Carl Woese's worries about the role of bio-engineering

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Comment on: **AL Caplan et al** (November 2015)

See reply: **AL Caplan et al** (in this issue)

Restriction-modification is a well-known bacterial defense mechanism against phage infection: restriction enzymes recognize phage-specific DNA sequences and cut and degrade phage DNA that is invading the cell. The CRISPR/Cas9 system, which was first described more than a decade ago, is another adaptive bacterial defense against invading phage DNA based on an “immunological memory” of previous phage infections.

Most molecular biologists, however, only know restriction endonucleases as an important part of recombinant DNA technology and as a basic laboratory tool. Similarly, the CRISPR/Cas9 system is now widely used for genome editing and has become more

popular than TALENs and zinc-finger nucleases [1,2]. Yet, many researchers only know it as a cheap and efficient method and not as an adaptive immune response to viral infections. This lack of knowledge is not surprising given that most publications and teaching in molecular biology omit the original purpose of restriction enzymes and CRISPR/Cas as bacterial defense mechanisms.

I think these tools may have made Carl Woese's concerns about how the application of science can overshadow the meaning of knowledge come true. In an interview, the American microbiologist and biophysicist said “Nothing wrong with bio-engineering per se. Wrong is when bio-engineering comes to define biology. Physicists understand this: long ago physics formally split into two allied disciplines, basic physics and engineering. What was formally recognized in physics needs now to be recognized in

biology: science serves a dual function. On the one hand it is society's servant, attacking the applied problems posed by society. On the other hand, it functions as society's teacher, helping the latter to understand its world and itself. It is the latter function that is effectively missing today” [3].

Will this single-minded focus on the application of CRISPR/Cas9 as a genome editing tool help us to create “better” living organism if we lack the knowledge that its primary purpose is to eradicate “bad” bugs? In particular, the definition of “better organism” and “bad bugs” is inherently anthropogenic and even biased.

References

1. Caplan AL, Parent B, Shen M *et al* (2015) *EMBO Rep* 16: 1421–1426
2. Corbyn Z (2015) *Nature* 528: S4–S5
3. Woese CR (2005) *Curr Biol* 15: R111–R112