

West were devising artefacts to utilize the heat from an earthen oven most effectively, India remained mostly engaged in thinking of the abstracts. It has become our second nature to amass pure knowledge and leave it to the 'lesser talents' to consider its practical utility, if at all. The trouble is, in our country such talents are not too many, nor are there sound policies to rear them in the arena

of basic sciences. This is very sad, especially when it is proved that motivated, we deliver well. In recent times, the successful design and production of the MANAS chips and the photo multiplicity detectors are worthy of mention. They are being used in the large hadron collider experiments at CERN. Unfortunately, that is more an exception than a rule.

For once, we shall do well to bear the boy's question in mind, not in the form it was put, but in the spirit it was set.

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Craig Venter, and the claim for 'synthetic life'

On 20 May 2010, *Science* announced the results of the work of Craig Venter and his group on the 'Creation of a bacterial cell controlled by a chemically synthesized genome'¹. This publication has received extensive media coverage as the first example of artificial creation of life, of man playing God, and so on.

What exactly has been achieved by Venter, and how important is it? Here is one assessment, in a brief Q&A format.

How momentous is Venter's achievement?

Venter's work represents a tremendous technological feat, requiring as it did success in three difficult and sequential steps: the chemical synthesis and assembly of a DNA molecule of length 1.1 million base-pairs; its cloning into a yeast cell as a yeast artificial chromosome (YAC); and finally and perhaps most difficult, the introduction of the YAC by a process which the authors name as 'genome transplantation' into a suitable recipient bacterial cell where the genetic instructions encoded in the transplanted DNA could be decoded and rendered functional. For convenience, these steps may be referred to as 'A', 'B' and 'C' respectively.

Although it is indeed a stupendous technological achievement, it could also be argued that conceptually it was somewhat ho-hum or routine. Furthermore, the three steps 'A', 'B' and 'C' have been individually successfully demonstrated by Venter himself in earlier path-breaking papers that were published in *Science* in 2007 (C)², 2008 (A + B)³, and 2009 (B + C)⁴; hence, in patent office terminology, the combination of 'A + B + C' being reported now would be considered 'obvious' or non-inventive,

since the whole in this case has not been greater than the sum of its parts.

From a conceptual point of view as well, most biologists would agree that our accumulated knowledge and wisdom of genetics and molecular biology in the last 50 years would have predicted or foreseen the present results that were obtained by Venter, once the technological hurdles were overcome (as they have in the last three years). Hence, there is certainly no 'Eureka' moment here. One should also keep in mind that the synthetic genome used in this work was virtually identical in its sequence to that of a natural bacterium (that is, with an almost certain likelihood of it being functional), with very few 'cosmetic' modifications.

And the claim that a 'synthetic cell' (or 'synthetic life') has been created?

There is an issue of semantics here. What has certainly been achieved, and is rightly mentioned in the title of Venter's paper, is a 'chemically synthesized genome'. Now, this synthetic genome was introduced into a pre-existing living bacterial cell, where the former hijacked the host's machinery (including its proteins, ribosomes and membranes) to decode its own information and thereby substitute the host machinery in its entirety, by what one may term as the process of 'infinite dilution'. Some may argue that creation of an authentic 'synthetic cell' would require the artificial synthesis of proteins, ribosomes and membranes as well without making use of the pre-existing living bacterial cell, which has not been achieved here. At the same time, Venter is correct in claiming that once the hijacking had been com-

pleted, there was no trace left of the original host and hence the resulting living entity can indeed be referred to as a 'synthetic cell'. The analogy could be to that of the construction of an arch as a structure in stone or concrete, which cannot be done without a scaffold but then becomes a free-standing entity once its keystone is in place.

To give Venter his due, the new organism could also be hailed as the first living entity in this world without an ancestor (if one assumes that the host cell that was used for genome transplantation was not ancestral, since its genome is no longer represented in the new organism; and, further, if one does not subscribe to traditional Christian beliefs!).

Any other comments?

Just a note of caution that Venter's is a private enterprise, and that there is certainly likely to be an element of profit-seeking in the publicity that he has been trying to generate with this work.

1. Gibson, D. G. *et al.*, *Science*, 2010; doi: 10.1126/science.1190719.
2. Lartigue, C. *et al.*, *Science*, 2007, **317**, 632–638.
3. Gibson, D. G. *et al.*, *Science*, 2008, **319**, 1215–1220.
4. Lartigue, C. *et al.*, *Science*, 2009, **325**, 1693–1696.

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