Medicine

Shooting down cancer

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A theory linking the scourge to stem cells may offer new ways of treating this most terrifying of diseases

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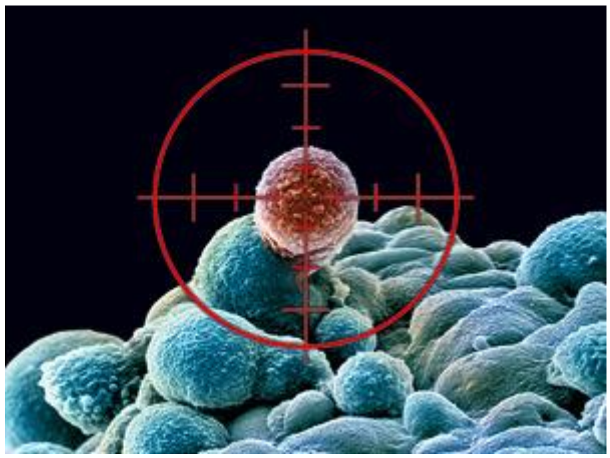

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EVERY age is afraid of plagues. For the most part, such plagues have been infections. The rich world, though, has brought infectious disease under control and, AIDS aside, the memory dims with every generation. Instead, the fear of disease has transferred itself to cancer. How to prevent it, and how to treat it if prevention has failed, fills the health pages of the newspapers. How this or that celebrity won or lost his or her battle with it seems to fill much of the rest.

The military metaphor is not confined to newspapers. It is 37 years since Richard Nixon, then America's president, declared war on the disease. During that time, the prognosis for cancer patients has got a lot better. Scientists have refined old therapies and found new ones. Moreover, governments have waged a relentless public-health campaign against the biggest cause of cancer—the smoking of tobacco. The war, however, has never looked close to being won. Scan the horizon and there is no sign of a cure.

Nor is there likely to be until the enemy is properly understood. Though luck plays its part in medicine, as it does in warfare, the big breakthroughs usually come from dramatic shifts in understanding. It was not, for example, until Louis Pasteur and Robert Koch proved the connection between germs and infection that doctors realised that to cure such diseases you had to kill the germs. The germ theory of disease made sense of a collection of illnesses that obviously had things in common (a tendency to appear in waves, for example, or to pass from person to person) but were maddeningly different in their details. It took a while, but proof of that theory led to antibiotics that can destroy a whole range of infections.

For cancer, a similar moment of enlightenment may now have arrived (see article). Like infections, cancers have prominent features in common, yet they are bafflingly different in their details. But, borrowing an idea from another part of biology, oncologists are coming to believe that most—possibly all—cancers involve stem cells, or something very like them. They are, in other words, caused and sustained by a small number of cells whose daughters grow into the tissue of a tumour rather as the daughters of healthy stem cells grow into the normal tissues that make up a body.

Patience, s'il vous plaît

This opens new ways of thinking about and treating the cancers. If its stem cells are eradicated, the rest of a tumour may die off. And if the secondary tumours—the truly feared killers in many forms of cancer—are the result of stem cells escaping from a primary tumour, as looks likely, then this knowledge may make them yield more easily to treatment.

This discovery is not a cure. But it does point the way towards one—or, at the least, towards better therapies. Some might be in action soon. For example, it seems that cancer stem cells are less vulnerable to radiation than other cancer cells, because their DNA-repair mechanisms are better. Radiotherapy might thus be made more effective against them by dosing them with existing drugs that inhibit DNA repair. Some existing drugs which are known to interfere with stem cells' biochemical pathways could be used to attack them selectively.

Other treatments will take far longer—the time needed for clinical trials would see to that and, in any case, a lot more research is in order. And there is the problem of designing drugs that can distinguish between cancer stem cells and those that spin off healthy tissues. But it all looks promising.

Blue sky ahead

The other interesting aspect of the stem-cell link is that it was inspired by work outside the mainstream of the huge cancer-research industry: stem-cell research is now a huge field in its own right. In science you never know where the answer is going to come from. Pasteur found it in a piece of practical science: he was trying to prevent food going off. Charles Darwin, by contrast, found a lead for his theory of natural selection in the whimsical hobby of pigeon fancying, where the birds showed an enormous variety of form and behaviour. And some discoveries happen by accident. Radioactivity came to light a century after the discovery of uranium when Henri Becquerel used uranium salts and photographic plates in the same experiment and found that one fogged the other.

In the 19th century it was commonplace to do an experiment simply to see what would happen. That was, in part, because experimenters were often amateurs who were spending private money. In these days of taxpayer-financed science, most experiments are executed with a pretty clear idea of what the outcome ought to be, especially when they are part of wars and campaigns against this or that. The paradox is that, although such efforts do not eliminate Becquerel-like discoveries, they risk limiting the chances of making them.

This accent on targeted research is understandable. Plenty of the work now done on cancer will be of the targeted sort. The Large Hadron Collider, the huge particle accelerator in Switzerland which was switched on this week (see article), is a grand project that could yield all sorts of discoveries. Yet the easiest way to sell it to politicians was to frame it as a search for a single particle, the Higgs boson.

Like natural selection and germs, the discovery of cancer stem cells illustrates how the most fruitful scientific findings are often not those of individual experiments, however intriguing, but those that organise knowledge into theory. The chemical industry took off within a decade or so of Dmitri Mendeleev's arrangement of the chemical elements into the periodic table, just as radio communications followed James Clerk Maxwell's mathematical unification of electricity and magnetism, and antibiotics came after Pasteur and Koch.

With luck, something similar will soon happen in biology in the wake of such things as the Human Genome Project. In retrospect, the discovery of stem cells—cancer stem cells included—may come to be seen as a step in a comprehensive theory of how organisms work. That understanding would be a formidable, if unforeseen, part of the legacy of the war on cancer and an essential part of its mission to save lives.
