Nylon-eating bacteria

Royal Truman's detailed introduction to the subject of whether or not nylon-eating bacteria demonstrate macroevolution in issue 29(1) is a welcome contribution, interesting, and insightful. It adds important weight to the argument that evolution hinders rather than helps scientific understanding.

I suggest we be skeptical whenever anyone claims that some man-made chemical is 'unnatural' and that microbes have never been exposed to it before. It may be true, but the number of organic substances produced by living organisms seems at present to be endless—the more we look the more we find. And all of them can be degraded by microbes of various kinds, otherwise they would build up into commercially exploitable deposits. Peat bogs, for example, are commercially exploitable biological deposits, but they are not the result of microbial failure. They result from an imbalance in the rate of production over degradation, usually caused by high water tables and low temperatures.

The following types of chemicals were quoted by Truman as having been dubbed 'unnatural substances' but just some of their naturally occurring sources are easily found with an internet search and are listed here in brackets: *toluene* (pine trees, *Myroxylon balsamum* a leguminous tree); *camphor* (camphor laurel and related trees, rosemary, basil); *salicylate* (willow tree bark, unripe fruits/vegetables, herbs, spices, nuts); *alkanes* (crude oil, plants, animals, fungi, bacteria); and, *naphthalene* (tar pits, magnolia, deer, termites, fungi, meteorites).

Earth's biosphere is built upon three diverse kinds of living organisms—producers, consumers, and recyclers. Ecology is the study of their interactions and the *Journal of Chemical Ecology* has been documenting chemical aspects of these interactions for over 40 years. One notable class of such interactions is the chemical warfare that goes on between producers and consumers. Plants constitute a large component of the 'producer' category and they cannot run away to protect themselves like animal consumers do. So they mount a variety of chemical attacks to limit the damage caused by consumers. In response, consumers must develop strategies to overcome these chemicals and so there is an ongoing 'arms race' consisting of attack and counter-attack. One example is *Leucaena leucocephala*, a leguminous tree native to Central America that was widely planted for stock feed throughout the world because of its rapid growth rate and high nutritive value. In some countries, however, it proved toxic. The problem turned out to be a lack of the naturally occurring gut bacterium *Synergistes jonesii* which broke down the toxic component.[1] By inoculating herds in those countries with cultured *Synergistes jonesii* the problem was solved, although ongoing exposure to *Leucaena* was required to maintain bacterial vigour.[2]

A chemical arms race also occurs in host-parasite relationships. It is sometimes referred to as the *Red Queen effect*, recalling Alice's experience of *Looking Glass* land where the Red Queen says: "Now, *here*, you see, it takes all the running you can do, to keep in the same place."

Apart from the host of organic substances produced by earth's myriad species there is yet another much larger catalogue of organic chemicals in the natural environment—intermediate breakdown products. They are everywhere. The onus of proof is clearly upon evolutionists when it comes to claims that man-made chemicals (or close analogues of them) do not exist in nature.

Another truly new insight into the capabilities of living organisms was recently presented by Andreas Wagner in his book *Arrival of the Fittest: Solving evolution's greatest puzzle*, reviewed in issue 29(1) by John Woodmorappe. Woodmorappe is to be congratulated for translating Wagner's major claims into everyday analogies which demonstrate that he claims far more than he delivers. In fact, the use of analogies is so fundamental to human thought, learning and understanding, that I highly recommend Hofstadter and Sander's book *Surfaces and Essences: Analogy as the fuel and fire of thinking*. But Woodmorappe said in the introduction that he would not be assessing the detail of the book and it is this which is relevant to nylon-eating bacteria. Wagner and his team are experts in network theory and their theoretical breakthroughs are quite breathtaking. He demonstrates, through examples in metabolic networks, gene regulatory networks, and amino acid sequence networks, that although there are more ways of being dead than alive there are still 'hyperastronomical' numbers of innovations that organisms can make just by taking one non-lethal random step at a time.

I will not try to explain or defend the credibility of these claims, but the examples and the principles involved seem to be sound. The upshot is that once such complex networks are in place they are capable of changing in mind-numbingly different ways in very short hops. Especially among bacteria where large numbers of individuals can explore the many dead ends (literally) without serious risk of population extinction, while a still-large number of other individuals with non-lethal small changes can move on to explore multitudinous new futures. Life can do it. It's not hard, apparently. But it should bring little comfort to thoughtful evolutionists because, like natural selection, Wagner's complex network behaviours do not even begin to function until the complex networks are *already in place*.

Meanwhile, the legwork of careful scientific investigation and validation remains to be done, and Truman's contributions are to be most warmly welcomed and encouraged.

Alex Williams
Perth, WA
AUSTRALIA

References

1. *Leucaena leucocephala* factsheet, www.tropicalforages.info/key/Forages/Media/Html/Leucaena_leucocephala.htm, accessed 8 April 2015.
2. Graham, S., Introduction, impact and retention of *Synergistes jonesii* in cattle herds grazing *Leucaena leucocephala*, MPhil Thesis, School of Agriculture and Food Sciences, The University of Queensland, 2010, espace.library.uq.edu.au/view/UQ:226061, acessed 8 April 2015.

» Royal Truman replies:

Alex Williams has made many valuable contributions to creation science research and I always read his contributions in this journal with much interest. He makes some excellent points in his letter and I urge everyone to read again what he wrote.

It is correct that most synthetic substances or *close analogues* introduced by humans into the biosphere already existed and were being recycled naturally at least in small quantities, so existing mechanisms could usually be optimized. A unique contribution we can make to science is a paradigm switch to understanding both the big picture and fine details of biology. We assume a Creator was involved who intended to solve current and future problems effectively and we can formulate testable design-inspired hypotheses. To illustrate, a common computing or engineering strategy is to create distinct and configurable modules for classes of problems and these modules are then reused in computer programs and machines. Once enzymes exist somewhere in an interacting ecological system for molecules such as toluene (figure 1),[1] salicylates (e.g. aspirin in figure 2), and alkanes (e.g. figure 3), then the basic 'modules' are in place not only to recycle a vast number of similar molecules but also other substances which contain their key chemical features linked at various positions like the example shown in figure 4.[2]

In a similar manner, it is probable that a large polymer of nylon or a polymeric side product did not exist having an identical structure in the past in nature. But biodegradable analogues which contain an amide bond certainly did, and sequential reuse of the same or a modified enzyme can break down the new polymers stepwise. This is usually a better design than requiring a unique enzyme for a unique molecule, with different portions responsible for processing different portions of the molecule.[3]

Conceptually armed with a design premise we can then ask the right questions to guide novel research efforts. Enzymes in the presence of energy-supplying ATP could also degrade valuable biomolecules needed by organisms, i.e. at the wrong time. How are these processes regulated? What would be sensible population sizes to provide an effective search algorithm, enhanced with mutations, to find solutions to ecological problems? What would the ideal trade-off be between microbial reproduction rates (to offer more search opportunities) vs the material, time and energy consumed to grow new members too often? How might a distribution of effort between different kinds of organisms be set up to optimize ecological problems being solved by coordinated efforts? (Gene transfers

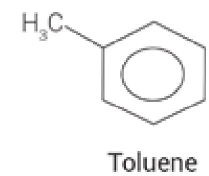

Figure 1. Chemical structure of toluene

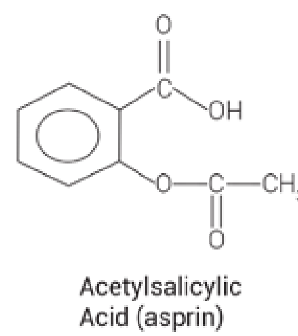

Figure 2. Chemical structure of acetylsalicylic acid (aspirin)

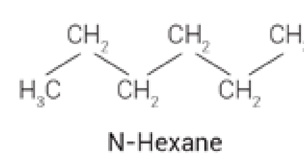

Figure 3. Chemical structure of n-hexane, an alkane

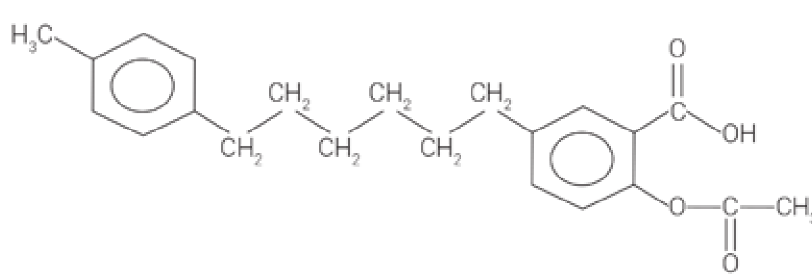

Figure 4. One of many possible chemicals which could contain the structures found in toluene, acetylsalicylic acid and alkanes

now make sense once the correct question is formulated. The guiding insight then becomes, how is this guided to determine what is transferred, effectively). What kinds of mutations would make sense (point mutations, frameshifts, multi-coding) and what rates would be most effective? If too fast and random, then highly effective enzymes requiring no change would deteriorate over many generations, but if too slow the solutions would offer little value when needed.

Many thanks again to Williams for the stimulating observations.

Royal Truman
Mannheim
GERMANY

References

1. Similar molecules could have additional functional groups attached.
2. How a final complex molecule like the one shown in figure 4 was synthesized by humans is irrelevant and I am not implying the molecules shown in figures 1–3 had to be used as raw materials.
3. Occasionally a multifunctional or multistep enzyme complex would make better design sense if the end product is needed quickly at that location. This kind of intelligent work organization is sometimes used in manufacturing wherein the sequential steps are handed over just in time to an adjacent workplace. This would make sense for a repetitive core biochemical process.