Matt Ridley on the genome

How significant is it that for the first time in four billion years a species on this planet has read its own recipe?

We don't entirely know how to understand the significance of this, but we have just in the last year, for the first time, got an absolutely nailed-down, gold standard sequence of what's in that. It's a very, very big document – as long as eight hundred copies of the Bible [inside the nucleus of every cell] – and it's written in DNA code, which consists of a four-letter alphabet. It's linear, digital, and just like text. We know in a sense that even with a 26-letter alphabet we could never exhaust the number of potential books that could be written, and that's what genomes are all about.

What significant scientific work was going on just before the discovery of the double helix?

It's a wonderful period, fifty years ago, with the birth of molecular biology. And in retrospect it all fits together. There were a whole series of steps that led to the discovery of what the gene was made of. Everybody knew what genes were; everybody knew that inheritance came in particles in some sense. There were blobs of inheritance: you either got blue eyes or you got brown eyes; you didn't get something in between. That was what Mendel discovered. By 1944 anyone who was in the know knew that genes were made of DNA. That was because of a series of brilliant experiments by a man named Oswald Avery, who never gets quite enough credit, who pinned down that DNA was the substance of which all genes are made. But nobody could figure out how, because DNA seems to be a monotonous and simplistic chemical compared with proteins, which had a lot more diversity.

If you go back to 1953 and ask who was predicting how DNA would have this capacity for carrying inheritance from one generation to the next, they were all barking up the wrong tree. They were talking about something to do with special quantum energy states; they were talking about special three-dimensional configurations. In fact, it turned out that it's a simple linear digital code. In other words, there are four chemicals and they're repeated in a significant order, which gives you a piece of text that tells you whether your eyes are blue or brown.

On the 28th of February, 1953, at 9:30 in the morning, it became immediately obvious that what we were talking about was a digital sequence. This is the time when Jim Watson found the base-pairing phenomenon. He discovered that these letters fitted together on the opposite strands of DNA in such a way that A and T fitted together with the same shape as C and G. It really was a Eureka moment.

Up until recently, we didn't hear much about Rosalind Franklin. What role did she play?

A very important one. She arrived on the scene in late '51, taking over the project from Maurice Wilkins, who had developed a technique for taking X-ray photographs of DNA. Franklin perfected this technique and managed to get a photograph that showed what shape the molecule was. Wilkins had suspected that it was helical, and she proved it beyond doubt. At this point, Watson and Crick started playing with models, and they solved the problem. Franklin could have done it though, as she had the best data. If she had done it all alone she would have gained it for Britain, for women, and for Jews. It would have been such a great story. So, in a way, I feel frustrated with her rather than sorry for her – that she didn't manage to grasp that prize. But there were lots of reasons for that, including institutional sexism, which has clouded the history of the discovery of DNA.

Massive Change Radio is a project by Jennifer Leonard, Bruce Mau Design, the Institute without Boundaries, and CIUT FM, Toronto.

How are old ideas and models changing as a result of the new genomics?

This is a science that revises itself continuously. A lot of early guesses about genomes have proved to be wide of the mark in interesting ways. That's not to say that things are proving the opposite of what was proved before. But, for example, an early guess was that there would be about 100,000 human genes. That's 100,000 discrete paragraphs of text in the genome that actually spell out the recipes for protein. And that seemed to be a pretty good guess, which was based partly on the idea that the human brain is so complex, that it would require a whole bunch of special genes that weren't found in other animals. It turns out that this is wrong, in a big way. We have 25,000 genes, not 100,000. That's 6,000 genes more than a microscopic worm has, and 15,000 less than a rice plant has. Far from being the most sophisticated machine on the planet, the human being is just an ordinary creature. Our species is just another twig on the evolutionary bush.

What are your thoughts on the hotly debated golden rice?

The man behind golden rice is Ingo Potrykus, a Swiss biotechnologist who had the desire to apply genetically modified plant technologies to solving some real Third World problems. In his research, he found that the most solvable problem was with vitamin A deficiency in rice. Something like 500,000 children a year suffer from sight problems as a result of vitamin A deficiency. So he asked, "What if we could just take a gene out of a daffodil plant and insert it into rice?" And he did it, on his own, not under the aegis of any corporation. He managed to persuade all the companies that had the patents that he'd breached to give him a license for free. He can grow this stuff in his laboratory, put it in his pocket, fly to Jakarta, and hand it out if he wants. There's nothing to stop him in the law, except for the fact that all the countries where he'd like to distribute it have passed laws, under pressure from organizations like Greenpeace, who disapprove of this technology, saying that he shouldn't be allowed to do this because the risks of it being a genetically modified kind of rice have not been properly assessed. I think it's pretty clear where right lies in that argument and where wrong lies. And, you know, he's been vilified by a lot of the environmentalists, and quite wrongly so.

Who knows, maybe one day it will be an example of the actual future proving to be far better than the forecasted hype of a future?

This is one of my great themes and holds true if you go back and look at the number of times people have predicted disaster, from Malthus at the end of the eighteenth century onwards. A very nice example was in a speech to the British Association for the Advancement of Science in 1898, when the scientist Sir William Crookes said, "England and all civilized nations stand in deadly peril of not having enough to eat." He predicted that we were all going to starve. Along came the Haber-Bosch process [a method of directly synthesizing ammonia from hydrogen and nitrogen, developed by German physical chemist Fritz Haber], which is how we make nitrogen fertilizer out of the air. The organic movement was a reaction against the use of inorganic nitrogen fertilizer. But if we hadn't done that, then we couldn't possibly feed six billion people, which is what we're managing to do now, and leave room for rainforests. The productivity of land without artificial nitrogen just isn't there. Again and again, technology comes to the rescue of these environmental problems rather than causing them.

What did James Watson say? That the problem is not the biotechnology itself but the slow pace in which we're applying it to solve some of our world problems?

Yes. Slamming on the brakes on a technology is not a morally free route to take. There are moral hazards in taking that course because you might be preventing a new technology from coming to the rescue of people with real problems. The sooner we can get some of these molecular technologies out there, the sooner we can get the cure for cancer organized through molecular biology, which is where it's going to come from, and where it's already coming from in some cancers. Then the better the future generations are going to be. In that sense, I'm a sort of techno-optimist and I'm sometimes called a bit of a Dr. Pangloss.

Matt Ridley is an award-winning author.