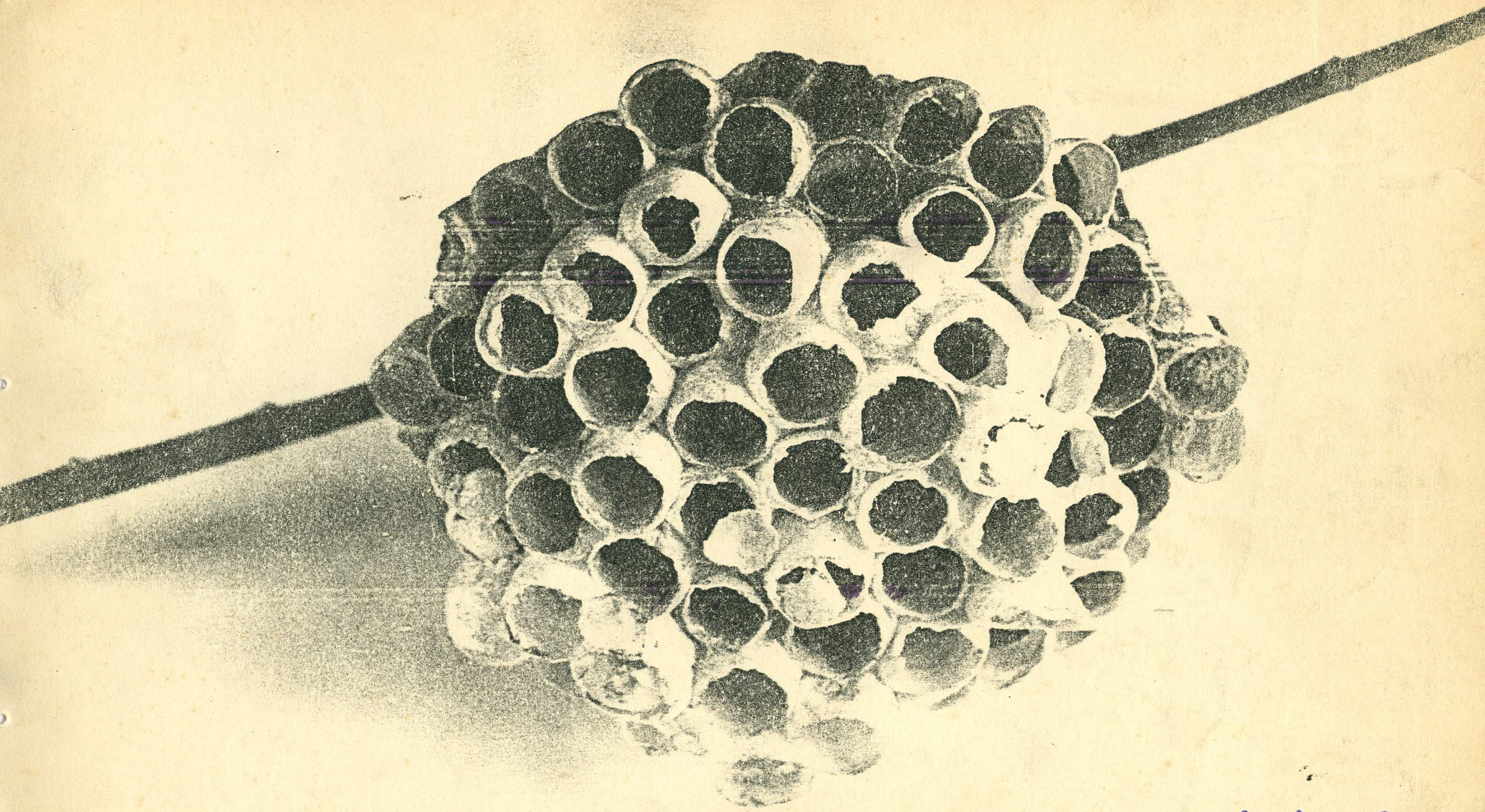




INSECT ARCHITECTURE

Indeep Sane

MSR- 4

I. D. C. Library
L. T. Bombay.

SPECIAL PROJECT

'INSECT ARCHITECTURE'

BY: PRADIP SAVE

GUIDE: Prof. A. G. RAO

I. D. C. Library
L. I. T. Bombay.

INDUSTRIAL DESIGN CENTRE

INDIAN INSTITUTE OF TECHNOLOGY.

BOMBAY.

. 1987

APPROVAL SHEET

Special project entitled 'Insect Architecture' by 'Pradip Save is approved in partial fulfilment of the requirements for Masters Degree in Industrial Design.

Guide :

Arjun 30/7/87.

Signature and Date

My Acknowledgement to

- . MYRMELEON FORMICARIOUS
- . EUMEMES
- . VESPA CRABRO
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- . EDWARD O WILSON
- . ADRIANO ZANETTI
- . KARL VON FRISCH
- . PROF. A.G.RAO, IDC, IIT-BOMBAY

MY APOLOGIES TO
THE INSECT WORLD
FOR DISTURBING AND KILLING
MANY INSECTS AND THEIR FAMILIES
FOR THE KNOWLEDGE OF
HUMANBEINGS

PRADIP SAVE



Name of Insect (ANTS)

Black coloured, 3 to 4 mm long
round abdomen, very active.

Location - Found on trees, built
among small branches.

Size - 20 cm ϕ and 25 cm (H) grows with
new layer formed above the outer most
layer.

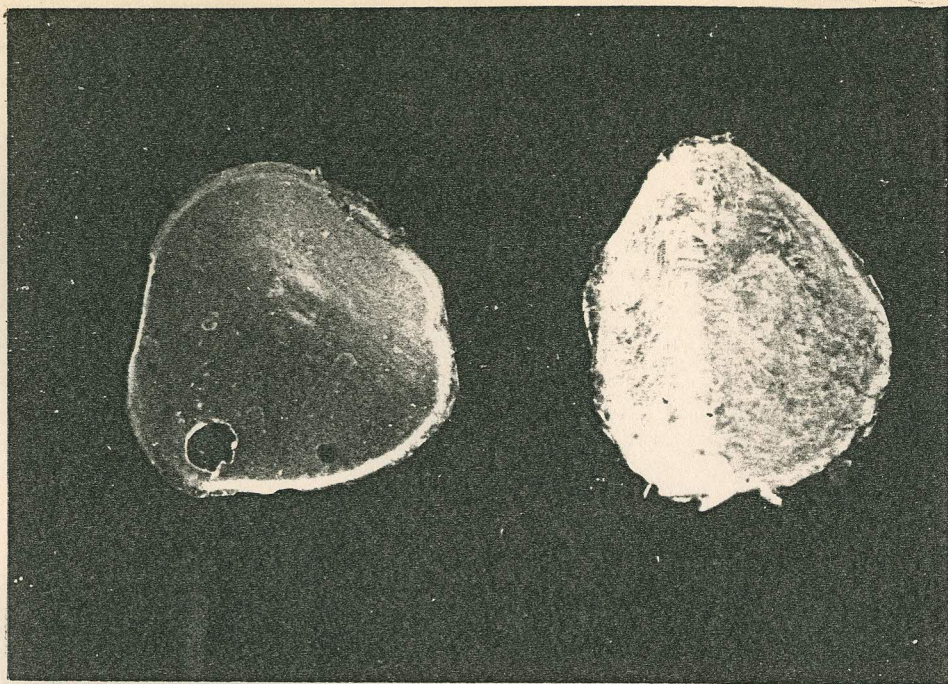
DISCUSSION

These social ants built colony with
layers growing outwards. Inside this
structure are numerous chambers
inter connected to each other. Outer
layer is of many canopies. The layers
are made of small wood fibers and some
binding material.

When their colony is disturbed, hund-
reds and thousands of ants come out
from numerous openings running in
every possible direction, on branches,
on twigs and upto the tip of the leaves
and gets so crowded that those on the
tips fall off the, actions are so fast
that its like a BURST OF AM ELECTRIC
CHARGE in slow motion.

FUNCTION

This structure is shelter for the whole colony. Canopies protects the openings from rain and the Sun. The layered cross section may be providing thermal insulation for the central chambers which are occupied by young ones and the queen.



Name of Insect

Location - Found on walls and wooden frames which have 90° corners.

Size approx - 8 mm (L) 8 mm (W) and 3 mm (H)

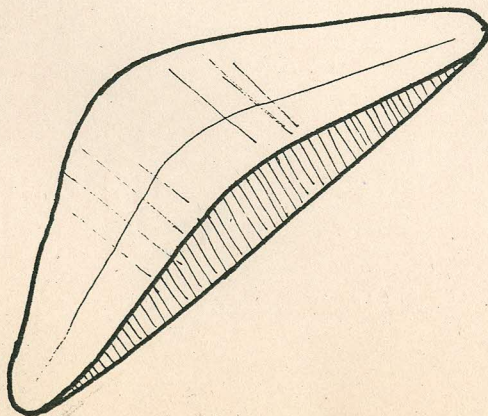
DISCRIPTION

This structure is made up of very thin membrain, probably made of silk extracted from their body. The two lower surfâces along with the walls are soft. Top surface is tough.

Insect leaves this structure with making a small hole in one of the corner

FUNCTION

This shelter provides protection for the insect in the process of metamorphasis. The structure is within the two right angle walls and the top membraine is the main part of the structure. Maximum required volume is achieved with its curveture with



probably use of minimum material.

Two other surface of this structure are
wall papers for comfortable living.



Name of the insect - MYRMELEON FORMI-
CARIOUS (ANT LION)

Location - Found in fine sand or dust
in dry and sunny areas

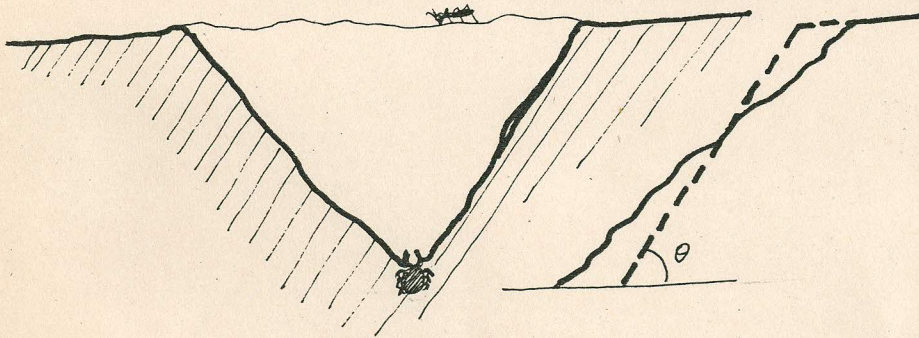
Size - From 1 cm ϕ to 4 cm ϕ

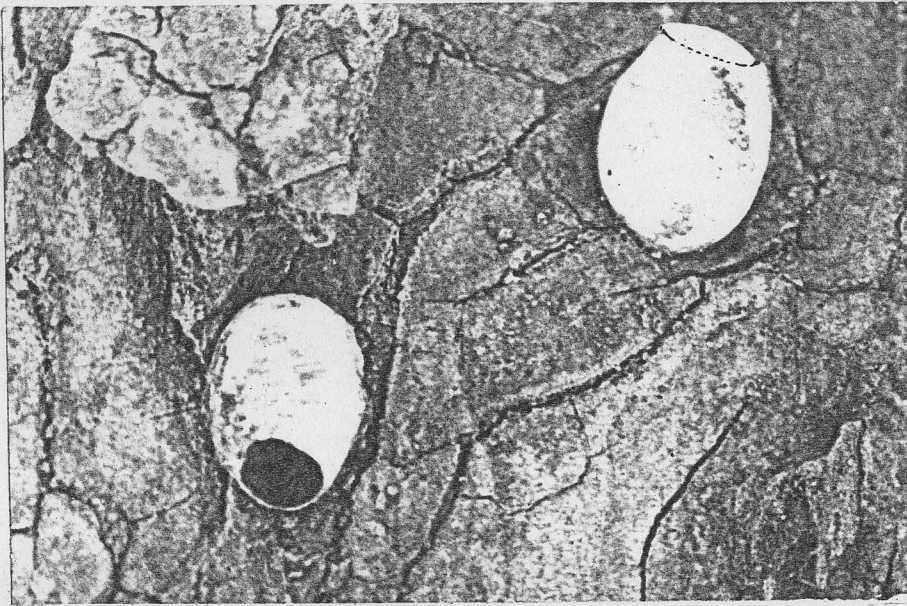
DISCRIPTION

Ant lion is larva of dragonfly. The funnel shaped structure is dug in the soil. This insect lives at the lowest end, burried completely only the two jaws out in open position. This structure is probably the simplest form in animal architecture.

FUNCTION

This funnel shaped pit is a trap to catch ants. The moment ant goes very close to the edge of the pit, it will slip down stright into the open jaws of the ant lion. This is achieved by maintaining the angle of the pit such that a sliighest disturbance cause a land slide and the pray is trapped.





Name of Insect

Location - Found on tree trunks

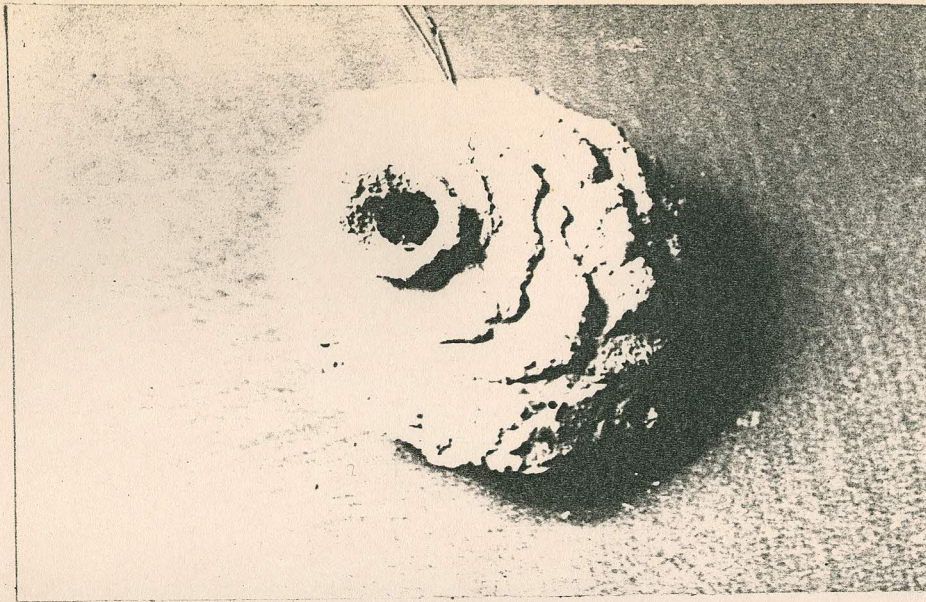
Size - 1.5 cm to 2 cm (L)

DISCRIPTION

These white coloured eggs are found on the trunk of large trees which have thick dead bark (like mango tree). Very tough and strong structure is rigidly stuck to the bark. Insect leaves this structures by pushing off the lid which is not visible when the structure is intact.

FUNCTION

This structure may be for protection, The structure^{of} body secretion. The lid have a remarkable similarly with what humanbeings have for their tins of soft drink. A fine groove provided from inside make the insect possible to push off the lid with the little force it can develop.



Name of Insect - EUMENES (POTTER WASP)

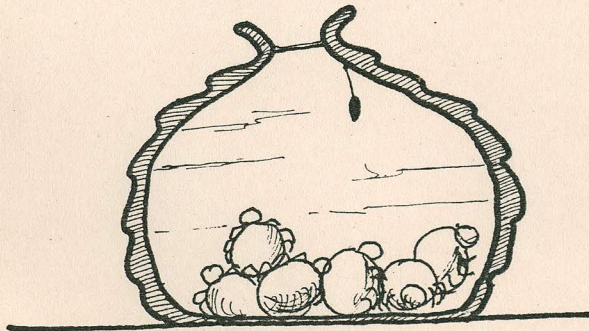
Location - Found on walls

Size - 2.5 cm ϕ

DISCRIPTION

This pot shaped structure is built with rings of clay with a small opening. Inside this pot paralyzed insects are stored as a food for the young one. Single egg is suspended from a thread is attached to the inside wall. Opening is closed with a membrane.

The egg after hatching will eat those paralyzed insects, grow big , will go under metamorphosis, will be an adult, break open the membrane and fly away.



FUNCTION

This structure provides storage for paralyzed food as well as protects egg and larva in its critical growing and metamorphic stage.

This structure is built with small pallets of clay. In one example on

a newly built wall this same structure was found built out of cement mortar, the one which was used for building the wall.

The pot shaped form is naturally stable and is the most suitable form for the material being used.

Name of Insect..... (Solitary wasp)

Dark blue, almost black, 2cm long,
thin connection between thorax and
abdomen.

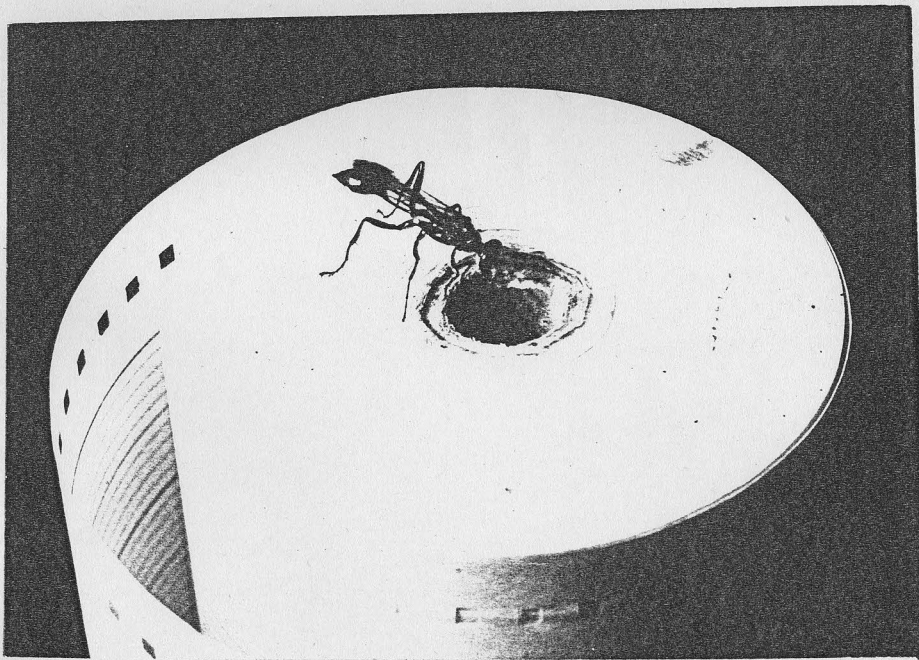
Location

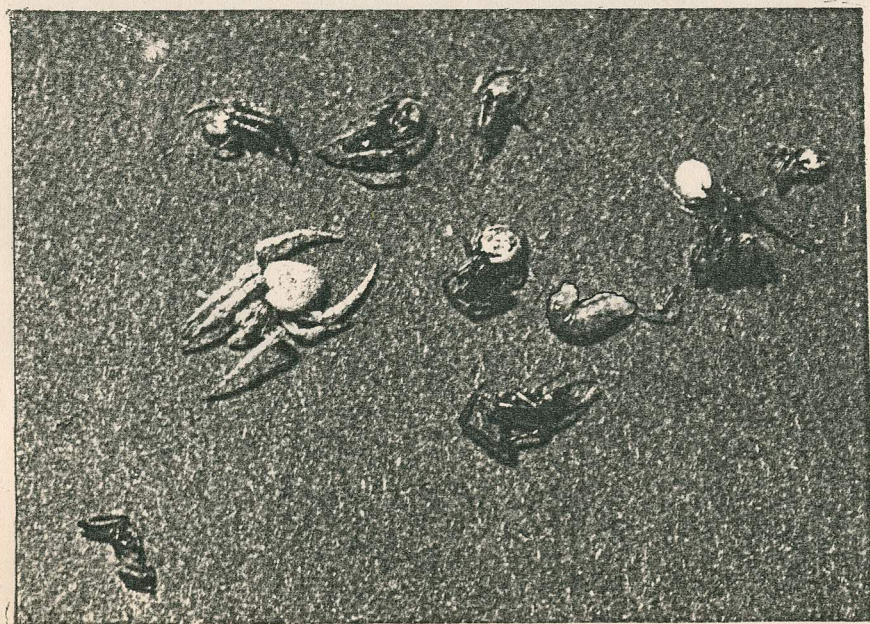
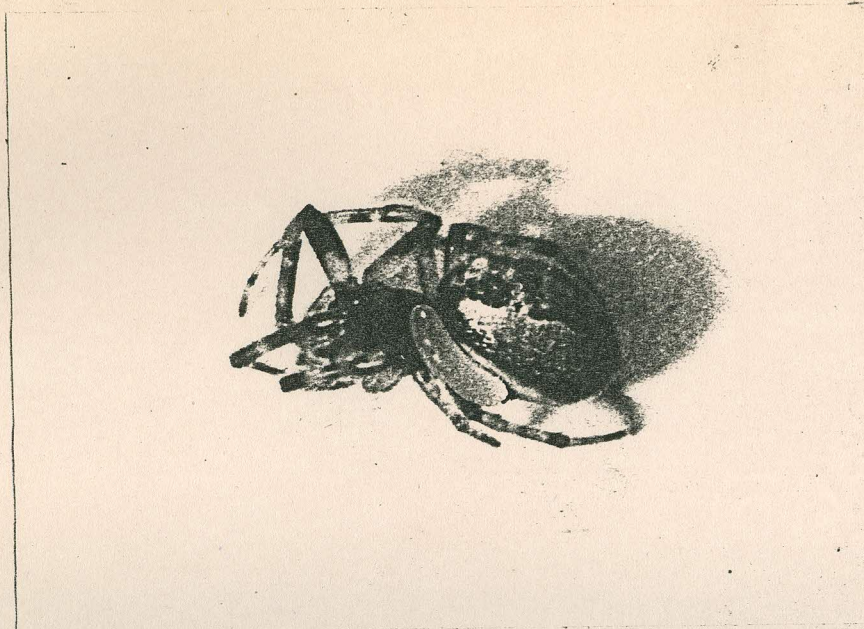
Found in the holes with round cross
section. Favourite place is electric
plugs.

Size - 6 to 8 mm $\varnothing$ and 12 to 15 mm
long.

DISCRIPTION

This wasp finds a suitable hole. If
the hole is longer than required, then
it builds a wall with a clay to shorten
the length. As mentioned earlier this
species also catches other insects
paralyze them and store as food for
their young one. In this case it
chose all spiders and almost all of
them were light green in colour. It
laid egg on a big spider, provided 12
spiders as food. Closed the opening
with clay ; building a small piece
at a time moving in a anti-clockwise
spiral. It used its mandibles as





vibrator, which made the clay into a very uniform mass as well the new part and old part formed a homogenous bond. Finally it whitewashed the scaled door.

WHAT HAPPENED INSIDE ?

Within few days egg hatched larva come out and started eating. Her diet was verocious. She eat almost two spiders a day. On sixth day she was 1.2 cm long. A day later she started giving out fibers and made a transparent capsule, which later turned brown. One end of the capsule was filled with some dark mass. Gradually it changed its form (metamorphosis) and formed an adult. It took two days for her to fly after coming out of the capsule. Initially I thought that this capsule is for protection against environmental condition. This capsule was broken and kept under observation just to see that, whether this insect can live in open atmosphere Within two days I found many small eggs on the body of that larve. Some other

insect paralyzed the larve and laid eggs over its body. 'Life seems to be really tough for insects'.

FUNCTIONS

As mentioned in earlier example function is to protect egg and food for the larva, as well provide protection for larva in its metamorphosis.

Why white wash on the door ?

Probably some other species or some species of wasp, if they can't find a suitable hole , built a tube of clay and lay eggs. They built three to four such tubes side by side. They probably white wash the doors so that when they built another cell they themselves should not cover the door of previous cells.



Name of Insect - VESPA CRABRO

Location - Found on trees, built among small branches.

Size - 25 cm $\emptyset$ and 30 cm (H)

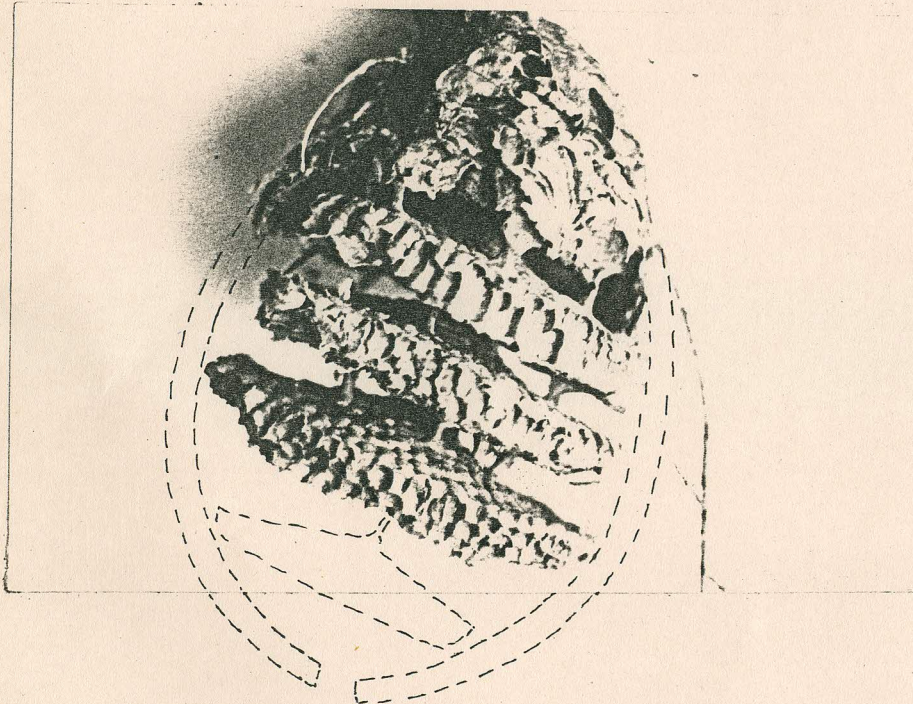
DISCRIPTION

This social wasp built multistoried building and cover the whole residential complex with protective layers. Protection from heat and rain and also from enemies. A single fight hole at the lower end. These nests grow down words and also in diameter, they break down the old outer walls and built with new dimensions.

FUNCTIONS

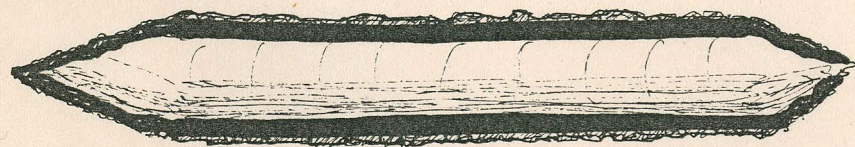
This shelter is a complete colony of one queen. The paper envelop built out of layer with many air pockets is an excellent thermal insulator. The temperature of inner chamber is always maintained at 30°C.

These wasps are perfect structural engineers, arrange the wood fibers along the stress to achieve good



structural strength.

When the temperature drops workers produce heat by rapid musical movement (live heaters). When temperature increases they carry water and evaporate on the inner walls, to produce cooling effect.



Name of Insect.....(BAG WORM)

Location - Found in houses, and also on trees.

Size - 5mm ϕ 4 cm long

DISCRIPTION

This structure is lined inside with silk and toughened from outside with attaching wood particles. This tube like bag is flexible at both ends. From the front end the worm peeps out and crowds with the bag along with it at the slightest danger it withdraws inside and closes the opening the lower end is a slit hole.

Once in the process of observation I cut opened the bag and removed the worm out forcefully. After few minutes the worm entered into the bag and started sealing the cut portion. His desire to enter in the bag was very strong and so I thought let's see if I don't provide him the bag. That fellow started giving out fibers and I thought he wants to built a new bag.

15
I provided him with crushed dry leaves and dry bark. Poor fellow probably must have lost some of his memory pack in the process of metamorphosis and built a structure with no order or geometry, just a shelter to protect from light.

FUNCTION

This bag is a armour which protects the larva from enemies and light. The composite structure with circular cross section have enormous strength and toughness.



Name of Insect..... (SPIDER)

Location - Found on trees

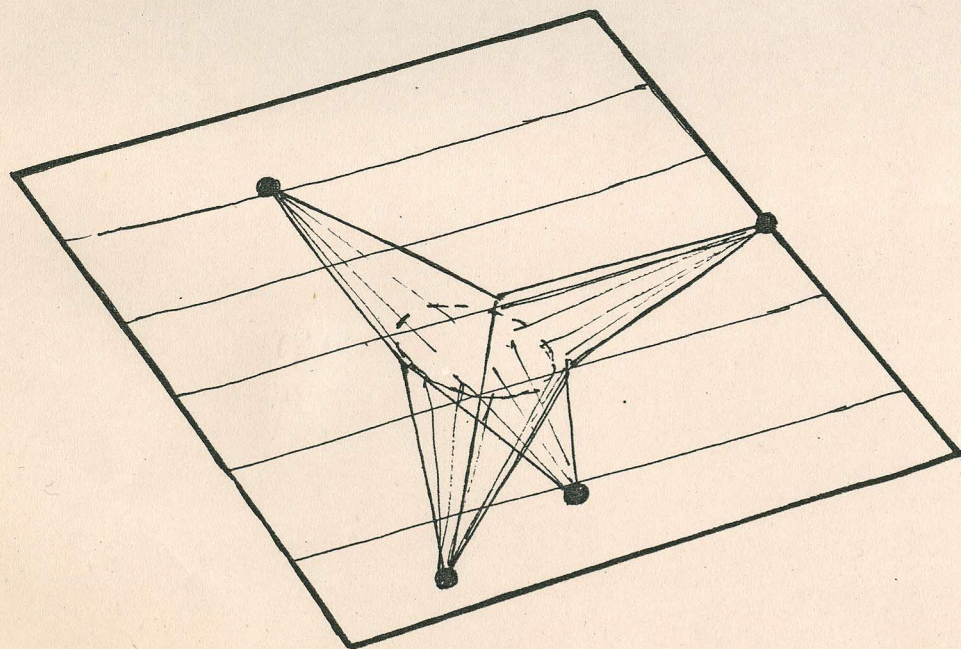
Size - Main structure 6 cm Ø

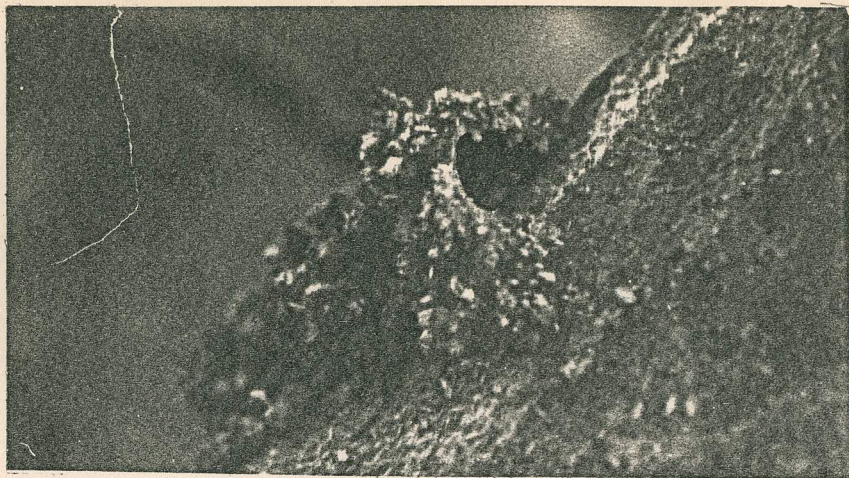
DISCRIPTION

This spider builds a very different type of structure. Two layers close to each other are supported with number of structural members finally ends with three basic points on top and a single point at bottom. Spider stays in between the two layers.

FUNCTION

Observations showed no specific function of this structure. It may look like a flower to other insect and they may land in this trap but this thing did not happened.





Name of Insect.....

Location - Found on the bark of the tree which have thin bark.

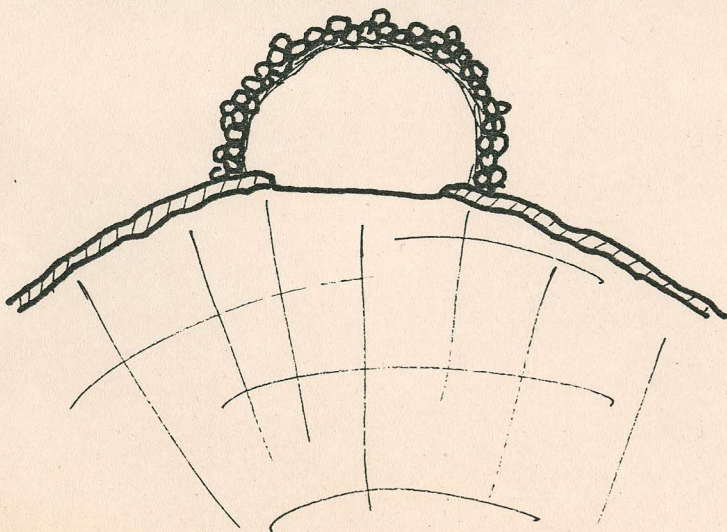
Size - 2.5 cm $\varnothing$ and 60 to 80 cm long many times branched.

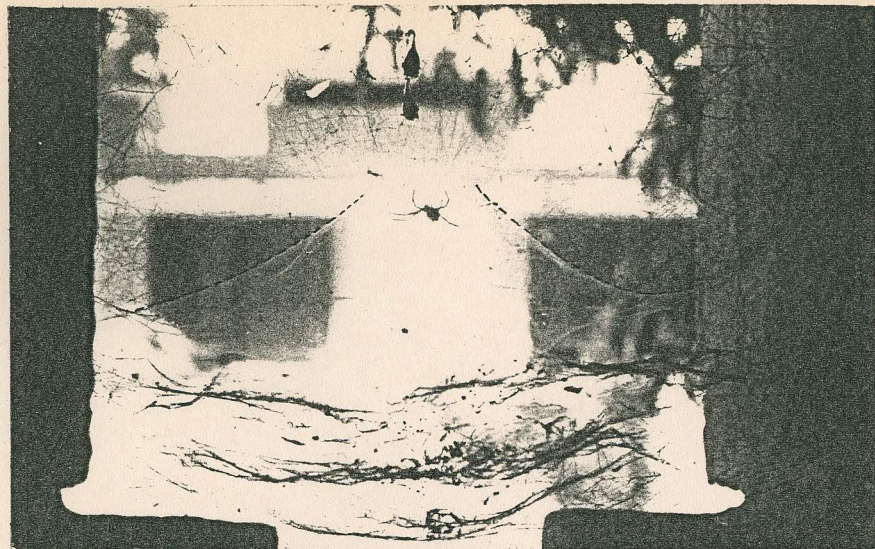
DISCRIPTION

This tube like thing have a growing end which is open. This insect eats the surrounding bark at fast rate and built this tube with shit balls. The structure is formed by connecting the balls with fibers from inside.

FUNCTION

Function of this structure will be protection from light, in a similiar way termites do, as they can't resist light. This is probably the unique strategy used in building shelter East a lot, walk a long use shit as building blocks.





Name of Insect..... (SPIDER)

Location - Found mostly in sheltered areas.

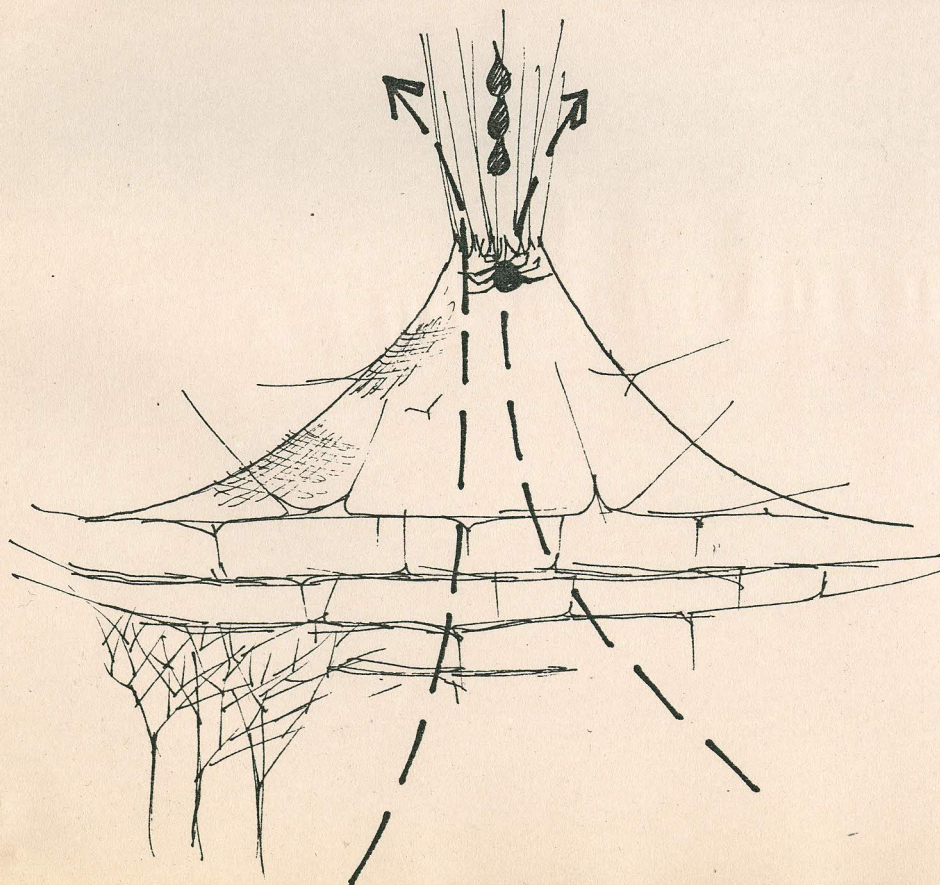
Size - 12 to 16 cm ϕ , Main structure 10 cm (H)

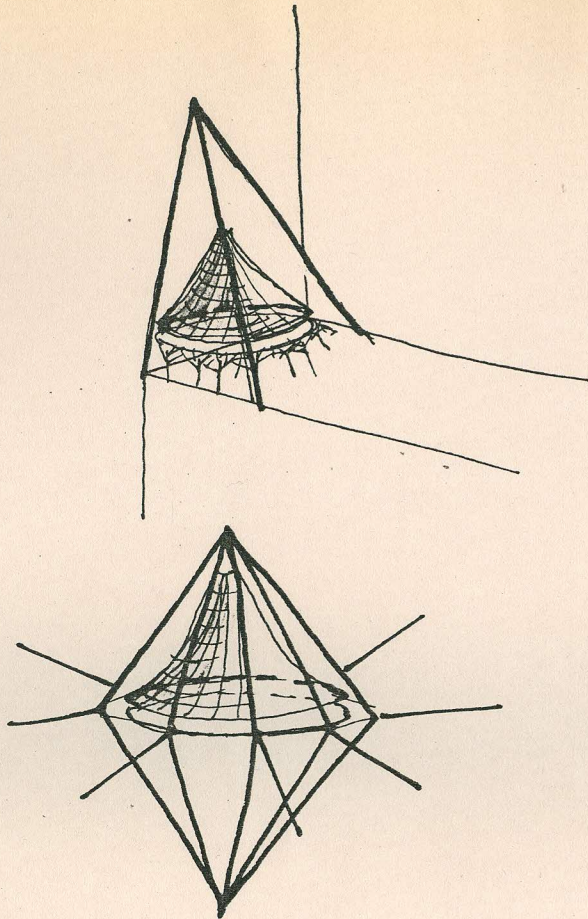
DISCRIPTION

This very interesting tent like form have great similarity with one of the man made structure 'CHINES FISHING NETS' Below the tent like structure 3 to 5 horizontal layers are found. Spider stays in top portion of the tent probably guarding the egg sacks. There are as many as 10 to 12 egg sacks, each containing around 20 eggs are attached to each other to form a chain.

FUNCTION

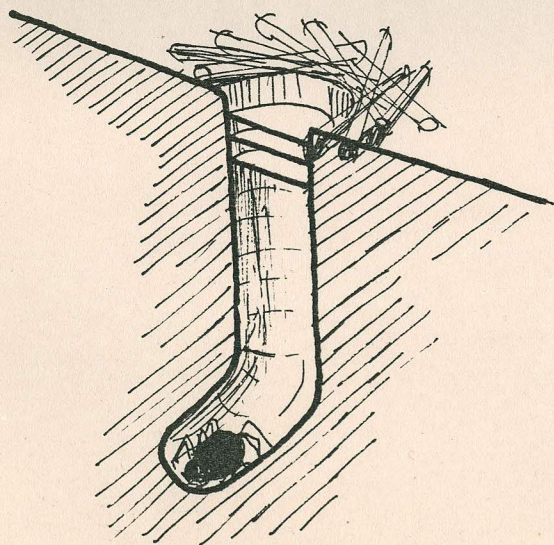
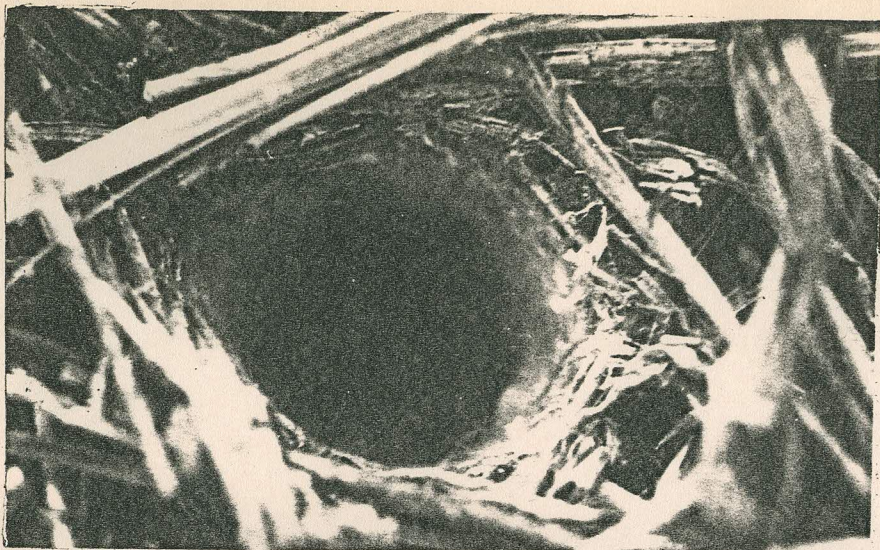
To derive the function of this structure have lot of controversy. If it is for the protection of eggs why such a huge tent, as the egg sacks are outside the tent. If the spider is inactive in the process of laying eggs





and wants protection, why should he waste so much of its valuable material to build so big structure and what for the layers at bottom.

Considering the total structure, its arrangement of layers small particles trapped in layers, tent shaped structure and position of spider and egg sacks. As a human mind I think probably, it built this structures in area where up-currents of air are existing. The air get filtered through the layers and due to the bell shaped form of the tend and small opening at the top of the tent, cause some cooling effect for the spider or egg sacks or for both, due to air passing through small hole.



Name of Insect(SPIDER)

Location - Found in hold in the ground

Size - 2 cm ϕ , about 10 cm long.

DISCRIPTION

A membrane made out of silk fibers slightly below the surface the surrounding was found among dry grass. When I punctured the membrane at close interval I found another membrane. There were three such membranes closing the silk lined tube. At the end of the tube I found an inactive big spider (1.5 cm ϕ).

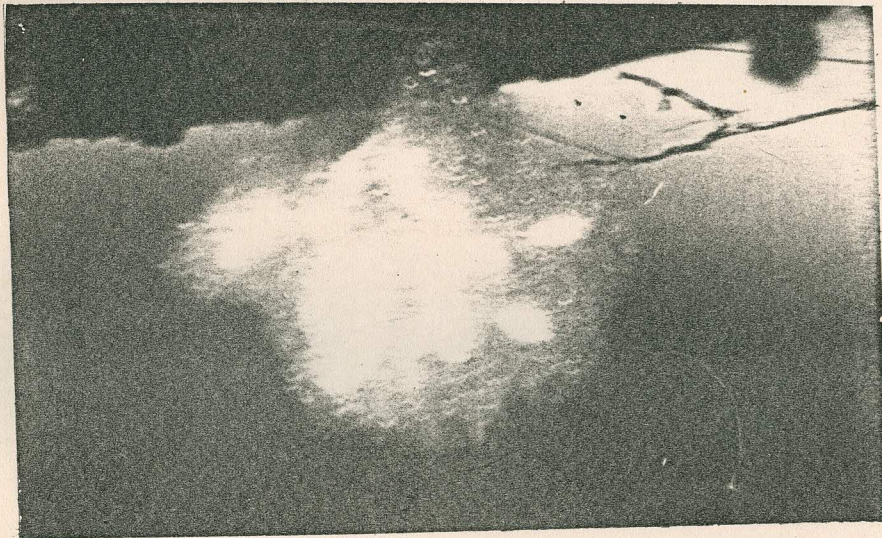
FUNCTION

The sticky membraines form a multi-layered door way, an old strategy for defence. This structure is built probably for protection in the critical period of moulting or for laying eggs and growing the youngs.

Name of Insect.....

Location - Found on trees

Size - 1.5 cm.



DISCRIPTION

A small fibrous mass attached to a branch shows small eggs inside. In bright light the inside eggs are hardly visuable. The whole mass is so light weight that unless one observes it closely it looks like a cotton ball hooked on a branch.

FUNCTION

This structure imitate cotton ball and by which provide protection for the eggs. The fibrous mass is impervious for small insects and big insects and birds just can not make out that there are eggs inside

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