

UABDIVULGA

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Ricard Guerrero



Guerrero has taken part in various scientific projects and is known in Spain as the first person to introduce the theory of microbial ecology. "Without microbes, life on our planet would be impossible", says Guerrero. "From the moment we are born we need bacteria to live".

One of the founders of the UAB and member of the Institut d'Estudis Catalans. Dr Guerrero is a visiting professor for the University of Massachusetts Amherst (USA). He has also been involved with producing the *Gran Enciclopèdia Catalana*, the *Diccionari Enciclopèdic de Medicina*, la *Història dels Països Catalans* and *Biosfera*. He directs the journal *International Microbiology* produced by the Spanish Society for Microbiology.

His research focuses on the structure and form of primitive ecosystems, the production of biodegradable plastics by microorganisms, risk assessment of releasing genetically modified bacteria into the environment, the microbial cycle of sulphur and the study of magnetotactic bacteria. His research has earned him the Narcís Monturiol Medal for merit in science and technology awarded by the Catalan Government (2000).

- You study the structure and function of ecosystems that existed 3.5 billion years ago. What techniques do you use to do this?

- There are various ways. We mainly use microscopic and molecular techniques developed here at the UAB. Using a confocal laser microscope we can observe the different layers of a cell, analyse its lipids and thus determine what types of cells there are, how many there are, and

whether they are alive. With this information we can analyse systems that are the same as what existed in the Archean Era (3,500 million years ago). These systems are called microbial mats, and are very difficult to observe today, unless we travel to very distant locations.

- What are these systems like?

- They are ecosystems in which there are only microorganisms. They actually do the same as today's ecosystems, but they have remained in a very ancient line of evolution, much older than that of plants and animals.

- And what do you do with these ecosystems?

- We are studying their structure and the interaction that takes place so we can explain how life began to evolve.

- Are you saying that the same molecular interaction has been occurring over and over again since the origin of life.

-Yes, ecosystems have essentially remained unchanged; it is their representatives that have changed. It's really like a theatre play. For example, "La Ratonera", by Agatha Christie, has been performed for the past 50 years, and during this time the actors have changed many times, but the play is still the same.

- It sounds like you're saying that we're the result of an ongoing sequence. What do you think is the driving force behind this evolution, and behind life itself?

- Well, we don't know exactly what life is. We could say that life is the property of being able to anticipate and to reproduce. The main objective of life, therefore, is to leave offspring. Life also has another very important characteristic: it reproduces through molecules with nucleic acid (DNA). It is the DNA that determines our hair colour, the fact we are a human being rather than a chimpanzee, the fact we have two arms rather than one, etc. These properties are passed down from one generation to the next, but there are always small changes during this process. These are called mutations.

- And so there are changes to the cast for the theatre play...

- The accumulation of these small changes makes life reproduce and means that life is constantly changing. It is this change in life-form that we call evolution.

- Tell us a little bit about evolution.

- Evolution is a characteristic of life. We could talk about "how people evolve during their lifetime", "how democracy has evolved in Spain", "how the universe has evolved". But I don't think the word is used correctly in those contexts. Evolution is really a mechanism by which living organisms leave many descendents from which the environment selects only those that are best

adapted. This is the Darwinian meaning of evolution, and the evolution Darwin defines in "The Origin of Species", published in 1859.

- But didn't Darwin say everything that needed to be said?

- We know much more today, things that were not known when Darwin was alive. For example, Darwin couldn't use biology like we do today, because he didn't know two essential things about life: how characteristics are passed down from one generation to the next -what we now call the cell theory- and how this reproduction takes place, that is, the role of the egg cell and the sperm cells in selecting only some characteristics, which today we know are contained in the chromosomes. But not all offspring have the same chromosomes. This is why we can have a son who is taller, more susceptible to illness and with different coloured eyes to his brother. Nature then chooses which is most appropriate...

- And which is most "appropriate" for nature?

- Nature always chooses one way or another. For example, if a fly without wings (drosophila) appears among the main population, it has much less chance of reproducing than a fly with big wings, so it will disappear. But on a windy island, flies that crawl along the ground, rather than flying, are more likely to reproduce than flies with big wings, therefore the flies with wings will disappear. The environment is essential. Another example. Animals tend to increase in size because this makes it harder for predators to attack them. But in Mallorca, the environment has selected a smaller type of goat because there are no predators.

- There is no advantage in being bigger, but what are the advantages of being smaller?

- Well, if they are smaller they don't need to eat as much, so they don't incorporate as much biomass. A large animal must eat a lot to maintain its balance. For example, humans must eat ten times our body weight a year. So, if I weigh 80 kilos, I must eat 800 kilos of food a year to meet my energy needs.

- Does that mean the environment doesn't always select the fittest?

- It is a mistake to think that Darwin said that the fittest survive. "Survival of the fittest" does not represent Darwin's theory at all, since he talked about survival of the better "adapted", not survival of the fittest. The problem is that Darwin was misunderstood, mainly because the British used him to support their imperialistic ideas. Darwin was a Victorian, and thought like a Victorian. This is why he never talked about symbiosis or cooperation, but rather about strength and destruction.

- You talk about a new paradigm. What is this paradigm?

- The paradigm of microbes. We have changed the way we consider microbes. Before, they were the pathogenic organisms constantly fighting with the organism. Now it is an interaction, and sometimes one wins, sometimes the other wins. Secondly, we are observing changes in bacteria that are not only sequential, but also a horizontal acquisition of genes. This implies supposing that the big evolutionary phenomena need complete genes to interact, and this is known as

symbiosis. For example, I will explain how an aphid could not exist without certain bacteria, and how these bacteria could not exist without other bacteria.

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