BREEDING *HELICONIUS* (NYMPHALIDAE) IN A TEMPERATE CLIMATE[1]

JOHN R. G. TURNER[2]
Department of Biology, University of York, England

Heliconius are among the most attractive of South American butterflies; they have beautiful bright color patterns, and their elongated wings enable them to perform quite remarkable tricks in flight, such as hovering, vertical climbs, and even flying backwards over short distances. Investigations on various aspects of their biology, reported in a wealth of papers, mainly in *Zoologica* and the *Journal of Insect Physiology*, have also made these animals into important research tools in such diverse fields as evolutionary genetics, ecology, behavior, and physiology. This is a brief account of the methods required to culture these organisms outside their normal tropical environment.

The methods described are those developed for genetical work on three species (*H. melpomene*, *H. erato* and *H. charitonia*) in England. Other species sometimes require rather more space, and, of course nongenetical work requires much less separation of females and therefore lends itself much more to mass culture. The results of the genetical experiments will be reported elsewhere (Sheppard and Turner, in prep.; Turner, 1973).

Techniques for culturing *Heliconius* in the tropics were developed under the guidance of William Beebe and Jocelyn Crane in Trinidad and have been described fully elsewhere (Crane & Fleming, 1953; Turner & Crane, 1962).

Culturing Adult Butterflies

Heliconius need to be kept at a temperature between 70°F and 105°F; below about 68°F they tend to become inactive (a slightly higher temperature for equatorial races, a slightly lower one for temperate races), but the night temperature when the butterflies are roosting can be brought as low as 60°F without obvious ill effects on the stock. Temperatures over 105°F become very dangerous after some time, particularly for butterflies which are already in a physiologically weakened condition, and in a changeable climate it is advisable to have thermostatically controlled windows as well as thermostatically controlled heating of the greenhouse.

---

[1] Dedicated to the memory of Roni Grainger.

[2] Present address: Department of Ecology & Evolution, Division of Biological Sciences, State University of New York at Stony Brook, Stony Brook, New York 11790.

A greenhouse provides the simplest way of producing an agreeable environment for the butterflies, as it can be relied on to produce diurnal fluctuations in conditions without resort to the elaborate programming machinery required when using an enclosed artificial environment chamber. However, during the winter the surface of the glass becomes extremely cold and the butterflies must be kept off it, either by double glazing or by enclosing the butterflies in some kind of mesh cage within the greenhouse. The minimum size of cage in which the butterflies will breed normally and live out a reasonable span has not been accurately determined. Breeding experiments in York, England were conducted in walk-in cages about 9 × 8 × 7 ft. and most forms did pretty well in these, although there was some obvious variation: the South Brazilian race of *H. erato* bred extremely well; the Amazonian race of *H. melpomene* bred well, although some individuals behaved as if they were a little unhappy in the confined space; hybrids between the South Brazilian and Amazonian races of *H. melpomene* spent excessive amounts of time on the roof of the cage and showed signs that a larger chamber might have served them better.

The London Zoo succeeded in breeding the Amazonian race of *H. melpomene* in a cage about 3 × 3 × 4 ft., but this is probably only to be recommended when space is very short. With care it is also possible to breed from female butterflies kept in the sunny bay window of a sitting room with good background central heating, but only about one in five females takes to this life sufficiently to live more than a week or so, and to lay eggs.

Temperate variations in day length do not seem to upset the behavior of the butterflies unduly, nor does cloudy weather, with the exception of very thick cloud during the winter. On the whole roosting takes place at roughly the normal time of tropical sundown, but for cloudy weather it may be worth providing some artificial light in the form of strip lighting suspended over the cages. It is a mistake to place the lighting inside the cage as the butterflies tend to damage themselves by flying against the elaborate fittings.

Cages are best constructed from a bolted frame of pre-drilled angle iron, which is commercially available, covered with mosquito net or "Lumite" saran screening fixed on with a rubber adhesive. Sliding doors are quite easy to construct with such material, and should be no more than waist high, to reduce the possibility of butterflies escaping when the doors are opened; an extra curtain of netting hanging loose across the inside of the door is an added insurance. Butter muslin (cheesecloth) is not recommended for cages as it is difficult to see what is going on

Figs. 1–2. The *Heliconius* breeding-system used at the University of York: (1) the greenhouse. *Passiflora* plants to the left and upper right, a pair of cages to the right of the door. (2) a pair of cages in use. To the left inside the cage—*Passiflora serrato-digitata* and *Abutilon* sp.; in the background—*Passiflora caerulea*. The slits on the left and in the wall separating the two cages are for introducing plants on long canes. (Photographs by Richard Hunter.)

inside the cage, thus cutting down attention to emergencies, and polythene is likely to produce unfortunately stagnant conditions in the air in the cage. An alternative of course is to buy commercially manufactured cages. (For the use of a plastic netting tent, see the article by J. Brewer, *News of the Lepidopterists' Society*, 1972, number 6.)

Heating elements should be kept out of cages, as butterflies, particularly when sick, can destroy themselves by landing on them.

If humidifiers are not available, then high humidity may be maintained in the cages by frequent spraying of the floor with a hose. In a greenhouse with a concrete floor it pays to cover this with heavy duty polythene sheeting, as this collects puddles. To act as a more constant supply of humidity, particularly during hot weather, it helps to have a bed of saturated peat about six inches deep occupying about half the floor of each cage.

Heliconius butterflies take pollen in addition to nectar (Gilbert, 1972). Food sources are therefore a flowering plant which produces a plentiful supply of pollen (I have found *Abutilon* excellent for this purpose and readily obtained), and failing nectiforous flowers, a supply of honey. I have found it best to supply honey neat on the petals of a plastic flower, and also diluted in water in a dispenser of the type used for giving drinks to caged birds. It is also good to have a supply of pure water dispensed from a wet sponge, in addition to the supply of puddles on the floor. Because of the preferences for red or orange flowers shown by most *Heliconius* (Crane, 1955) it is good if sponges, plastic flowers and bird feeders are of one of these colors. In winter, honey can be changed once every two or three days, but in hot weather daily changes are needed, particularly of the honey-water mixture, to reduce the concentration of alcohol.

The cage should be supplied with additional plants to provide perching surfaces for the butterflies, and also shade; moving out of hot dry areas seems to be an important factor in the survival of the butterflies in the greenhouse during hot weather. *Grevillea robusta* is excellent for this purpose, and provides a photogenic background.

Culturing the Early Stages

Heliconius larvae feed on quite a wide variety of the five to six hundred species of *Passiflora* (see e.g. Alexander, 1961; Brown & Mielke, 1972). The three species used in the present experiment all laid and fed readily on *Passiflora caerulea*, which is a very vigorous grower and can be obtained easily from nurserymen in England (not in the USA), as it is a popular ornamental. Another good hardy species with large leaves, although a little slower growing, is the horticultural hybrid *P. allardi* (again unfortunately very rarely cultivated in America), which is eaten readily by *melpomene* and *erato* at least. In addition any of the tropical species which are natural foodplants (for example *P. laurifolia* and *P. serrato-digitata* for *melpomene*) may be used, but tend to be much slower growing and therefore harder to replenish. *P. biflora* makes a good foodplant for *erato*, but suffers badly from exposure to sun and low humidity.

Females lay regularly on the growing shoots of *Passiflora* vines placed in the cages. The simplest technique is to place a healthy young plant, potted and on a six foot cane, in the peat bed along with the other plants. The larvae can be left to feed on this plant, and require little attention, as cultures of these species outside the tropics seem to be relatively free of epidemic diseases. However, the larger larvae are prone to eat the young growing shoots of the plant; as these are the only sites used by the females for laying, they rapidly slow down the rate of egg production, as well as destroying any eggs and young larvae that are on the shoots when they are consumed. It therefore pays to move half-grown larvae by hand to the lower and older parts of the plant. With judicious transfers of larvae, three healthy *caerulea* can keep pace with the offspring of a normally fertile *Heliconius*, and thus provide one with continuous culture. For non-genetical work where the offspring of several females are mixed it is clearly necessary to provide more plants.

With an adequate food supply the larvae of the different species do not seem to compete excessively, and all can be cultured in the same cage. The larvae of *H. erato* and *H. charitonia* pupate on or near the plant on which they have fed and can safely be left to do so. *H. melpomene* larvae tend to wander between six and twelve feet before pupation (the warning sign of this is that they turn bright purple) and may thus get into the wrong cage, producing contamination of another brood. This is avoided by placing final instar larvae in standard cylindrical breeding cages (obtainable from English suppliers), to feed on cut vine stalks. The slow-growing but tough-leaved *P. laurifolia* is ideal for this purpose. The larvae will then pupate either on the gauze lid of the cylinder or on the cut stalks. Once all the larvae have pupated the stalks are placed vertically in the peat bed, and the butterflies allowed to eclose freely in the cage.

→

Figs. 3–6. The *Heliconius* breeding-system used at the University of York: (3) To show the sliding door of the cage. On the left, *Passiflora serrato-digitata* and *P. auriculata.* (4) Inside the corner of a cage, showing the peat bed, polythene-covered

floor, butterfly-feeders, *Abutilon* (left), *Grevillea* (center), *P. caerulea* (foreground, mostly defoliated). (5) Transferring *Heliconius melpomene* larvae to a cylinder for pupation. Buckram cylinders behind. (6) An interracial hybrid of *Heliconius melpomene* feeding from a honey-water dispenser. (Photographs by Richard Hunter.)

Pupae which have become detached from their silk pad for any reason may be placed to eclose in the bottom of one of the larval breeding cylinders in which the plastic walls have been replaced by a cylinder of stout buckram, but this method results in the crippling of about one butterfly in five, when it fails to climb the buckram to blow out its wings. It is better, but more time consuming, to stick the cremaster of the pupa onto a woody branch, using a little clear rubber adhesive. This method has a high success-rate.

Eclosed offspring are collected and frozen once every one or two days, or transferred to other cages for breeding, or of course may be left in the cage for a continuing culture. The delay of a few days before males become fertile after eclosion gives one a little latitude in collecting them.

Butterflies are best transferred from cage to cage not in the hand, which may injure them, but in the small suspended gauze cages which breeders use for mating large silk moths.

When a female dies or is killed and her cage is required for another brood, the existing *Passiflora* plants can be covered completely with black organdie (organza) sleeves to separate the old brood from the new.

Envoy

Princes or professional researchers might seem to be the only people with the resources to grow these butterflies. Certainly genetical work requires a large amount of space because it is necessary to separate each female in a six foot or larger cage; in addition a considerable amount of greenhouse space is taken up with the stocks of *Passiflora* vines. But there is no reason why an amateur with a reasonably well appointed greenhouse, particularly in the warmer parts of the temperate zone, should not be able to cultivate these insects for fun. This they certainly provide.

ACKNOWLEDGMENTS

I am grateful to Miss Jocelyn Crane-Griffin, who instructed me in *Heliconius*-technique in Trinidad, and to Professor Philip M. Sheppard FRS, who originated several of the greenhouse techniques described here.

The detailed design of the cages, and their construction, was the work of the late Miss Veronica A. Grainger.

The work would not have gone forward without the expert attention given to the *Passiflora* plants by Mr. Colin Abbot and Mr. John Arber.

The final preparation of this paper was supported by a Biomedical Sciences Support Grant (HEW Grant #5S05 RR 07067) awarded to the State University of New York at Stony Brook and by NSF grant #B039300.

LITERATURE CITED

ALEXANDER, A. J. 1961. A study of the biology and behavior of butterflies of the subfamily Heliconiinae in Trinidad, West Indies, Part I. Some aspects of larval behavior. Zoologica (New York) 46: 1–24.

BROWN, K. S. & O. H. H. MIELKE. 1972. The heliconians of Brazil (Lepidoptera; Nymphalidae). Part II. Introduction and general comments with a supplementary revision of the tribe. Zoologica (New York) 57: 1–40.

CRANE, J. 1955. Imaginal behavior of a Trinidad butterfly, *Heliconius erato hydara* Hewitson, with special reference to the social use of color. Zoologica (New York) 40: 167–196.

——— & H. FLEMING. 1953. Construction and operation of butterfly insectaries in the tropics. Zoologica (New York) 38: 161–172.

GILBERT, L. E. 1972. Pollen feeding and reproductive biology of *Heliconius* butterflies. Proc. Nat. Acad. Sci. USA 69: 1403–1407.

TURNER, J. R. G. 1973. Passion flower butterflies. Animals 15: 15–21.

——— & J. CRANE. 1962. The genetics of some polymorphic forms of the butterflies *Heliconius melpomene* Linnaeus and *H. erato* Linnaeus. I. Major genes. Zoologica (New York) 47: 141–152.

OBSERVATIONS ON THE HABITAT OF *SATYRIUM KINGI* (LYCAENIDAE)

RONALD R. GATRELLE
126 Wells Rd., Hanahan, South Carolina 29405

From my field observations during the past four years, along with data gathered from other sources, I have come to certain conclusions regarding the breeding habitats, flight habits and foodplants of *Satyrium kingi* (Klots & Clench).

I first collected *Satyrium kingi* in Escambia County, Florida, near Cantonment. It was a single worn female, taken 2 August 1969. I was not sure of its identification until I compared it with material I collected in South Carolina in 1970.

In addition to the Florida spot, I have taken *kingi* at four localities in South Carolina: (1) at Givhans Ferry State Park in Dorchester County; (2) on the south side of Highway 642 where Dorchester and Charleston Counties meet, about 200 yards inside Dorchester County; (3) in Berkeley County at the Naval Weapons Station, near the golf course; and (4) in Charleston County just outside the south gate of the Air Force Base along Dorchester Road.