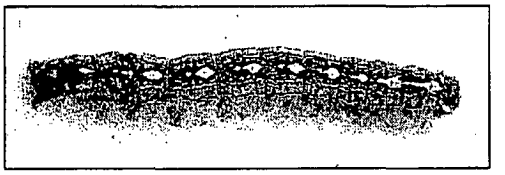
Wisconsin Entomological Society Newsletter

Volume 28, Number 3 November 2001

The Year of the Caterpillar

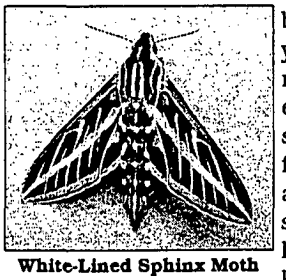
by Phil Pellitteri



Caterpillar-of-the-Year...
Forest Tent Caterpillar (*Malacosoma disstria*)
6/20/01, Door County, WI
Photos: Janice Stiefel

It has been a good year for winged critters, but I would call this the year of the caterpillar. Clouds of spring butterflies! The early flight of Red Admirals gave way to hoards of spiney caterpillars eating Stinging Nettles. This has resulted in a big fall flight. There were a good number of American Painted Ladies also with a few calls about the Pearly Everlastings getting gobbled up by black worms. The White-lined Sphinx moths had a

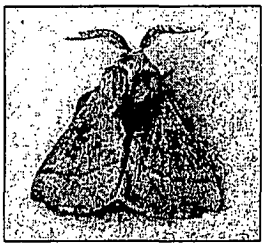
White-Lined Sphinx Caterpillar
(*Hyles lineata*)—green form
7/16/98, found by Dorothy Boyer
Cedarburg, Ozaukee Co., WI



White-Lined Sphinx Moth
8/19/98, adult of above

banner year. I got a number of e-mails and samples from around the state with hornworm larvae. The caterpillars can be quite variable with black and yellow markings along the back to green with red, black and yellow dots along the back. Some people could find dozens of larvae! Now everyone is seeing adults in their flower beds.

The orange with white striped and black spined caterpillars that attacked pansies were Variegated Fritillaries. This is the first time I had to put them in the pest category. Most people were more than happy to leave them alone once they saw they were butterflies. Not so with the flush of loopers this spring. I had large numbers of Bilobed Looper Moths (*Autographa biloba*) and Gray Looper Moths (*Rachiplusia ou*). They seemed to prefer Delphiniums which is a plant we rarely see insect pressure on. During the spring flight we also had tremendous numbers of Armyworm moths. We did not get the outbreak of larvae that we expected, but people would report dozens of moths in their garage if they left the light on and the door open.



Forest Tent Caterpillar Moth
7/13/01, adult of above

Everything pointed to strong spring migration of many Lepidoptera. In the southern part of the state I did get about ten calls from people who found adult Imperial Moths. I have seen a moderate number of Pandorus Sphinx larvae on grape, some Abbot's Sphinx on peas, and the usual number of Cecropia calls. It was a good fall for Monarchs with the new record of seven adults on one Butterfly Bush in the Pellitteri garden.

No question the caterpillar-of-the-year was the Forest Tent Cater-

Please see, **CATERPILLARS**, *Page 2*

WES Annual Meeting and Photo Salon

November 10, 2001

The next meeting of the Wisconsin Entomological Society will be held on Saturday, November 10th at Russell Labs in Madison (map and directions appear on page 8). The meeting will begin at 1:00 P.M.

The program will include brief presentations of insect activity this past summer, as well as the *Annual Photo Salon*. Members having slides of entomological subjects are encouraged to participate in this event. Each entrant may submit up to five slides, labeled with the subject and name of the photographer. The slides will be evaluated by the audience, which will vote to select the winning entries. A print of the first place slide is awarded to the winner and is also added to the display in the Entomology Department office. The photographer's name is added to the William E. Sieker Memorial Plaque. On the agenda is the election of officers for 2002. Nominations are welcome and can be made at the meeting.

The Wisconsin Entomological Society Newsletter is published three times a year, at irregular intervals. It is provided to encourage and facilitate the exchange of information by the membership, and to keep the members informed of the activities of the organization. Members are strongly encouraged to contribute items for inclusion in the newsletter. Please send all news items, notes, new or interesting insect records, season summaries, and research requests to the editor:

Janice Stiefel, 2125 Grove Road, Bailey's Harbor, WI 54202, e-mail: jstiefel@itol.com

NOTE: Please report any address changes to Les Ferge, 7119 Hubbard Ave., Middleton, WI 53562. e-mail: ferge@chorus.net

CATERPILLARS, *from Page 1*

pillar in the northern half of the state. Last year we had a big blow-in of moths to Green Bay, Stevens Point and other cities after a storm front, We did have some problem in a number of cities, but the big news was the forest defoliation and "*science fiction*" feeling of caterpillars everywhere. They sanded the roads in Antigo, and used fire hoses to blow them off the trees in Rhinelander. A street sweeper was used before the Grandma's Marathon to prevent runners from slipping on the crushed caterpillars. There is a Sarcophagid fly that will be turning things around, but the "*friendly or government fly*" as it is called will also become a nuisance next year. For a picture of some of these critters check my web page at: http://www.entomology.wisc.edu/entodiag.html#highlights ❦

Phil Pellitteri is president of WES and the District Outreach Specialist at the College of Agriculture & Life Sciences, Dept. of Entomology, UW-Madison, WI.

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OOPS! On page 1 of the June 2001 issue of the newsletter, Volume No. 29, should be changed to 28; Number 2 stays the same. Sorry for any confusion this has caused.—Ed.

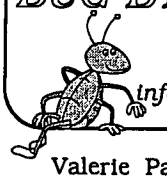
2002 Dues Notice!

A collection envelope is enclosed with this newsletter, for the convenience of members who haven't paid their dues for 2002, No envelope is provided if you are paid up for 2002 or beyond. Please check the address label on this newsletter for your current dues status. Send check to our treasurer, Tom Rocheleau, 3100 Buena Vista St., Madison, WI 53704. Also appearing after your name will be your membership category:

Individual . . . . . $5.00 per year
Family . . . . . $10.00 per year
Sustaining . . . . . $15.00 per year
Patron . . . . . $25.00 per year

Be sure to notify us of any address changes when you send in your check or you may notify Les Ferge, 7119 Hubbard Ave. Middleton, WI 53562. ❦

BUG BYTES...



Backyard and field observations, plus information of interest

Valerie Passoa, a member of The Ohio Lepidopterists and new member of WES, wrote a wonderful article, *Magnificent Wild Silk Moths* (family Saturniidae) for *Carolina Tips*, the educational publication of Carolina Biological Supply Co. Her enthusiasm and fascination for this family is evident as she discusses their life history. Both adult and larval photos of three species are illustrated in color. Go to: http://www.carolina.com/tips.htm and scroll down to October 1999 to read the article. A free color copy may be obtained by calling Kathy Dimont at 1-800-334-5551, ext. 6418.

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Caterpillars of Eastern Forests is a FREE 113-page Federal Government publication. It contains useful information on the caterpillar life cycle, morphology, rearing, preserving, photography, along with spectacular color photos. Contact Richard Reardon at (304) 285-1566 or e-mail: rreardon@fs.fed.us

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9/22/01, San Antonio, Texas: e-mail from WES member, Pat Seawell—"I know Monarchs are not supposed to lay eggs on the way back south! I've read it in several places. BUT I have eight caterpillars that I'm going to do my BEST to raise! I didn't even look for them—just had two little *Asclepias curasavica's* on my patio I had never gotten around to planting. I happened to notice the leaves were being eaten—ta-da! The caterpillars were already several days old. Now I'm bringing in *curasavica* from the back 40 for them and they seem to be thriving! I just hope I have enough *curasavica* growing in the back 40! It's such a jungle out there that the Monarch moms evidently couldn't find it. So they laid on the little plants in the 4" pots!!!! Updates to follow! We've had very few Monarchs passing through—compared to previous years." ❦

Butterfly Basics

✔Lepidoptera is from the Greek words for "*scaly wings*" and refers to both butterflies and moths. There are more species of butterflies and moths known than any other group of animals besides beetles.

✔Butterflies and moths sip nectar through a *proboscis*. This long mouth or feeding tube is used to suck up liquid food such as flower nectar and water. When unrolled this "*tongue*" can be as much as three times the length of the insect's body.

✔Butterflies taste with their feet. if they like what they taste, they will proceed to drink with their *proboscis*.

✔There are ten times as many moth species as butterfly species.

✔The largest butterfly is the Queen Alexandra Birdwing. It has a wingspan of 11 in., bigger than many birds.

✔The beautiful color patterns on butterfly wings, which resemble Impressionist paintings, are mosaics made of different kinds of overlapping scales.

✔A butterfly's skeleton is on the outside of its body.

✔Butterflies fly best when their body temperature is between 85-100 degrees Fahrenheit. They warm their muscles in the sunshine before they fly.

✔Butterfly antennae are usually slender and have knobs at the tips, called clubs. Moths have tapered or wide, feathery antennae.

✔Individual female butterflies can lay from 150 to 1,600 eggs during their lifetime. The number varies with each species.

✔Butterflies do not bite or spread human diseases.

✔Some butterflies beat their wings as many as 40 times per second, reaching a top flying speed of more than 16 miles per hour.

✔The oldest butterfly fossils date back about 40 million years.

✔Butterflies tend to have slender bodies in comparison to the size of their wings. Many moths have stout bodies and scales that give them a furry appearance, both on their bodies and their wings. ❦

Courtesy: *Butterflies ALIVE!*

THE EYES HAVE IT

by Paul Burton

The helmet-like head of the dragonfly is mostly eyes, as it has been for over 300 million years. These insects appeared first in the swamps of the Carboniferous Age and have changed little over millions of years. They are living fossils. The dragonfly is a design that has stood the test of time, not only as a marvelous flying machine, but also as an efficient aerial carnivore that greatly depends on its vision for survival.

One can learn a lot about how a dragonfly uses its eyes by examining their positioning on the head, as shown below in photos of the Canada Darner.

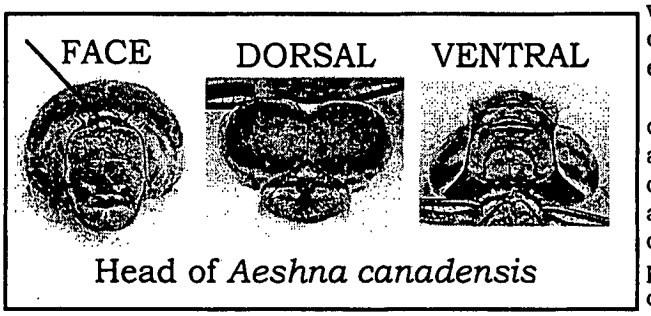
The main eyes of insects, including those of dragonflies, are of the "compound" type. They may also have "simple" eyes, which are responsive to light and dark but probably don't form a real image. A simple eye consists of an overlying clear lens with underlying neurons that respond to light stimulus (a line points to one in the face-on view at the left).

In the photo on the left, the compound eyes wrap around the sides of the head and meet at the top. The middle photo shows the head as seen from above, and the two eyes form a broad and expansive "seeing" area. Obviously, the most extensive visual field of the dragonfly is upward.

The photo at the right shows the head from below, and much of this aspect of the head is occupied by mouthparts. Although the dragonfly can see downward, its range of vision in this direction is obviously limited. For example, compare the eye area exposed to light coming from above (middle photo) with the area exposed to light from below (right photo).

Compound eyes are made up of many smaller eyes called ommatidia (ah-ma-t'id-ee-ah). These microscopic eyes, which are made up of several cell types, are in the form of elongate cylinders. Lying above the surface of each cylinder is a small biconvex lens. In outline, these lenses are hexagonal in shape and they make up the outer surface of the larger eye.

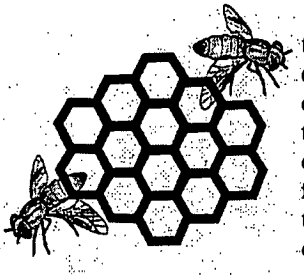
The eyes of some insects have less than a dozen ommatidia, as in worker ants. Obviously, they don't see very well. However, each eye of a large dragonfly may be made up of up to 25,000 or so of these smaller ommatidial eyes.



Head of *Aeshna canadensis*

In a dragonfly, the brain interprets the signals sent to it from the ommatidia, and then tells the rest of the dragonfly how to respond to what is "seen." In the simplest of terms, the dragonfly brain probably decides whether to flee what it sees, eat what it sees, or attempt to mate with what it sees.

Do we know what a dragonfly really sees? Studies show that the eye apparently sees an erect image in the form of a mosaic, as if the field of view were made up of thousands of tiny hexagonal "windows" (see diagram below). Such eyes are not particularly suited to provide great visual acuity, as in hawks, for example, but they are superb at detecting even the slightest movement.



In the diagram at the left, a portion of a dragonfly eye detects a couple of deerflies trying to avoid becoming a meal. The individual eyes, with their hexagonal lenses, can easily detect when a deerfly moves from the visual field of one ommatidium to an adjacent one. This allows the dragonfly to accurately track the path of the deerflies.

Dragonflies are utterly dependent on their large eyes in tracking and targeting prey, as well as in finding mates of the same species with which to copulate. Their antennae are tiny, and there is little evidence that they have much of a sense of smell (which is not the case with worker ants, which have a well-developed sense of smell). With an expansive visual field of almost 360 degrees, it has been suggested that about 80% of the dragonfly brain is devoted to circuits associated with vision and that 10% of a dragonfly's total energy expenditure is vision-related.

Apparently dragonflies can see all the colors we see, and in addition they can detect light in the UV range as well as the plane (the direction of vibration) of polarized light. Another characteristic of the dragonfly eye is that it is designed to detect flickering light, such as that reflected off the wings of a prey insect. Knowing that dragonflies respond to flickering light can be useful to a person attempting to photograph them in flight. By waving a camera lens back and forth, they often fly by to investigate the photographer.

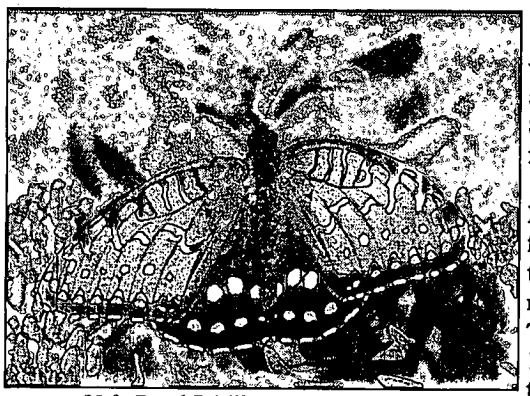
As was previously stated, "the helmet-like head of the dragonfly is mostly eyes." A dragonfly in flight generally flies with its body at an angle, with the head downward (not unlike a helicopter). This maximizes the forward and upward viewing area because of the position of the eyes. Also, it's no coincidence that dragonflies usually grab their prey from underneath, for their eyes are positioned to mainly look upward. In fact, in some dragonflies the corneal lenses (facets) of the eye are larger in the dorsal aspect of the eye, presumably to enhance their ability to see upward.

The most abundant large dragonfly at The Ridges Sanctuary in Bailey's Harbor, Wisconsin during

Please see, **EYES**, *Page 7*

REGAL WEEDS...The Surprising Value of an Old Field

by Ann Swengel



Male Regal Fritillary (*Speyeria idalia*)
Photo: Ann Swengel, 6/18/97

In 1990, my husband, Scott, and I started a study of the Regal Fritillary, then listed as threatened in Wisconsin. This striking butterfly was a challenge to study here because so few and so small populations were known to exist. But its association with native prairie flora was a good steer for us to find more populations to study in states further west, such as Minnesota, which has more and larger prairie preserves. Consistent with our observations there, the few sites in Wisconsin where we could still find Regals, or where Regals had been found until recently, were native prairies.

We didn't find Regals (or other prairie-associated butterflies, like Poweshiek Skipperling) in all prairies— not just in Wisconsin, but also in other states. The bigger and "better" the prairie flora, the more Regals. The smaller and more isolated and "worse" (more degraded) the prairie flora, the less likely Regals were present at all.

On a vacation in southwestern Missouri in April 1991, we visited prairie after prairie with magnificent spring prairie flora, including violets, the caterpillar food plant for Regals. Of great interest to my ornithologist husband, we also found wonderful grassland birds, including Henslow's Sparrow—a very rare encounter elsewhere in our study, but amazingly numerous there.

The first we could return to Missouri during the Regal's flight period was June 1992. Amidst a glorious early summer prairie flora, we found abundant Regals, and all those Henslow's Sparrows hadn't been some fluke either.

PUZZLES

Back in Wisconsin, we had found an occasional Regal in the tiny patches of lovely native prairie flora at the Thomson preserve, but in 1992 Andrew Williams found the core population in a large nearby tract more recently added to the preserve. Highly degraded but never plowed, this tract had not seemed worth checking, in our limited survey time. He also told me about the Hogback, at the time a farm pasture grazed by cows—weedy and brushy—but with a glorious diversity of native prairie plants, and lots more Regals than the Wisconsin prairie preserves we'd been surveying.

These seeming anomalies could be explained by another factor—management (see *WES Newsletter* Vol. 28, No 1, March 2001). Prairie preserves are typically managed with cool-season fire, which is less favorable for Regals than other methods such as light grazing (more likely to be found on private land), because burning kills Regals when in an immature life stage.

FOR THE BIRDS

Meanwhile, Scott was intrigued by his sense that, in our multi-state surveys, prairie-specialist butterflies like Regals and declining grassland birds like Henslow's Sparrows often seemed to be more abundant in the same places. My number-crunching bore out his hunch. It wasn't just a matter of smaller sites having shorter surveys and so, lower totals of both groups of animals. Instead, for both the butterflies and birds, I calculated relative densities (individuals per kilometer of surveying). Places with relatively more of the grassland birds per survey distance tended to have relatively more specialist butterflies too.

I wasn't surprised that generalist butterflies that live in forests and fields (like Eastern Tiger Swallowtail) had no correlation with grassland-restricted birds. But it wasn't so obvious to me that prairie-specialized butterflies should correlate with the grassland birds, which occur widely in both prairie and degraded old fields (the weedy fields that grow back after a site has been plowed or heavily grazed). I'd thought that grassland butterflies—species which also occur widely in both prairie and old fields—might correlate best with the birds. Instead, the grassland and generalist butterflies were similarly uncorrelated with the birds.

THE TEST

Scott was eager to test this correlation further. Could places with impressive grassland bird communities (fairly well known in their locations) be good leads for finding sites to support prairie-specialist butterflies, whose locations aren't as well known? In fact, he predicted that Regals should live at Buena Vista Grassland (near Stevens Point) because of its outstanding grassland bird community, conserved under the "umbrella" of programs to help the Greater Prairie-Chicken. While this site does have some factors favorable for Regals (large grassland size, management with some unintensive grazing and haying and only a little burning), I still thought he was crazy because this wasn't remotely a prairie—it had been drained, plowed, abandoned, and regrown as old field. That's why this site hadn't been included in the statewide Regal status survey (1993-94), with which I'd been a cooperator.

Poetically, I found the first Regal here (see *WES Newsletter* Vol. 24, Nos. 2-3, November 1997). It turns out that the largest known Regal population in Wisconsin lives here—measured both as total individuals recorded and as total land area occupied. But this bird-butterfly correlation only works so well. We found Regals in a large old

Please see, **OLD FIELD**, *Page 5*

OLD FIELD, *from Page 4*

field in St. Croix County (based on a tip from a high school teacher in Hudson), but in no other old fields so far.

Nonetheless, such factors as management, land use history, size, and landscape context can make up for disadvantages in vegetation—to the remarkable degree that Regals, the quintessential prairie butterfly, can in very special circumstances inhabit an old field, and even thrive there. It's not possible, simply based on classifying the vegetation, to know for sure whether prairie-specialized butterflies should or can't live there. In our study, some glorious patches of prairie vegetation "underachieve" the potential of their plants by having few or no prairie butterflies, while some degraded prairies and old fields "overachieve" beyond the seeming limitations of their plants by actually having some prairie butterfly populations in them.

"RESTORATION"

From what I've read and heard, many prairie botanists and ecologists believe that native flora is by definition categorically better. Taken to its logical conclusion, this would mean "restoring" Buena Vista to prairie plants. But to prepare a site for a prairie planting, this means getting rid of what's there now -- usually through broadcast herbicide spraying and/or repeated plowing. This is obviously destructive to animals as well.

I used to assume such a project was at best beneficial to a site (improving its native diversity of plants and animals), and at worst neutral—even if nothing significant is gained (after all, prairie plantings mostly contain common, easily cultivated prairie plants, since these are the ones most likely to be available as seed and most likely to establish in a planting), at least nothing significant would be lost. After all, it's only an old field—what significant species could live there?

Based only on the plants, it would seem that nothing noteworthy would get lost by restoring Buena Vista. But surely Regals would be destroyed in the process and it's not clear when—or if—Regals would find suitable breeding conditions again in the replanted site. Buena Vista is too large to "restore" all at once, or ever, in its entirety. But to the extent it got "restored", that would be the extent Regals would lose, for an indefinite period of time. It's hard to imagine wanting a conservation program to make a rare species native to that habitat even rarer.

Mating Regals—male left, female right
Photo: Ann Swengel, 6/18/92

Everything else being equal, the more the kinds and the extent of native plants, the better. But everything else is rarely equal among sites—including a one-shot event in its history that proves catastrophic (intentionally or not) to a population of a localized insect. If the insect population dies out, it won't return, even if the habitat is suitable, unless another population exists within dispersal distance of the site -- a rare circumstance for Regals in Wisconsin. Thus, I hope for greater interest in developing and implementing techniques to increase the species richness and nativeness of a site's vegetation in more gradual and less drastic ways.

I've come to appreciate how much more is necessary than just plants in order for rare and localized insects to persist in a site. I've also come to appreciate how very hard it truly is to restore a site—improve it without losing any of the good already in it, and it can be surprising how much good can be in some seemingly very degraded places. ❦

Ann is vice-president of the North American Butterfly Association (NABA) and a member of WES. She and her husband, Scott, enthusiastically survey butterflies and have published many scientific papers on their observations.

Witnessing a Miracle

by Christy Thompson

Everyday there are little miracles happening in nature, but it is not every day that we are fortunate enough to witness them. At The Ridges Sanctuary in Bailey's Harbor we raise Monarch butterflies for visitors to observe and to help the children at the summer camps appreciate the magic of metamorphosis. In one of our generations of butterflies, there was a crippled male Monarch that had wings which never unfolded completely when it came out of its chrysalis. This male would try so hard to flutter his wings to lift himself up, yet it just made for another crash landing. We kept him in a flight cage longer than the others because we figured he would soon become bird food if we released him. After all, what good is a butterfly that can't fly?

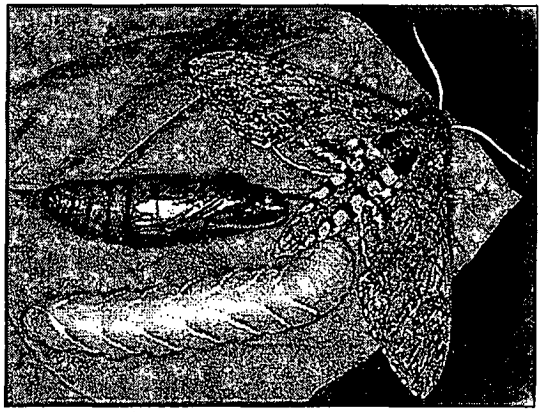
The day eventually came when this handicapped insect was to get a taste of the real world, or maybe, to be tasted by a part of it. We said our good-byes to our buddy and carefully set him on a healthy milkweed plant. I don't know if he even had a foothold before a faded, tattered-winged female Monarch (that appeared to have been around the block a time or two) swooped down towards him. Right there in front of us, these two began mating as if they had planned out where and when to meet. That had to have been the best example of love at first sight I have ever seen, or will ever see. This is not normal behavior for Lepidoptera. Apparently, the female is the one that emits her pheromones to attract the male to her. In this situation, rules were broken, as this was no ordinary copulation. So much for "*bird food*". This butterfly had all of us fooled.

If you are in Door County next summer, watch for Monarchs with folded, weathered wings to find out just how successful this odd couple really was. ❦

Christy was an intern at The Ridges Sanctuary this past summer. She is a graduate of UW-Stevens Point and hails from Port Washington, WI. Currently, she is on a two-year stint as a volunteer with the Peace Corps in Vanuatu, located in the Pacific Islands.

The Tobacco Hornworm

by Nick Keuler



Carolina Sphinx/Tobacco Hornworm
(*Manduca sexta*)—larva, pupa and adult
Photo: Nick Keuler

During the course of my studies at UW-Madison, I stumbled upon a wonderful entomology class entitled, *Insects and Human Culture*. As part of the requirements for the class, we reared a Tobacco Hornworm from egg to adult. The experience proved both enlightening and frustrating, as the development of the insect was beautifully intricate, yet quite fragile (as my first two specimens would whisper from the grave).

In what follows, I intend to give a fairly detailed (if at times possibly dull) life history of the Tobacco Hornworm, inserting juicier tidbits at my leisure. Said differently, if you want to appreciate the captivating, you'll have to trudge through the mundane. Such it is with most learning.

The insect in question is known scientifically as *Manduca sexta*, and is a member of the Order Lepidoptera (butterflies and moths) and family Sphingidae (sphinx or hawk moths). It ranges from southern Canada to Argentina, but is more common in the warmer climates of the Gulf Coast and Central and South America. It is a close relative of the Tomato Hornworm, which enjoys cooler climates.

The egg is fertilized shortly before it is laid. Since the covering of the egg is impermeable to water, small holes exist in the shell to allow sperm to enter. Females then lay their eggs during the late evening hours, one egg per tobacco leaf. They hover near the plant, curl their abdomen up, and deposit an egg on the underside of the leaf. A female can lay more than 700 eggs during her lifetime. Eggs are about 1.5 mm in diameter, and are light green in color due to a protein found in the yolk, but they become more translucent as the embryo develops. Shortly before hatching, a black stripe can be seen through the shell; this is the *black horn*. The black horn changes to red after the first instar.

Under ideal conditions of 78° F. (25° C), larvae will emerge in about 120 hours. The cooler the rearing conditions, the slower the insects will develop. Below 65 ° F (18 ° C), development ceases. Larvae hatch by using their mandibles to chew a hole in the shell. Then, in a display of the tremendous efficiency so common in insects, larvae will eat the entire shell before moving to feed on the plant. The larva prefers tobacco, but will feed on any plant in the nightshade family (tomato, potato, eggplant, etc.). Curiously, if started from hatching on anything other than tobacco, it will readily switch to tobacco, but if started on tobacco, it will starve before it eats anything else.

The emerging larva is pale yellow-green and about 4 mm long, and displays a very long black horn on its tail end, often longer than the body. No one knows the purpose of the horn, but the best proposed guess is that it does nothing important at this time. A larva at this stage is quite aggressive and if crowded, will rear back on its hind legs and swing its body around in a violent fashion. The insect eats voraciously during this period, increasing its weight nearly six-fold. Eventually, the insect begins to take on the characteristic blue-green hue, which it acquires from pigments in the tobacco.

> The horn of the Tobacco Hornworm is normally RED after the first instar; while the horn of the Tomato Hornworm, or Five-Spotted Hawkmoth (*Manduca quinquemaculata*) is BLACK.

At about 48 hours after emergence, the animal stops feeding and begins to weave a silk mat. Glands in the head and thorax produce a silk thread that is laid down on the leaf. The insect then crawls onto the mat and starts to molt. Upon molting, the insect is usually dormant for a few hours to allow for exoskeleton expansion and for the hardening of the mandibles. Once the mandibles are hardened, the insect eats the shed exoskeleton except for the very hard head capsule.

Growth continues in this fashion for four more feeding/molting cycles of 3-4 days each, with the only contrast being that larvae do not weave a mat for the remaining molts. After the 4th molt, larvae feed constantly for five full days, and just before pupation, they are nearly 90 mm long, and weigh 11 grams. Not coincidentally, *Manduca* means 'glutton' in Latin.

Tobacco Hornworms have developed two very important survival adaptations. Larvae exhibit herringbone markings along the length of their body, which are fashioned to appear as veins in a leaf, and thus help to camouflage them. Hiding from predators would seem to be rather unimportant though, because the caterpillars accumulate high concentrations of nicotine from tobacco leaves, and are, therefore, toxic to birds. The nicotine does not harm the insect because it has devised a means of filtering and safely storing the toxin. The only true predators of the insect are humans and several species of parasitic wasps.

When the final larval glut is over, the caterpillars move off the food plant and look for soil in which to burrow. At this point, larvae take on a frantic air, and if a suitable site for pupation is not found, a larva may walk as far as a city block to find one that suits it. This *wandering* stage

Please see, **HORNWORM**, *Page 7*

HORNWORM, *from Page 6*

lasts about two days. When a proper place is found, the insect quickly burrows, disappearing in a matter of minutes. Ideally, larvae will go down about 10 to 15 inches below the surface, and if they encounter an impenetrable object before they reach the desired depth, such as a tree root or rock, they will resurface and try again elsewhere.

The larva now begins to shrink and form into an elongate football. The muscles used in moving the rear legs and mandibles are degenerated and absorbed, providing nourishment. The insect can no longer walk, but instead rotates along the long axis in order to form a cell slightly larger than the pupa.

In three to four days, the pupa is completely formed. At this stage, the insect is a dark reddish color, and sports a handle-like protrusion near the head that will become the proboscis. Although the insect is covered with a hard cuticle, it is able to wiggle its abdomen thanks to three small joints.

The length of time spent in the pupal stage depends upon the hours of light received by the larva. If a larva is exposed to 12 or fewer hours of light (conditions similar to those of late summer), the insect will enter a dormant stage and remain underground for 8 to 9 months. If the insect is exposed to 13 or more hours of light (early summer conditions), it will begin to develop immediately, and will emerge in about a month.

The details of the adult's escape from the pupal case are largely unknown. It seems quite fantastic that a small, frail, adult moth is able to tunnel up through a foot or more of hard-packed soil, but no other plausible explanation affords itself.

[My experience with this segment of the metamorphosis of the Tobacco Hornworm, is that the pupa actually inches its way to the top of the soil and then the adult emerges.—Ed.]

In any event, once at the surface, it will crawl up a plant stem to ready its small, deflated wings. The moth pumps fluid into the wing veins to inflate them, then hardens the wings. This takes about 6 to 8 hours and usually occurs during the evening. When the insect is ready to fly, (usually at dusk or night) it must shiver to increase its body temperature to about 98 ° F (37 ° C) before the flight muscles will work properly. *Manduca sexta* is the fastest flyer in the entire class Insecta, with recorded velocities of nearly 45 mph.

The coloration is a purposefully nondescript mottled black, gray, and light brown, making it nearly invisible on the right type of tree bark. The only exception to this color scheme is six pairs of yellow patches on the abdomen. This gave rise to the Hornworm's second name, *sexta*, which means 'six' or 'six-fold' in Latin.

Adults typically live about a week, feeding entirely on nectar. The moths hover near the flower and extend their coiled proboscis into the corolla of the flower. The proboscis is about twice as long as the body and allows the insect to feed without landing, reducing the chances of predation. Lurking spiders could feast for days on a single moth.

Females undergo a two to three day puberty period in which they do not mate or lay eggs. When they reach maturity, they release pheromones to attract males for mating, and the cycle repeats.

Thus ends my treatise on a rather interesting little insect. I'd like to credit Walter Goodman, Professor of Entomology, UW–Madison, as the source for the vast majority of this information. ❦

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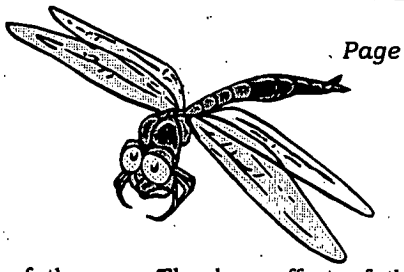
EYES, *from Page 3*

the month of July is *Somatochlora hineana*, the Hine's Emerald Dragonfly. Overall, its eyes are very similar to those of the Canada Darner, although those of *S. hineana* and other Emeralds are characterized by their beautiful emerald green color. This color is provided by a greenish pigment in cells just beneath the corneal facets



of the eye. The lens effect of the cornea probably contributes to the appearance of great "depth" in the emerald color

Dragonflies also have three simple (= not compound) eyes near the center of their "forehead." Are these for seeing near objects? Or do they to help orient the dragonfly in space by perceiving changes in light intensity? No one really knows. The larger simple eye in the middle of the forehead lies beneath a projection covered with tiny hairs. Its function may be the same as that of the bill of a baseball-style cap: to shade the eye.

In 1917, R.J. Tillyard wrote: "*When a dragonfly is held in the hand, the eyes are seen to glow with a most beautiful light...*". This glow should remind us to give thanks that we can share this planet with an insect that has remained essentially unchanged over 300 million years of time. Perhaps Nature achieved a kind of perfection in the design of the dragonfly. ❦

Paul Burton received his doctorate in zoology at the U. of North Carolina. Although he has a rich background in invertebrate zooloby, he ultimately became a cell biologist and spent almost 30 years at the U. of Kansas as a teacher/researcher. He is a Professor Emeritus from that university, and since his retirement he devotes his time to writing books (with his wife, Fran) on area history and studying dragonflies. He lives in Ephraim, WI.

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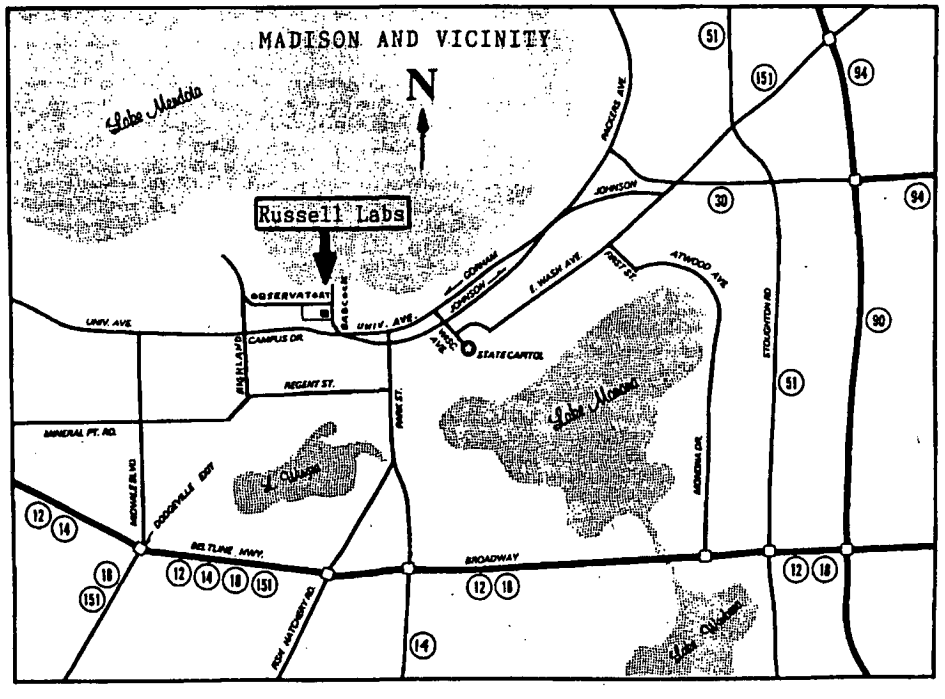

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