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MIGRATIONS OF THE AMERICAN MOTH, *Urania fulgens*

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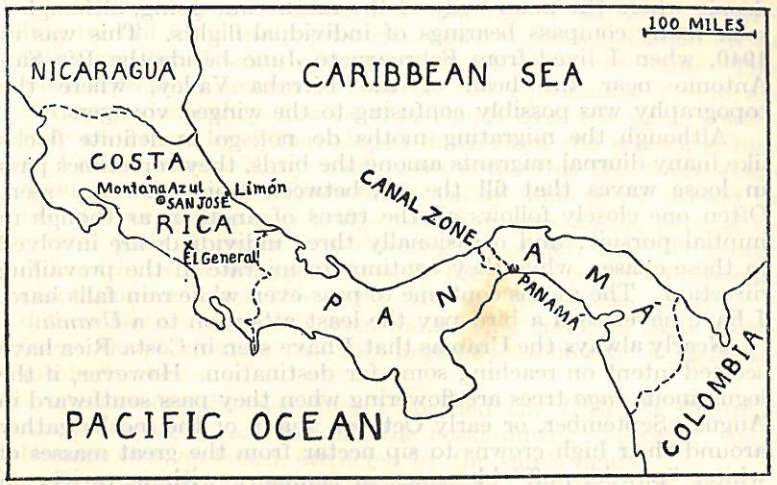
One of the most beautiful of the tropical American moths is *Urania fulgens,* which at first sight I took to be a butterfly, as it is active by day and is about the size and shape of a large Papilio, with long, attenuate "tails" on its hindwings. The upper surface of all the wings is black, adorned with bands and spots of glittering metallic green. I first became aware of this extraordinary moth at Montaña Azul, where I dwelt for a year, collecting plants and studying birds, on the narrow back of a ridge that ran north and south, jutting out from the flank of Costa Rica's cordillera Central toward the northern lowlands. The crest of this ridge was in pasture, while forest covered its sides that fell away into deep ravines, through one of which (that to the east) flowed the Río Sarapiquí, a tributary of the Río San Juan that separates Costa Rica from Nicaragua. In April and May 1938 moth after moth passed northward along this ridge all day long. Their flight was strong, rapid, and direct, with only a slight waver. Some travelled low over the grass, others above the tops of the tall, scattered trees. Doubtless when they reached the unbroken forest down the mountain-side they flew above its roof, for neither here nor elsewhere have I seen these moths traversing dense woods.

About the first of June, I began to notice a significant number of these moths travelling southward up the ridge, towards the continental divide; and soon the great majority were headed in this direction. A small minority still flew northward, against the main stream of traffic, while a few aberrant individuals went in other directions. I never saw any pause to rest or feed. This southward stream of moths continued into August, thinning out toward the end of the month.

Observations continued over a quarter of a century, in various parts of Costa Rica, have convinced me that, like the Monarch Butterfly (*Anosia plexippus*) in North America and many kinds of birds, *Urania fulgens* performs two-way migrations, northward early in the year, southward later. The time of these movements varies somewhat from year to year. In the Valley of El General (at the head of the Río Térraba drainage system on the Pacific side of southern Costa Rica, where I have long resided and made most of my observations) the vanguard of the northbound voyagers might appear in March or even February, and in 1959 the northward flight came chiefly from early January until mid-February However, April and May were the months in which the largest and most sustained northward movements occurred, and sometimes they continued well into June or even early July. Usually, however, the majority of the moths were flying southward by June. Through July and much of August they continued

to pass, and exceptionally the migration lasted into October. In 1944, I noticed a few Uranias in El General in December, but this was most unusual. In some years, the northward or the southward flight failed to appear, perhaps because the moths were taking other routes.



These migratory movements of *Urania fulgens* have been recorded as far north as the state of Veracruz in eastern México. In Costa Rica the flights were country-wide: I have watched them on both the Pacific and the Caribbean slopes, and in the central plateau. Others have seen the moths passing high up on the volcanoes. In El General, the lay of the Cordillera de Talamanca, the coastal range, and the intervening valley, diverted many of the travellers from a straight north-south course. In spring, the northbound moths passed in various directions between north and west: if those going due north did not change their course, they would have passed over the high summits of the Cordillera. Correspondingly, the southbound travellers later in the year might be seen flying in any direction from south to east: a continued southerly course would have taken them over the coastal range into the Pacific Ocean. Day-flying migrants among the birds—swallows, Eastern Kingbirds, Swainson's Hawks and Broad-winged Hawks—likewise deviate from the north-south line as they pass through this region, flying between north and west to reach México and the United States in spring, between south and east as they return to South America in the fall.

The density of these flights of moths varied greatly from day to day and from year to year. Sometimes, even in the middle of the migratory season, one saw only a few moths pass in a day. At the other extreme, one August, in the pasture behind our house, I counted a hundred passing overhead in three minutes. Usually,

if one watched long enough, he would notice a few of the moths diverging from the main stream, some going in random directions and others exactly contrary to the majority. It was hardly possible to follow these erratic individuals to learn whether they later corrected their course. But only in one year was I unable to decide where the main body of the moths was going, although I took many compass bearings of individual flights. This was in 1940, when I lived from February to June beside the Río San Antonio near the head of the Térraba Valley, where the topography was possibly confusing to the winged voyagers.

Although the migrating moths do not go in definite flocks like many diurnal migrants among the birds, they sometimes pass in loose waves that fill the air, between which few are seen. Often one closely follows all the turns of another, as though in nuptial pursuit; and occasionally three individuals are involved in these chases, while they continue to migrate in the prevailing direction. The moths continue to pass even while rain falls hard. I have never seen a bird pay the least attention to a *Urania*.

Nearly always the Uranias that I have seen in Costa Rica have seemed intent on reaching some far destination. However, if the leguminous *Inga* trees are flowering when they pass southward in August, September, or early October, many of the moths gather around their high crowns to sip nectar from the great masses of white, "powder-puff" blossoms, in company with a variety of butterflies and hummingbirds. How the metallic golden-green of their sable wings glitters in the morning sunshine! At the height of the migration in September, 1969, I found many Uranias fluttering over the Inga trees in the half-light of the dawn, about the time the bats disappeared. This observation, repeated on several mornings, suggested that the moths had slept nearby; but I never could discover how they pass the night. All day hundreds of Uranias continued to visit the Ingas, passing eastward from tree to tree of a coffee plantation shaded by them, finally leaving from the eastern end of the grove. As the flowers wilted, or their supply of nectar ran short, after the middle of the afternoon, the moths gradually deserted them. Their departure from the Ingas at this time probably explains why, on some afternoons, I noticed unusually heavy eastward flights between three and four o'clock.

While so many Uranias were visiting the *Inga* flowers, a few settled on the tiny, yellowish florets of a lauraceous tree (*Ocotea* sp.) that was blooming profusely at the edge of the coffee plantation. But I never noticed a single one on several native candelillo trees (*Cassia spectabilis*) that at the same time displayed great masses of yellow flowers, nor on the red trumpets that made neighbouring flame-of-the-forest or African tulip trees (*Spathodea campanulata*) conspicuous from afar. During the northward migration in spring, I have seen Uranias gather around the white bloom of the copalchí (*Croton glabellus*), a tree of the euphorbia family, but on no other kind of flowers.

Rarely they settle on wet mud.

I was impressed with the magnitude and extent of Urania's migrations when I travelled from Costa Rica to South America in 1940. On July 25, I noticed a substantial increase in the number of these moths, which since early in the month I had seen flying southward above the streets and buildings of San José. Travelling by rail from the capital city down to Puerto Limón on the following day, I saw countless moths all along the route. They were especially numerous between the continental divide and Cartago, where they flew in thin clouds over the open fields, a mile above sea level, that sloped down from the sprawling mass of Volcán Irazú. Many more were noticed as the train wound down the spectacular Reventazón Valley; and as we crossed the broad river on the iron bridge near Siquirres, at the edge of the coastal plain, Uranias were crossing the water, too. They were still with us as we sped through the level cacao and banana plantations toward the port. As far as it was possible to determine their direction from the moving train, all these moths, from the highlands to the lowlands, followed a generally southerly course.

At Limón, that evening, I boarded the *Ulga* for Cristóbal. As we voyaged eastward off the coast during the night, many Uranias flew on board, attracted by the ship's lights.

Throughout the twelve days that I spent on the Isthmus of Panamá, the great migration of moths continued undiminished. The broad stream of them covered the whole forty-mile stretch of land from the Caribbean to the Pacific; but they were particularly numerous on the Pacific side, as though massed together here by the prevailing winds or the northward curvature of the Isthmus. From the roof of my hotel I watched multitudes of them fly over the city of Panamá. All along the highway from the city to Summit, in the middle of the Isthmus, they were passing; and many were struck lifeless by speeding cars. They were especially noticeable over the Canal itself, sometimes in open clouds, sometimes as scattered individuals. Here above the water, where there were no obstacles to deflect them from their course, I took their directions with a compass. The great majority were flying north-northeast, with some veering more to the northeast, others inclining more towards the north; but all were crossing the Canal from the North American to the South American side. Evidently the southbound moths that I had watched in Costa Rica had altered their course to follow the curvature of the continent and reach South America, instead of losing themselves in the Pacific Ocean, as would have happened if they had continued undeviatingly southward.

On the evening of August 8, in the channel opposite Balboa, I boarded the *Santa Lucia*, to proceed down the west coast of South America. As the ship glided out of the mouth of the Canal in the failing light, a continuous swarm of the moths flew past, always crossing the water from North to South America. They

seemed not to notice the ship, whose high vertical side blocked their passage like a long and lofty wall, until they nearly collided with it, when they fluttered up and over the barrier and continued onward toward the northeast. They were still flying past when we entered the open water of the Gulf of Panamá, and many came aboard during the night. Next morning, the wire screens over the intakes of the ship's ventilators were covered with their crushed bodies and bright shattered wings. Many more lay dying upon the decks, where they readily fell into the hands of children delighted by their beauty. The trade winds blowing across the Isthmus must have carried many out to sea, to perish in the water.

Although in the coastal waters of both the Caribbean and the Pacific many Uranias flew aboard the ship in the night, apparently they continued to travel in the dark only because nightfall found them over the sea. Watching from the roof of the hotel in Panamá City, I saw them continue to fly past until daylight waned, when their numbers gradually diminished. In the early part of the night, I noticed none in flight, although the lights of the city below me would doubtless have revealed them if they had continued their passage. Early next morning, they were flying again. In Costa Rica, I have failed to see them pass in the moonlight.

In days spent at Buenaventura and Guayaquil on the southward voyage, I saw no Urania. From Lima we crossed the Andes to the forests of the Amazonian basin, where I made the acquaintance of *Urania leilus*, a species slightly larger than its northern congener, and even more beautiful because of the greater amount of golden-green on its dark wings. At the end of August, these moths were not migrating but flitting along the roadway and among the vegetation.

I next met the familiar *fulgens* in late November, when we ascended the beautiful Río Esmeraldas in northwestern Ecuador, in a dugout canoe laboriously poled against the swift current. Here the moths were not migrating, but flitting among the luxuriant vegetation on the shores, resting on moist sand, or flying across the broad channel, as often in one direction as in the other. Their behaviour here contrasted sharply with the purposeful journeying that I had always noticed in Central America. Many had frayed wings, as though they had come from afar. In this lovely land they seemed to have reached their journey's end and to be enjoying a well-earned rest. Indeed, they could hardly have gone much further without changing their habitat, for here they were in a verdant cul-de-sac, with the widest of oceans on the west, bleak Andean summits on the east, and to the south the increasingly arid Pacific littoral, I wondered whether any of the Uranias that I saw here were the same that I had earlier seen migrating through Costa Rica or Panamá. It does not seem impossible that some had come from México, for the Monarch Butterfly has been proved by marking to travel

from Canada to México, a distance about equal to that from México to Ecuador.

In the last few years, I saw so few Uranias that I concluded that they were vanishing along with the forests, the destruction of which has been proceeding at an accelerated pace throughout tropical America. But from mid-August to early October of the present year (1969) they passed eastward and southward through El General in greater numbers than I had seen for a long while.