MAGNUS LUNDGREN

THE BACTERIUM’S WEAPON AGAINST THE VIRUS
– a powerful genetic tool

Magnus Lundgren’s research field – the bacterial immune system – has been red-hot in the last years, and has been described as genetic engineering’s second revolution.

Everything is based on the discovery of a new immune system in bacteria and archaea, called CRISPR. That stands for ‘clustered regularly interspaced short palindromic repeats’. These particular repetitive sections of DNA give rise to molecules that recognize and snip foreign genes from intruding genetic material. It is one of the bacteria’s weapons against viruses. The discovery paved the way for a new type of genetic microsurgery that enables you to go in and make detailed changes to the genetic material of plants and animals, for example.

“The CRISPR system was a real breakthrough. Its great precision makes it possible to modify genes much more accurately, easily and cheaply than before. In an extremely short period of time it has changed how hundreds of laboratories work,” says Magnus Lundgren, professor at the Department of Cell and Molecular Biology at Uppsala University.

The discovery also opens up entirely new possibilities for treating, and perhaps curing, genetic diseases such as cystic fibrosis and sickle cell anaemia. Magnus Lundgren explains that he has developed a variant of the CRISPR technology that acts as a kind of genetic switch that can be positioned in front of a gene. The switch consists of a protein complex, Cascade, and a replaceable piece of RNA that indicates the gene to be switched off. Genes can be switched on and off without necessarily affecting the gene itself.

“The most common way of establishing what genes do is to modify them. With the new technology, however, the gene itself need not be affected. Besides being an important tool in medical and biological research, it can also be used to tailor industrially important microorganisms for producing biofuels, for example,” says Magnus Lundgren.

The research team is also interested in how CRISPR works in bacteria in nature, and whether it is possible to transfer the unique bacterial immune system to other types of cells, starting with yeast.

“We are trying to tailor a new immune system. It could eventually be significant in agriculture and production of pharmaceuticals, for example,” considers Magnus Lundgren.

The newly discovered immune system has proven to be both adaptive and heritable, enabling bacteria to remember and inherit resistance and thus pass immunity on to subsequent offspring. As soon as the bacterium is infected by a DNA containing a similar sequence, the DNA is destroyed. A system as advanced as this was a surprise, because they were not thought to exist in organisms a simple as bacteria.

“We want to understand what happens when the immune system learns to recognize viruses. And how the cell finds the virus, and snips and inserts the DNA. This could then be used to modify the genetic makeup of different types of organisms,” says Magnus Lundgren.

Development is proceeding at a prodigious rate. Magnus Lundgren believes that within a few years, the technology will be used in humans and their genetic material to make very precise modifications. Cutting and pasting genes evokes both curiosity and hope, but also raises issues, with a host of ethical aspects to take into consideration. As a researcher and expert in the field, Magnus Lundgren is frequently asked for comments and explanations, both in the media and for other organizations interested in the new genetic engineering.

“In step with the development of the technology, ethical discussions about how it should be used are becoming increasingly urgent. I really enjoy being on the front line of research. I see it as a huge, important task for us scientists: informing about and discussing new research, and at the same time taking the opportunity to contribute to the public debate,” says Magnus Lundgren.