projections. The four ribbons here are comparable with two in Fig. 3.

Figs. 3 and 4 belong to young normal lac cell. The corresponding stage is shown of a crown-shaped cell photographed in the usual artificial illumination of a microscope and illustrated here as Fig. 5. The same object polarised light appears in Fig. 6. When wax fibres are thick they become opaque as can be easily understood. Now each patch of wax pores, Fig. 2, produces in a normal cell, two flat ribbons of wax fibres as seen in Fig. 3. In the abnormal cell or in the crown shaped cell

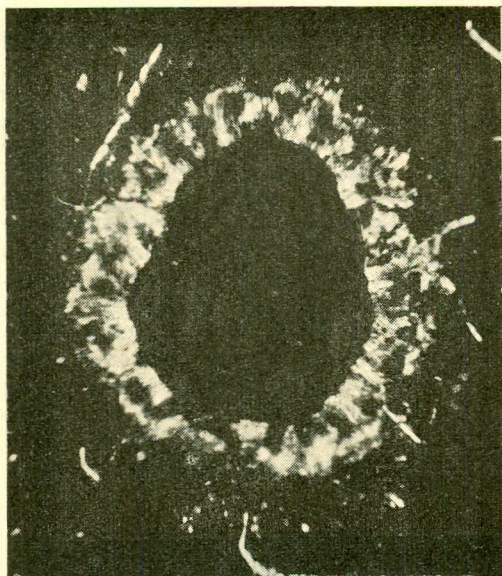


Fig. 6.—*Lakshadia sindica*. Cell, Fig. 5 now under polarised light, revealing fibres of wax. Fig. 6 has to be critically compared with Fig. 5 for appreciating details.

each ribbon is further split into two, so that each patch of pores secretes four smaller ribbons. All round the cell the regions producing wax remain six but the number of smaller ribbons increases to four per patch. Fig. 5 illustrates this feature best in its anterior region. Under polarised light every fibre of wax is illuminated so that Fig. 6, photographed with its help shows a general exudation of wax like rays spreading out in all directions from a common object. The circumference of the cell is occupied by wax fibres appearing in smaller ribbons, leaving space between two such ribbons. Figs. 5 and 6, can be described fully but the interested reader will see all the details on a careful comparison of the two illustrations. Figs. 7 and 8 represent a later stage of the crown-shaped cell than Figs. 5 and 6 revealing more secretion of wax and wax fibres thicker and darker. Thus Fig. 7 is darker than Fig. 5. Since all wax gets illuminated by polarised light wax fibres being more numerous in Fig. 8, give the latter a broader rim brighter revealing more wax. The batch of wax ribbons, shaped like the tail of a fish, from the middle of the body on each side, in Fig. 8, is to be compared with Fig. 3, Fig. 8 represents a crown shaped cell, Fig. 3 a normal cell.

The two pictures (Figs. 9 and 10) represent a more advanced stage of the crown-shaped cell than does the cell, Figs. 7 and 8. Ordinary light shows thick fibres of wax, as dark parallel lines, in front and in middle to the left of the insect

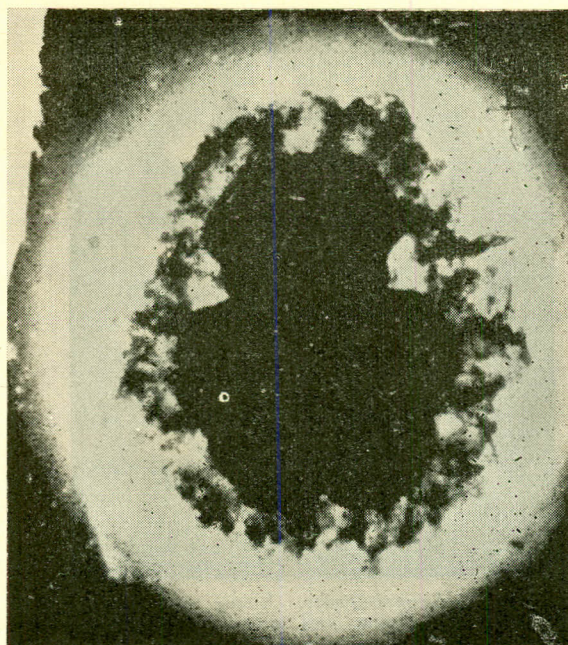


Fig. 7.—*Lakshadia sindica*. Crown-shaped cell more advanced than Fig. 5. Wax fibres are thicker and hence more opaque.

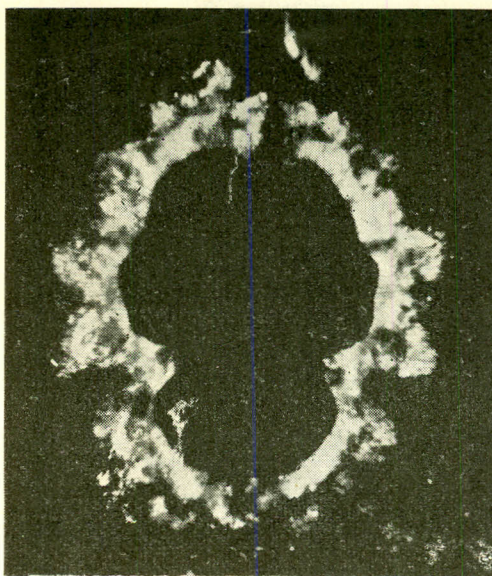


Fig. 8.—Crown-shaped cell, Fig. 7, seen under polarised light, revealing copious secretion of wax fibres, as mass-effect.

body, in Fig. 9. The body is surrounded in all by six batches of wax fibres. Wax-secretion is quite pronounced by this time and polarised light gives, in Fig. 10, a collective or mixed appearance of wax exudation without any details. The last pair of

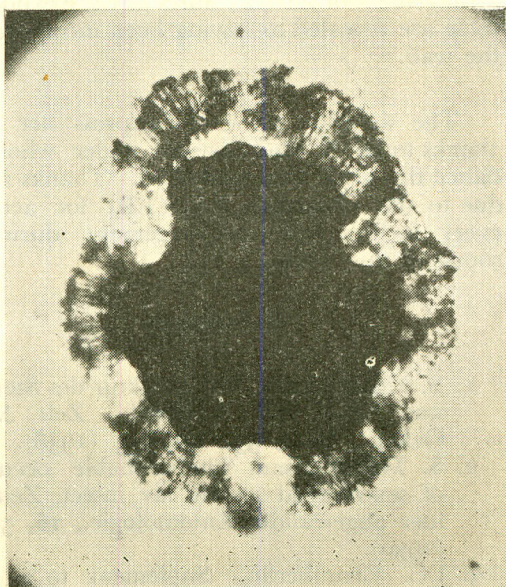


Fig. 9.—*Lakshadia sindica*. Crown-shaped cell more advanced than that of Fig. 7 under ordinary light. Wax fibres in front are like parallel lines and much clearer due to their being thicker at this stage.

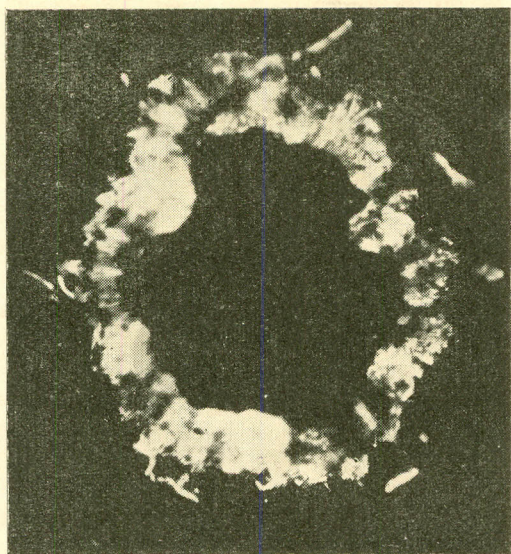


Fig. 10.—The same cell as Fig. 9, under polarised light. The picture is indistinct as exudation of wax is massive and presents a collective effect.

illustrations still presents an immature female that forms the crown-shaped cell. The cell was placed in Canada balsam without any dehydration with alcohol or treatment even with xylol. This was the technique adopted with all specimens, Figs. 3 to 10, both inclusive. In Fig. 11 is a microphoto-

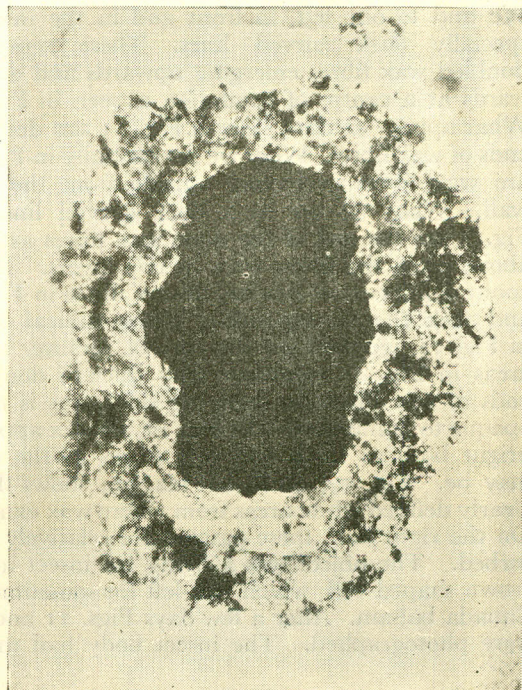


Fig. 11.— Crown-shaped cell of *L. Sindica*. Later stage than cell Fig. 9 but revealing shrinkage of the body in the middle. The circumference of the cell, in the middle and to our left shows a dark curved line corresponding to the external spot specifically shown in Fig. 1. This dark curve line is not identical with a white line intimately touching the body as shown in Fig. 12.

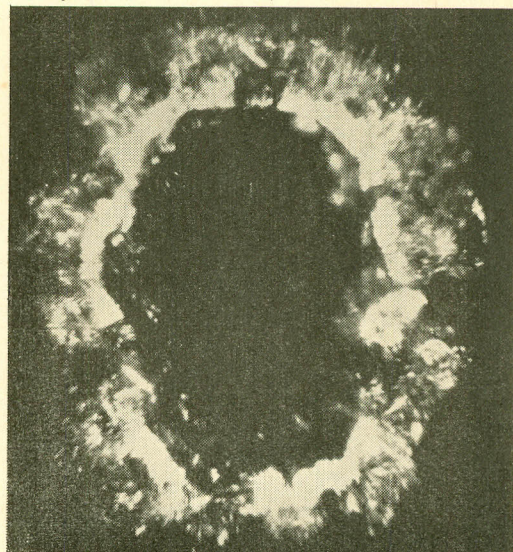


Fig. 12.— Cell Fig. 11 seen under polarised light. The white curved patches immediately touching the body outside represent wax exudation from six regions on each side. A critical comparison of Figs. 11 and 12 is necessary.

graph with ordinary illumination from below. We find to our left, in front and in the middle, specially dark curved lines. These represent doubled wax fibres emerging upwards and downwards at a centre of exudation as seen in Fig. 1. What appear as dark lines in Fig. 11 are doubled ends of wax fibres. What we see specially in Fig. 1 are wax fibres projecting outside from the side wall. What we see as a dark curved lines in Fig. 11 are the end of the same wax fibres as seen above when the fibres were in two layers. If we count white curved patches of wax fibres in Fig. 12 and seek the corresponding topographical spots in Fig. 11, we shall get the correct picture. Dark areas in Fig. 11 represent only thick or doubled ends of wax fibres for here the thick wax is most opaque to illumination. In Fig. 12, all wax appears bright both as thick and thin fibres as the case may be. Fig. 12, on its left margin, shows three clearly defined white areas from where wax exudes. On the right half, these patches are relatively disturbed. The object was a living lac insect in its crown shaped cell which was left for sometime in Canada balsam. After a few days Figs. 11 and 12 were photographed. The insect body had much

shrivelled by then. But nothing disturbed the arrangement of the wax fibres already exuded and these are revealed as having been incorporated in the wall.

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