Wider aspects of a career in entomology. 6. North Carolina

Hugh V. Danks

This series of articles outlines some ancillary aspects of my entomological career, for the potential amusement of readers. It reports the sometimes unexpected challenges of working in new places and in the real world, an approach that serves also to expose some conclusions about research activities and some information about insects and their environments.

Employment opportunities were limited by a decline in the Canadian economy as my postdoctoral fellowship in Ottawa came to an end. After a few temporary research jobs, I applied in 1972 for a 2-year position at North Carolina State University in Raleigh, to help run a new MSc program on insect pest management, organized by R.L. (Bob) Rabb. My chief responsibility would be to coordinate and teach ecological aspects of the program (and I knew that my lectures could include the challenges of managing pests across enormous areas, as illustrated by Canadian research on the dynamics of spruce budworm populations). Some local research would be possible too.

My interview in Raleigh took place in early April. The temperature was about 80°F [27°C], and redbuds (Figure 1a) and dogwoods were in bloom. Back in Ottawa, traces of winter snow persisted (Figure 1b)…I accepted the job.

Figure 1a. Roadside in the southern United States in early April, showing shrubs in leaf and redbud trees in flower.

Figure 1b. Roadside in Ontario at a similar time of year, showing still-dormant shrubs and trees as well as residual snow.

Obtaining the necessary visa proved difficult. United States authorities declared that the waiting list for immigrants of my nationality was so long that I was not eligible to come for 6 years. They could not be made to understand that I wanted only a temporary visitor's work visa for a 2-year appointment. Finally persuaded to grant my visa after intervention by the university, the authorities asked "why don't you want to immigrate to the USA?"

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My wife Thelma and I made a short visit to North Carolina to search for accommodation. We drove along the scenic Blue Ridge Parkway (Figure 2), part of the Appalachian mountain range. The route and timing of that journey proved to have been chosen with extraordinary luck. All the campsites were empty (except for us) after days of heavy rain caused by Hurricane Agnes. The massive amounts of water drained into the valleys below, contributing to serious flooding and road closures. Without today's electronic devices and otherwise preoccupied, we skipped along the mountains largely unaware of these events. We were greeted with surprise in Raleigh because we had made it through.

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Figure 2. View from the Blue Ridge Parkway, 24 June 1972. The blue haze has been attributed to release by the trees of isoprene, the subject of some entomological investigations.

That visit yielded not only accommodation but also other information. For example, no one recognized Canadian currency, which was eyed distrustfully (and not accepted) as though it had come from the game of Monopoly.

A small truck was booked for the move itself, but on the scheduled day the rental company insisted that we use a much larger truck registered in the United States. The vehicle was 40 feet [more than 12 metres] long, far too big for our household goods, and posing some danger to fire hydrants and other objects when turning corners. At the border, the customs officer opened the giant truck with great suspicion; but then saw the remarkably shallow layer of possessions it contained. He smirked slightly, and sent us on our way.

In Raleigh, class materials used American spelling, such as behavior (not behaviour) and color (not colour). For years afterwards, I had to exercise extraordinary diligence to avoid spelling errors. One exercise was designed to illustrate the contrast between S-shaped population growth (as populations reach equilibrium because surplus individuals migrate away) and J-shaped growth (as populations crash after the carrying capacity has been exceeded). Winged aphids could leave from some small tobacco plants as crowding increased, but cages prevented departures from other plants. A test run showed the expected patterns perfectly. However, the course itself took place in hotter weather, and the tobacco plants grew so rapidly that they outpaced the reproductive capacity of the aphids. As aphid numbers increased, counts were modified from the whole plant, to a sample, to a subsample, and finally to a subsubsample. With every aphid population and tobacco plant still growing exponentially, the experiment had to be abandoned. Rather sheepishly, I supplied students with data from the test run instead.

The course included guest lectures by invited speakers: P.S. (Phil) Corbet and W.G. (Bill) Wellington came from Canada. One guest, a senior entomologist from Florida, had packed essential heart medications in his checked baggage, which was then misplaced by the airline. I was very worried about him given the absence of these essentials, the stress thereby created, and the demands of the lecture itself. Fortunately, frequent assertive contacts with the airline prompted a delivery to our building just before the lecture began. On my future travels, I applied that lesson to carry all essentials — as well as to be assertive on critical matters!

Preparing for the start of classes was not without disruption. Our accommodation had been built recently and we were among the first tenants. Therefore, several defects had not yet come to light. A sewer misalignment caused a flood of dirty water from other residences to rise out of our toilet, carrying coloured tissue and other unwanted products, and introducing a vile smell that persisted

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Figure 3. Young tobacco plants in flower in a crop field in North Carolina.

for many days until the fitted carpet was replaced. The air-conditioning unit failed repeatedly too, and a serviceman came many times. More than once he had been called out just as he sat down at his home to eat a watermelon, as a way to cool down in the stifling heat.

Watermelons grown in North Carolina were readily available. Other crops included peanuts, corn, soybeans, and cotton. A substantial crop was tobacco (Figure 3): 678 million kg were harvested in the 2 years I was in North Carolina. Tobacco fields are ploughed in fall to limit the winter survival of several major agricultural pests, but a field neglected after harvest might generate thousands of tobacco hornworms that had overwintered in the soil, causing widespread damage to seedling tobacco in the spring. Therefore, authorities would intervene in fields not ploughed by a certain date, and then bill owners for the work.

Caterpillars of the tobacco budworm (Figure 4) and the corn earworm were common on tobacco and other crops. In the fall, some of them bore large numbers of white macrotype eggs deposited by tachinid flies. The tachinids were potential control agents, but had been neglected because their build up coincided with the start of university classes, and identifications were challenging. I decided to study them.

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Figure 4. Larva of the tobacco budworm, a common host of the tachinid parasitoids that were studied. Length about 3 cm. (Whitney Cranshaw, Colorado State University / © Bugwood.org.)

A rearing facility on campus maintained large numbers of these moths on artificial diet, and an experimental farm some distance away supplied fields of tobacco managed in such a way that they would support caterpillar populations throughout the season (by allowing plants to flower after topping them at a different time for each field). Such infrastructures are important for many kinds of research. Here they provided a reliable research site, a supply of host larvae for experiments, and a means to rear larvae after collection.

I spent many hours sampling larvae in these and other fields, collecting them into individual diet cups to prevent large larvae from cannibalizing others. It was a pleasant chore to take samples from tall tobacco plants with flowers occasionally visited by hummingbirds. Nevertheless, attention had to be paid not only to ensure careful sampling and recording, but also because a large larva can deliver a painful bite near the fingernail, a shock that might cause a valuable sample to be inadvertently flung away!

Host caterpillars were sampled throughout the season. A taxonomic study of tachinid eggs demonstrated that nearly all of the eggs attached to these hosts belonged to a single tachinid species. When many hosts bore eggs, large numbers were reared at different temperatures. Daily

microscopic examinations monitored the development and mortality of hosts and parasitoids, after the size and instar of each caterpillar and the position of each tachinid egg had been recorded. The university offset all of this work the following weekend by shutting down the electrical supply without notice (apparently for maintenance), disabling the temperature-controlled cabinets for more than 2 days, and making any future data on development useless. Some insects had completed a few stages of development at the highest temperature, but not in cooler conditions. I went back into the field for another time-consuming collection of larvae, and set up replacement experiments. Two weekends later, the university shut down the power yet again without notice. Still more cultures were set up, although by then few larvae were available in the field. Reviewers of the manuscript from this work must have thought poorly of the resulting erratic and somewhat limited sample sizes, and I was tempted to provide an explanation (including pointed commentary!), but decided that it would not be appropriate for publication. Such human disruptions of research are not uncommon, and the insects too may be unpredictable, reinforcing the lesson that wise researchers do not guarantee results in advance.

Adult tachinids (Figure 5) were fully active only in bright sunshine. An unusually long, but totally artificial, longevity could be documented for females kept in dull light. Substantial numbers of the eggs they deposit are unsuccessful. Eggs that do not hatch before a caterpillar moults are shed, removing most eggs except on the long-lasting final instar. As the eggs hatch and maggots begin to penetrate the host cuticle, caterpillars turn their heads and bite, destroying many parasitoids. The same response may defend against other attackers, including collectors (see above).

Insektarium.net

Figure 5. Adult tachinid of the genus *Winthemia*, similar to the species studied. Length about 0.8 cm.

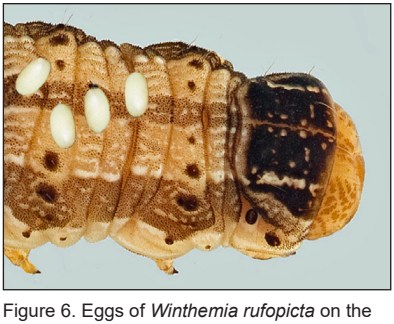

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Figure 6. Eggs of *Winthemia rufopicta* on the anterior segments of a fully grown larva of the corn earworm. Egg length about 0.9 mm.

Many eggs are deposited where the caterpillar cannot reach them, the top of the body behind the head (Figure 6). My observations of ovipositing females suggested that this placement is keyed by caterpillar movement, and a smaller peak at the back shows where flies have targeted the wrong end. A fly deposits several eggs on a large host, and flies do not appear to discriminate against previously parasitized hosts. Therefore, many eggs can be found on a single caterpillar.

A Malaise trap (Figure 7) monitored the seasonal activity of adult flies and potential hosts. Few hosts of this polyphagous species were accessible in the spring, but suitable hosts built up through the season. However, the spectacular loads of tachinid eggs in the fall occurred only where emergence of another generation of flies in the same field was accompanied by a decline in accessible caterpillars as many entered the ground to pupate, and in fact the tachinid was not especially abundant. Evidently, as for many other potential biological control agents, parasitoid abundance is governed by host populations, not the other way round. Moreover, these temporal and spatial interactions mean that the relative numbers of hosts and parasitoids in a given field can change rapidly. Therefore, spot records of percentage

Figure 7. The Malaise trap referred to here, near a crop field (not yet planted) in North Carolina early in 1973.

parasitism, the statistic customarily compiled by agricultural agents, are potentially meaningless.

These and other detailed findings confirmed a general lesson from my previous research projects: wide-ranging analysis of the life cycles of individual species gives valuable information not discovered by less thorough approaches.

Although research avenues were familiar to me, environmental and cultural settings were not. The weather in Raleigh includes summer storms, torrential downpours, and extreme heat and humidity, responsible for the failed class experiment with aphids on tobacco. I might have achieved much less without the almost universal air-conditioning (and the serviceman who worked on ours). Comparable heat and humidity occur in the Florida Everglades, where we camped one year. Illustrations of early explorers there show them dressed from head to toe in heavy fabric despite the conditions, and we soon understood why as the resident mosquitoes gave us their undivided attention.

A tornado once passed through the experimental site. Small wire-mesh emergence cages, set up to reveal when tachinid adults would emerge from overwintered caterpillars, were torn out of the ground and carried off. I found only a few of the missing cages — up to half a kilometre away. Scattered replicates remained intact. These peculiar numbers echoed the developmental data ruined by power interruptions, and reviewers of a subsequent manuscript must have been similarly unimpressed.

The same tornado mangled the Malaise trap, creating a gap in data. The collecting head on that trap was a killing bottle. If there is no killing agent, captured insects, especially blundering beetles, move around destroying taxonomic characters as they scrape off the wing-scales of moths and break off the setae of tachinids. Those taxa are difficult to identify too if they have been immersed, so that ethanol is not a suitable killing agent. Care was needed to recover the remains of the killing bottle, pulverized beneath the wreckage of the Malaise trap, because it had been charged with cyanide.

Although summers were almost subtropical, some winter days were cold enough for snow. However, heavy snowfalls were infrequent, so that there was no local equipment to clear the roads. If more than a small amount of snow fell, some owners might simply abandon their cars on the travelled part of the roadway, returning to retrieve them when the snow had melted. After one light snowfall, we were trapped behind a vehicle stuck on a slight incline. We tried to help the

driver multiple times by pushing her large American car, but she offset our efforts by constantly turning the steering wheel and spinning the tires despite advice to the contrary. Eventually, with a young child getting cold in our own car, she was told abruptly to get out and let me drive! Stunned by the order, she complied, allowing the vehicle to be eased up the slope and on to a level section, from which she was able — apparently still stunned — to drive away.

This approach to interpersonal relationships was not the normal one in North Carolina. The mode of speech was unfamiliar to me too. For example, some people might respond to my attempt to set up a meeting with a slow and elaborate, but inconclusive, reply: "Well... now... Hugh. ... Let us consult... our schedules, ... to see... whether or not... we can find… a time… that we could arrange…". I resisted the temptation to finish those colleagues' sentences — most of the time.

Another newly arrived visitor to North Carolina left a shop and heard "Y'all come back and see us, y'hear", the typical local farewell. The staff were confused when the visitor, unfamiliar with that expression, walked back in and said "Yes?"

Soon after my own arrival in Raleigh, an African-American lady approached me from the nearby aisle of a department store. "'Scuse me, sah", she said, "c'ny' tah-attaah". Luckily, before the number of requests to repeat what she had said could become embarrassing, her young son walked up carrying a necktie, and I realized that she must have wanted to see if it suited him and had asked me "Can you tie a tie?" Apart from the language barrier, she had chosen the correct customer to ask: my school uniform in England had included a tie — all day, every day. Certainly I could tie a tie!

I enjoyed my time in North Carolina, but was happy to return to Canada in 1974. Strict United States tax requirements had to be met before temporary residents were allowed to depart. Canadian immigration requirements were complicated too, because we arrived with two children born in the United States. Those matters contributed to considerable delays, and we entered Canada only minutes before our American visas expired (when we would have become "illegal aliens").

Crossing the border reminded me of the very different Canadian climate that I knew so well from earlier research, especially in the winter. Indeed, the subject of snow had come up during one coffee break in Raleigh, when I mentioned that snowplows in Ontario are identified by flashing blue warning lights (Figure 8). In a state where police cars have conspicuous blue roof lights (Figure 9), this information led to the drawled response from a departmental technician: "Well, … if a flashing blue light is chasing you round here, … it ain't a snowplow".

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Figure 8. Ontario snowplow, showing the blue warning light.

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Figure 9. North Carolina police car, showing the blue roof lights.