FROM THE BRITISH MOTH TO THE AMAZONIAN BUTTERFLY

Researchers from the Universidad del Rosario were part of an international team that announced in the prestigious journal Nature that it had found a gene shared by two species on different continents.

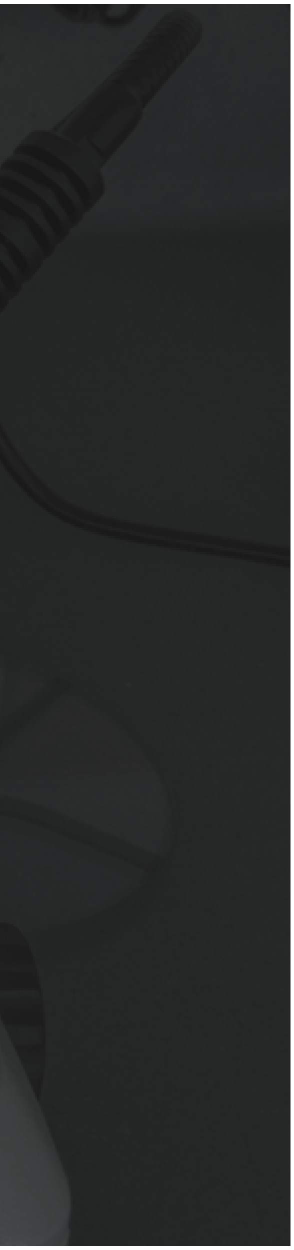
"Famous peppered moth's dark secret revealed," was the headline on the BBC World Service.

"Two of the most famous examples of evolution have the same simple explanation," read the Washington Post headline in the United States.

Both these media, along with several others, used similar terms to get out this news in June 2016, after the journal Nature published an important finding by scientists from several of the world's universities, among them the Universidad del Rosario, that a gene called cortex was responsible for the striking colors of the Heliconius, a tropical butterfly found in the Andes and Amazonia, and also the black of British moths.

The importance of the finding was that the characteristics of the butterflies (their brilliant colors) and the moths (the

By Ángela Constanza Jerez / **Photos by** Leonardo Parra



BEFORE THE INDUSTRIAL REVOLUTION, THESE MOTHS WERE WHITE WITH BLACK MARKINGS. THEN THE BIRCH TREES WHERE THEY LIVED DARKENED DUE TO A COATING OF SOOT. THE MOTHS BECAME EASY PREY FOR PREDATORS BECAUSE THEY COULD NO LONGER CAMOUFLAGE THEMSELVES, SO THEY TURNED COMPLETELY BLACK

color black), two of the best-known examples of natural selection proposed by Charles Darwin in the 19th century and taught to biology students, were caused by the same gene acting in different ways in the two insect species, and that these physically distant but related species shared a behavioral pattern.

"We were surprised to discover that cortex is the gene responsible for producing those colors, since its original function is to control cellular division. We don't know how it is controlling the generation of color, and we want to find out," explained Camilo Salazar, professor at the Universidad del Rosario and expert in evolutionary genetics.

↑ The cortex gene allowed tropical butterflies to take on bright colors that attract mates and alert predators to their toxicity.

The Universidad del Rosario participated in one of the two teams that worked in parallel but independently from each other to study the moths and the butterflies until they found what they had in common.

FROM WHITE TO BLACK

On the one hand, there was a team of researchers from the University of Liverpool in England, who studied the British moths for four years trying to identify the genes that allowed these insects to adapt to new conditions in order to survive.

Before the Industrial Revolution, peppered moths were white, speckled with black, but they subsequently turned completely black. The tree bark that was their habitat had turned dark due to soot adhering to it, making it impossible

→ "Continuing this research will allow us to clarify the molecular and functional details of how the cortex gene works in order to understand the evolutionary origin of these biological adaptations, not only in insects but also in human beings," says researcher Mauricio Linares, Dean of the Faculty of Natural Sciences and Mathematics.

→ Carolina Pardo, professor at the Universidad del Rosario, is part of the team that is studying the application of natural selection in the specific case of South American butterflies.

for the light-colored moths to camouflage themselves, and making them easy prey for predators.

"Thus, the so-called carbonaria (black) moths, which could better camouflage themselves, became more abundant. This is an example of natural selection, where the organism that survives is that which is better equipped to face changing environmental conditions," explains Carolina Pardo, principal professor at El Rosario and expert in evolutionary genetics.

Pardo participated in the consortium, on the team that studied the application of natural selection in the specific case of the South American butterflies. The consortium included scientists from Cambridge, Sheffield, and York Universities in the United Kingdom; Harvard University in the United States; the National Museum of Natural History in France; the Smithsonian Institute for Tropical Research in Panama; the University of Adelaide, in Australia, and the Department of Biology of the Faculty of Natural Sciences and Mathematics of the Universidad del Rosario in Colombia.

"This team discovered that the cortex gene, as opposed to how it worked in the moths, had enabled the butterflies to take on bright colors to attract mates and warn predators of their toxicity," explains Mauricio Linares, Dean of the Faculty of Natural Sciences and Mathematics at the Universiad del Rosario and director of the research group on Evolutionary Genetics, Phylogeography, and Ecology of Neotropical Biodiversity, in which Pardo and Salazar both participate.

He adds that the two projects provided evidence that despite having been separated from a common ancestor 100 million years ago, the moths and butterflies use the same genetic region to adapt in different fashions to their environments in order to survive.

ANOTHER FINDING SURPRISED THE RESEARCHERS IN BOTH TEAMS. WHILE THE CORTEX ENABLED THE ADAPTATION OF THE BUTTERFLIES MILLIONS OF YEARS AGO, IN THE CASE OF THE BRITISH MOTHS IT DID SO ONLY 200 YEARS BACK

EVOLUTION OVER HUNDREDS, NOT MILLIONS OF YEARS

Another finding surprised the researchers in both teams. While the cortex gene enabled the adaptation of the butterflies millions of years ago, in the case of the British moths it did so only 200 years back. According to scientists at the University of Liverpool, the change took place in 1819. Fur-

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"We were surprised to discover that the cortex is the gene responsible for the bright colors of the butterflies," said Camilo Salazar, expert in evolutionary genetics.

thermore, as British media pointed out, white moths with black markings are increasing in frequency today, since pollution, and the soot it left on trees, has decreased.

"This shows us that evolutionary changes can occur over very short periods of time. We don't necessarily have to wait thousands or millions of years to see them. It is also evidence that many environmental changes generated by humans can affect nature," adds Salazar.

The Dean of the Faculty of Natural Sciences and Mathematics underlines that having found that the same gene is used in different ways by different organisms to adapt to such dissimilar ecological environments may teach us an evolutionary principle.

"It may take a long time, often millions of years, for evolution to generate biological molecules that perform certain complex functions. But once evolution 'nails' a useful and successful molecular structure, it is easier to slightly modify the gene that produces it so that it will perform new functions and allow new adaptations to begin, rather than wait millions of years for the appearance of another molecule that will perform a similar function," explains Linares.

For this reason, he affirms that is very important to continue this research. "It gives us the opportunity to clarify the molecular and functional details of how the cortex gene works, and helps us understand the evolutionary origin of these biological adaptations, not only in insects but also in human beings, since very similar functional and regulatory mechanisms may be behind many of the biological marvels that characterize us, including many of our adaptive systems and organs," he says.

EXPERIMENTAL STATION AT THE SERVICE OF RESEARCH

The Universidad del Rosario established its Faculty of Natural Sciences and Mathematics in 2008, and in 2013 it decided to establish the José Celestino Mutis Experimental Field Research Station, expected to begin operations in 2017, to continue the study of butterflies and continue to produce new knowledge in the sciences and mathematics, work that was begun at the University in the 18th century by the field station's namesake, scientist José Celestino Mutis.

"The primary goals of this open-air laboratory are to support research on nature and promote the sustainable coexistence of human beings with their environment, to complement undergraduate and postgraduate instruction, and to train new generations of professionals in the programs of the Faculty, i.e. Applied Biology, Applied Mathematics, and Computer Science, with Earth Sciences soon to be added.

Field stations are important for monitoring the interaction of human beings with the natural environment, and they will be the first to inform us about changes to the natural environment on the planet Earth. They are responsible for the key scientific studies on the interaction of humans with the environment in areas such as climate change, loss of biodiversity, invasive species, and decreasing numbers of pollinators.

In Colombia, the José Celestino Mutis Experimental Field Station will be the academic home of innovative research of national importance and transformative global significance in areas such as climate change, environmental resilience, biodiversity, animal behavior, ecological succession, forest restoration, biogeochemical cycles and gas exchange, and the biology of conservation.

At the same time, it will provide field courses for students and researchers from Colombian and international schools, universities, and other institutions, and work to raise the general public's awareness of agricultural and economic development and responsible and sustainable agriculture and livestock farming.

The Field Station will be on 12.5 hectares (about 31 acres) of land located 14 km from La Vega, Cundinamarca, and 12 km from Sasaima on the western slope of the Eastern Ranges (Cordillera Oriental) of the Andes at an altitude of 1,300 meters (4,265 feet). About 80% of this area is covered with forest endemic to the climate in Colombia's coffee-growing zone.