The ICAC Recorder

Editorial

For most scientists, CRISPR (clustered regularly interspaced short palindromic repeats) is an exciting new gene editing tool. CRISPR is widely considered to have all the elements that can radically transform nature like never before. In the future, it might actually be recognised as the most important scientific discovery of the 21st century! As a result, the September 2019 edition of the ICAC RECORDER focusses exclusively on 'CRISPR for cotton improvement'.

But CRISPR is not just about a gene editing tool. It was actually discovered as God's own armoury gifted to tiny bacteria so that they could fight viral invasion. Science might never be more fascinating than this.

Picture this: A tiny little virus injects its DNA into a tiny bacterium so it could hijack the bacterial DNA and grow into a new virus. But the little bacterium swings into action! It understands the danger of the invading DNA, so it reads the DNA sequences of the virus and selects a short, 30-letter segment and copies it into its own genomic DNA to create a CRISPR library of the invading viral DNA pieces. The bacterium now is ready to combat viral attacks. As soon as a bacteriophage injects its DNA into the bacterium, the bacterium recollects its DNA spacer library to read and recognise identical sequences in the invading viral DNA to destroy it by cutting it into pieces. The bacterial CRISPR library keeps expanding with each invading new viral DNA, and that genetic information is passed on to its children for immunity against bacteriophages. One would have thought that the bacteria are smarter and that the bacteriophages would have gone extinct by now — but the bacteriophage viruses keep evolving too, in this God's game of chess. Numbering more than 10 quintillion (10^{31}), bacteriophages are likely the most populous living organisms on the planet.

Interestingly, the British microbiologist Ernest Hanbury Hankin, who worked in India, published a research paper on bacteriophages in 1896 in the journal *Annales de l'Institut Pasteur*. 10: 511–523. In it, he indicated the possible presence of bacteriophage viruses in the Ganges and Yamuna rivers that had the ability to control cholera due to bacterial infection. Twenty years later, the French-Canadian microbiologist introduced the term 'phage-therapy' to cure dysentery using bacteriophages. These scientists considered the bacteriophage viruses to be smarter than the bacteria. Almost 100 years later, scientists confirmed that not only were bacteria just as smart, they also had the CRISPR armoury — which is now used by scientists to edit genes in an absolutely precise manner to better understand gene functions, cure genetic disorders, and improve agricultural crops.

There is a raging debate whether CRISPR would be used for human welfare or if it could end up in the hands of a maverick scientist, who could distort the natural course of evolution in the pretext of creating 'better human beings' or 'elite organisms'. Charles Darwin's cousin, Sir Francis Galton, termed the coin 'eugenics' (well-born or good-genes) and suggested that the human race could be enhanced by retaining superior individuals and by eliminating the disabled and inferior. His idea created an era of havoc in human history across Britain, France, the United States and Germany, ultimately culminating in horrendous death camps and genocide.

A new chapter in the era of eugenics appears to have begun in 2018, when a Chinese scientist named He Jiankui claimed to have edited the genomes of twin girls by knocking out the *CCR5* gene, which would make them immune to the HIV virus. Jiankui's work not only drew flak from the scientific community, but also raised red flags against the potential misuse of the technology. It wouldn't be wrong to say that CRISPR technology is powerful enough to be used for human welfare — or misused for disastrous consequences, much like nuclear energy. The ICAC RECORDER does not touch upon those aspects of the debate, but would like agricultural scientists to consider all possible consequences before they attempt to modify natural evolution.

Information on CRISPR has grown by leaps and bounds over the past 20 years. There are brilliant reviews and videos on the internet that could provide general information to the reader on the potential of CRISPR, as well as the possible consequences.

There are four mini-reviews in this volume that describe CRISPR in the context of the extant gene editing technologies, biosafety regulatory mechanisms and the promise of gene editing for cotton improvement. I believe that the four mini-reviews in this volume of the ICAC RECORDER focus spotlight on the future of cotton through the prism of CRISPR/Cas. Happy reading.

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