NOTES ON THE BIOLOGY OF *ORNITHOPTERA GOLIATH* AND *O. CHIMAERA* (PAPILIONIDAE)

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Ornithoptera goliath Oberthur and *O. chimaera* Rothschild are included in the subgenus *Schoenbergia*, for which information on the early stages is scanty. Jordan (1908) mentions of *O. goliath*: "it has been bred several times but nothing appears to have been published."

Ornithoptera goliath titan Grose-Smith

O. goliath (Fig. 9) is one of the rarest *Ornithoptera* species. It is widely distributed, from the island of Ceram (East Indonesia), Waigeu, the whole mainland of New Guinea to Goodenough Island. However, it is always rare and very local. Its rarity may be due to the scarcity of its *Aristolochia* hostplant and the peculiar way mature larvae almost totally destroy their host before pupation.

Early Stages

Egg (Fig. 1). Very large, diameter 4.6–4.7 mm. Yellowish, pearly white, slightly flattened at the base. Generally deposited on mature leaves of the hostplant. Incubation period varied from 14 days (Sogeri, altitude 500 m.) to 19 days (Wau, altitude 1300 m.) depending on local average temperatures.

First instar larva (Figs. 2–3). Groundcolour of head, prothoracic shield, body, legs and prolegs black. Fourth abdominal segment has broad, greyish white saddlemark, mid-dorsally divided by black stripe. All segments carry long, spiny, black tubercles.

Second–final instars (Figs. 4–6). Groundcolour remains unchanged. Tubercles fleshy, blunt, with broad base, black with the exception of the two light yellow dorsal ones on abdominal segment 4. The same segment carries a light yellow transverse stripe, which is dorsally as wide as the segment, laterally narrowing slightly down to spiracles. Some larvae have one or more additional lateral yellow spots on 3rd abdominal segment. Osmaterium light yellow. Measurements of a mature larva: Headcapsule, length 9.2 mm, width 8.6 mm, total length of larva 104.0 mm.

Pupa (Figs. 7–8). Groundcolour broadly yellow. Wingcases with brown base and small brown streak near apex. Thorax dark brown, tegulae and head yellow. Dorsally, between the wingcases, abdominal segments 1–6 have broad yellow saddlemark with 2 black longitudinal lines. Abdominal segment 7 dark brown to

black, segment 8 dark ventrally, yellow dorsolaterally. Abdominal segments 6–9 each with 2 short, black processes.

The pupal period extended from 35 days to rather longer, depending on average temperatures of its habitat.

The pupa of *O. goliath* closely resembles that of *O. alexandrae*.

General Observations

Hostplant. As far as is known, *O. goliath* appears to be monophagous. Its host is a large *Aristolochia* species generally growing near running creeks in hilly country. Leaves resemble those of *A. tagala* but are shorter and thicker. Stems, when mature, are covered with thick layers of dry bark that produce a strong, pungent but pleasant odour when removed or scratched. Some old plants reach 20 or more meters up into the canopy of tall trees. In captivity 2 larvae were successfully bred on *A. tagala* (Womersley; Carver, pers. comm.).

Behaviour of larvae. The female butterfly deposits from one to several eggs on the hostplant, depending on its size. Young larvae feed on young leaves and tender shoots, gradually extending their feeding to older leaves and stems during their growth. Mature larvae, however, feed exclusively on mature, corky stems, severing these in several places, cutting off the upper parts from the roots and causing these parts to dry and perish.

It was observed in one instance that several larvae were devouring the same piece of stem resulting in it being cut into several lengths, some with one or more larvae at their ends, which fell to the ground where the caterpillars continued to devour it until little or nothing remained. Another larva was seen eating the base of what was left of the main stem down to the roots. By the time most larvae were ready for pupation, little remained of what was once a tall *Aristolochia* vine. In one instance a young larva was found on an isolated small hostplant, obviously too small to support the larva beyond its third instar (Pasternak, pers. comm.).

Unlike many other *Ornithoptera* species, *O. goliath* larvae do not wander far to pupate from where they were last feeding. For its pupation the larva generally selects the underside of a strong leaf of any kind of shrub growing near the remains of the *Aristolochia* hostplant and at a height varying from 0.5–3.0 m. above the ground, in a cool, shady position.

Predators. No predators have been observed on the larvae of *O. goliath*.

Adult behaviour. Although powerful fliers, the butterflies seldom leave their habitat. Mostly females are seen on the wing in their search for hostplants. However, both sexes can be seen feeding on flowering

trees in the forest or on the orange-red flowers of the introduced African Tulip Tree, *Spathodea campanulata*, where it grows in or near the edge of the forest. Males of *O. goliath* were observed several times being chased over long distances by males of *O. priamus poseidon*. Often the former tried to escape by rising high above the treetops, folding their wings and diving down to about tree level. If *O. p. poseidon* males made contact, they attacked with outstretched legs. Some captured *O. goliath* males showed damage, generally to the hindwings as tiny notches and holes, possibly caused by the sharp tarsal claws of the *O. p. poseidon* males. Females were not attacked. Both sexes were seen actively feeding during early morning hours until about 0930. During the warmer hours males were seen resting with folded wings, when the peculiar underside coloration made them nearly invisible against the foliage. Females rested with wings spread. Largest number of eggs counted in a female was 20, including immature eggs.

Ornithoptera chimaera chimaera Rothschild

This species (Figs. 19, 20) is widely distributed over the highlands of the whole mainland of New Guinea at altitudes ranging from 1600–2800 m. Adults are sometimes seen feeding on flowering trees, mainly during the dry season (June–October). The early stages are generally hard to find, although the foodplant (*Aristolochia* sp., Fig. 11) is found in many areas. For their oviposition the females generally choose habitats in steep mountain gorges and ridges where the hostplant grows in dense vegetation in damp, cold conditions. Such places are often difficult to reach.

Early Stages

Egg (Fig. 10). Large, diameter 4.0 mm. Colour light yellow. When deposited, covered with bright orange-yellow substance, sticking it firmly to the rough underside of a mature leaf of the hostplant. Incubation period long, from 14 days onwards, depending on average temperatures of its habitat.

First instar larva (Figs. 12–13). Groundcolour reddish black. Head, prothoracic shield, legs, and spiny tubercles black except fleshy base of the 2 dorsal tubercles of 4th abdominal segment which is yellow.

Second–final instars (Fig. 14). Groundcolour varies from reddish black to black. Tubercles fleshy, black, the 2 dorsal ones on abdominal segment 4, yellow or sometimes partly or faintly yellow tipped (this depends on localities). Osmaterium bright yellow. Measurements of a mature larva: Length 94.0 mm, headcapsule length 8.1 mm, width 7.7 mm.

Pupa (Figs. 16–18). Groundcolour dark brown to black. Colour of wingcases varies from black to dark yellowish mottled brown, except for a yellow base extending to about ¼ of the wingcase length. Head, thorax and ventral parts of abdominal segments black. Tegulae black with a bright, narrow, orange-yellow disk. Saddlemark yellow but broadly divided middorsally, extending laterally on abdominal segments 1–5 forming broad yellow spots, increasing in size caudad and

reaching greatest width on segments 3 and 4, where it is crossed by a black stripe.

The yellow area ends on segment 5 where it is triangularly shaped and reaches halfway down this segment.

Abdominal segment 6 dark brown to black, segments 7–9 each carry a broad, dorsal, orange-yellow spot, which is middorsally divided by black stripe, and yellow area latero-dorsally. Cremaster orange-yellow dorsally, black ventrally. Latero-dorsally the abdominal segments 6–9 carry 2 sharp, black spines each. Pupal period long, depending on average temperatures of habitat, from 7–10 weeks or longer.

General Observations

Behaviour of larvae. Young larvae feed on tender leaves and shoots, mature ones mainly on old leaves and parts of the stems. Shortly before pupation the larva chews some bark from the main stems but otherwise does not cause additional damage. *O. chimaera* larvae often walk a long distance away from where they have been feeding last, in their long search for a suitable pupation site. In one instance it took a larva five days of restless wanderings before it finally settled down for pupation (Pasternak, pers. comm.). Average height of pupa above the ground 1–4 m. Longest distance recorded from hostplant where pupa was located: nearly 20 m.

Predators. In some areas an estimated 30% or more of fourth instar larvae perish after being attacked by parasites (Braconidae, *Apanteles* sp. *vitripennis* group?) (Fig. 15). The occurrence of these parasites appears to be local, or may be seasonal as in some habitats none or very few larvae were attacked. In some instances, where more than one larva was present on the same hostplant, the smallest were attacked and devoured by the stronger specimens. This cannibalistic behaviour does not appear to be the general rule.

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LITERATURE CITED

JORDAN, K. 1908. Indo-australian butterflies. Page 16 *in* A. Seitz, The Macrolepidoptera of the World, 9.

FIGS. 1-2. *Ornithoptera goliath* Oberthur: (1) egg; (2) first instar larva.

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FIGS. 3-4. *Ornithoptera goliath* Oberthur and *O. priamus poseidon* Doubleday: (3) first instar larvae; (4) *O. goliath*, mature larvae destroying hostplant, *Aristolochia* sp.

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FIGS. 5-6. *Ornithoptera goliath* Oberthur: (5) mature larvae destroying and (6) eating main stem of hostplant, *Aristolochia* sp.

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FIGS. 7-8. Pupa of *Ornithoptera goliath* Oberthur: (7) latero-dorsal view; (8) lateral view.

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FIGS. 9-10. Life stages of *Ornithoptera*: (9) *O. goliath* Oberthur, ♀ imago; (10) *O. chimaera* Rothschild, egg.

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FIGS. 11-12. *Ornithoptera chimaera* Rothschild: (11) hostplant, *Aristolochia* sp., and (12) first instar larva, lateral view.

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FIGS. 13-14. *Ornithoptera chimaera* Rothschild: (13) first instar larva, dorsal view; (14) fifth instar larva.

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FIGS. 15-16. *Ornithoptera chimaera* Rothschild: (15) fourth instar larva attacked by parasites; (16) pupa, lateral view.

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FIGS. 17-18. Pupa of *Ornithoptera chimaera* Rothschild: (17) lateral view; (18) dorsal view.

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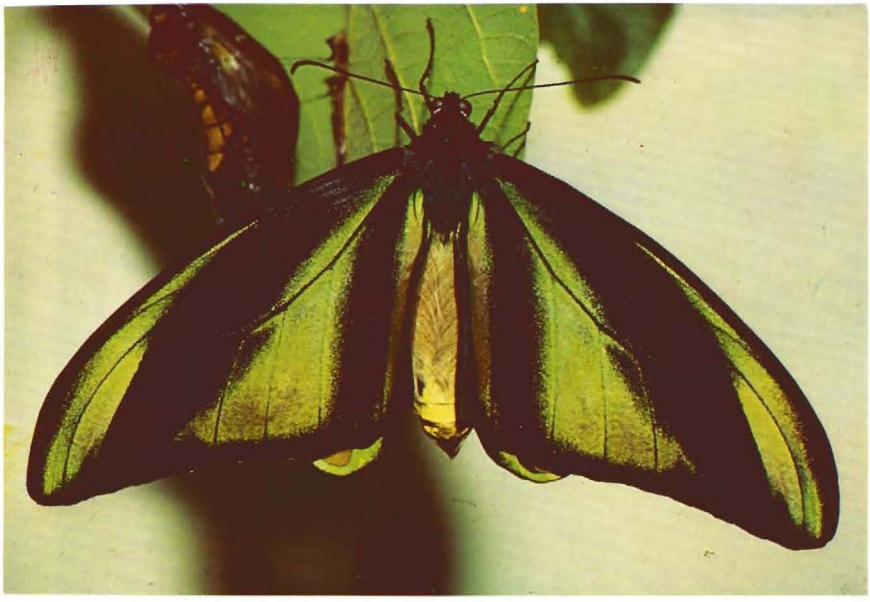

FIGS. 19-20. Imago of *Ornithoptera chimaera* Rothschild: (19) ♂, freshly emerged; (20) ♂, wings spread.

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