WEEK 1 AN ABUNDANCE OF BACTERIA: INTERVIEW WITH A MICROBIOLOGIST

ACT – Anusuya Chinsamy-Turan
ER – Ed Rybicki

ACT It is a real pleasure for me to have with us today Ed Rybicki, who is a microbiologist based in the Department of Molecular and Cell Biology. Today, we will talk about microbes and the fascinating world which they've created for us.

ER Thanks for having me.

ACT So one of the things that I've really been fascinated about is the fact that, you know, we look at this rich biodiversity on our planet today but we have to realize that it actually started 3.8 billion years ago and I'm reminded of Charles Darwin's very famous quote at the end of his Origin of Species when he says "from so simple a beginning endless forms have and are still being evolved."

ER And have been continuously in one stream from then. So everything we have right now is the same age and it all started about 3.8 billion years ago.

ACT Exactly. Why do you think it is that microbes have been so successful for all this time because they still are successful.

ER Well they were around at the start. They are the origin of life. The origin of life itself is something that looked quite a lot like a bacterium. What we have now is 3.8 billion years worth of very sophisticated organism. They look simple and people think they're primitive but they're not. They're extraordinarily sophisticated because they've got rid of a lot of the stuff that other organisms have. Like we, more than half

of our genome doesn't look like it does anything. Bacteria have stripped it down. For example bacteria and archaea, which are two completely different classes of organisms, have stripped things down so that, in fact, they are simple but they're very sophisticated. That's how they managed to actually cope with all of the environments on this planet.

ACT So highly adaptable, I mean we know they can live on mountain-tops and in deep ocean vents, I mean they're really incredibly adaptable.

ER It's even better than that, they can live in the stratosphere. They can live kilometres down underneath the ocean floor.

ACT Goodness, that's amazing, that's really quite something. So, you know, when we think about - again - the simple organisms we know that somewhere along the line we had the development of organelles within cells and I'm sure you're an expert on Lynn Margulis' work and about her idea about how this came to be.

ER What's quite strange is people still think that what Margulis said is a theory. It's established fact. What happened is that, at some point, two or more billion years ago a bacterium ended up inside an archaea and that may have been the origin of the nucleus but even if it wasn't, if the two lines had separated sufficiently a bacterium that produced energy ended up inside another archaeal cell. They're not bacteria they are archaea and gave it an energy source that otherwise it didn't have and allowed it to become more complex. That was the origin of all eukaryotes.

ACT Yes

ER And Eukaryotes obviously all animals and all plants but after that you had a photosynthetic bacterium ended up inside another one of these organisms that has provided not once but several times the origin of photosynthesis in eukaryotes. The one event that we see all around us is green plants. That's one kind of alga that got inside a eukaryote. All of the other kinds, there are several different origins for chloroplasts.

ACT So but the cyanobacteria are the beginning of this photosynthetic group of organisms, and we know that when they evolved there was such an important step in the evolution of life on Earth and maybe you can tell us why.

ER They call it the great oxidation event so if you go and look at rocks you'll notice that, if you go back through time, at one point there was no oxygen freely available and after a certain time there began to be and then it proceeded to explode, literally. That was the development of cyanobacteria and their ancestors, because what we see now are the descendants of the original bacteria. It was a useful way to harvest energy, you had the sun blazing down giving you free energy. They managed to start tapping into that. That gave them an enormous evolutionary advantage over literally everything else. The same time it provided enormous biomass for everything else. In fact, bacteria have engineered our planet in tems of geomorphology. A lot of rocks depend on the fact that there were bacteria around.

ACT But also oxygen in the environment because that was one of the most important steps is the oxidation of the atmosphere which gave other organisms an opportunity to develop as well so very very important. So, you know, one of the very well-known evolutionary biologists Stephen Jay Gould has said that today we live in the age of bacteria. Do you agree with that statement?

ER I think he should have said we have always lived in the age of bacteria and we always will.

ACT And why do you say that?

ER Because they're essential. You carry around a kilogram and a half of bacteria inside you.

ACT Exactly and on my skin. Exactly, there's more bacteria on me than my own body cells, is that correct?

ER No, it's about even. It's about one to one, but if you didn't have them you wouldn't be making vitamin B, for example. They break down a lot of different things

in your gut that otherwise would just pass through unchanged. So you're benefiting from it, they're benefiting from it, so we have a mutual symbiosis with a very, very wide array of bacteria and so does every single other animal that's got an alimentary canal on this planet.

ACT That's really interesting. I think it's important for us to realize that bacteria are not just things that cause plague and that cause diseases and you know there is lots of benefit that they also give us as well, so.

ER We humans are selfish. We tend to study what makes us sick or what benefits us and that is a tiny, tiny fraction of the entire world of bacteria. And if you are, if you've been reading Nature News recently for example you realize that the speculation that there is life on - in oceans - on other planets in the solar system and moons especially so Europa Enceladus, possibly even Titan, have got enough liquid water inside them that could sustain, given the same kind of origins that life on Earth came from which is deep ocean vents, probably, then you very possibly have earlier development of life there because these places were cooler than the Earth at the same time. So we may well have been colonized by them.

ACT Well I know the idea about, you know, the development of life from out outer space or Panspermia hypothesis it's very, very well-known hypothesis and I was thrilled recently to visit the Adelaide museum and see the Murchison meteorite the one that actually had so many amino acids on it. It was just, it was like, you know to go and pay homage to this little rock that came from outer space, it was wonderful. But, thank you very much for joining us today, it's been fascinating to talk about microbes. I think we've all learned so much and I think it opened our minds to the wonderful world of microbes. Thank you.

ER Excellent, thank you.