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What Darwin's theories tell us about the shape alien life will take

All aliens must evolve, says a new study from scientists at the University of Oxford – and that gives us something to look for

Scientists are suggesting what ET might really look like. Photograph: Courtesy Everett Collection/REX

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"It's life, Jim, but not as we know it." How many times did we hear Mr Spock say this back in the day when classic Star Trek ruled the airwaves?* What always interested me back then was how did he know that it was life if it was so barely recognisable by Earthly (or Vulcan) standards?

Turns out a group of scientists from the zoology department at the University of Oxford may have the answer. Don't look for faces, eyes, limbs or any of the large-scale things that are so

familiar to life on Earth. Don't look at the chemistry either. Instead, look for the hallmarks of natural selection.

Natural selection lies at the very heart of Charles Darwin's theory of evolution. It is the process by which favourable adaptations are retained and accumulate in populations. As time goes by, lifeforms adapt to be more and more suited to their individual environments.

This leads to the appearance that they have been designed to fit into their surroundings. However, there is no magic involved, the favourable adaptations allow these entities to live longer and have more offspring, so naturally the fittest rise to dominate the population.

Natural selection extends down to the level of individual cells where environmental hardship can force cells to work together for their common survival, thus building complex cells, multicellular life, animals and then social structures.

It is this complexity and cooperation is what we should look for says Samuel Levin and co-authors to recognise aliens - not little green men or very big teeth (well, not necessarily anyway). By doing this we could also sidestep the thorny problem of defining what life actually is.

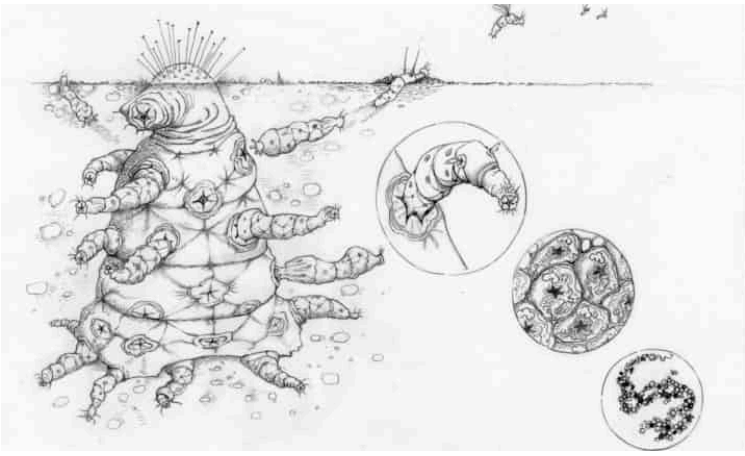
There have been many attempts to define life over the years, and all of them run into trouble at some point. Take, for example, the idea that life's defining characteristic is that it must be able to reproduce. Well, a flame reproduces but can hardly be said to be alive. Then there are the mules: creatures that are usually sterile but are clearly alive.

Chemical definitions such as 'life must be based on carbon and contain DNA' are no better because they are completely unfounded. We simply do not know whether other chemicals can build replicating molecules like DNA. Silicon shares some of carbon's characteristics, so may be ok under the right conditions (whatever those are!).

The authors sidestep all of this and zero in on the rise of complexity and cooperation as the thing to look for. They write:

In particular, the evolution of complex life on the Earth appears to have depended upon a small number of what have been termed major evolutionary transitions in individuality. In each transition, a group of individuals that could previously replicate independently cooperate to form a new, more complex life form or higher level organism.

That includes us. We are collectives of cells all working together. Our individual cells are themselves collectives containing smaller sub-units like the nucleus and energy-giving mitochondria. It's like Russian dolls all the way down to the molecular level. These changes were driven by natural selection because they allowed once competing entities to work together for a common good.



The Octomite - an example of a complex alien that has undergone natural selection and so is composed of many different parts. Photograph: University of Oxford

The authors suggest 'the Octomite' not as a lifeforms we might expect to find but as an illustrative example of what to look for. Namely, a hierarchy of once separate entities that now function together for the common goal of survival.

This is the most interesting part of the paper: the call to jettison our attempts at defining life and just recognise it by something that it uniquely does, which is evolve.

It reminds me of Isaac Newton's response to queries about the meaning of his mathematical law of gravity in 1687. When asked how the gravity gets from one celestial object to another, he said it didn't matter how it happened, all that mattered was that it did and his equation gave the right answer.

In other words, we should concentrate on way life does not what it is, and draw our insights from what things do, not how they might do it. As Mr Spock might be driven to say 'Science Jim, but not as we know it." That's not meant to denigrate the work at all. Indeed, as I read the paper, another of Spock's great catchphrases kept jumping to my mind: "Fascinating."

**The answer is none at all in the literal sense. It's a line from the song Star Trekkin but Spock does say similar things on a number of occasions.*

*Stuart Clark is the author of The Search for Earth's Twin (Quercus) and can't quite believe he actually linked to **that** song.*

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