

► involved in transplanting them is paid for their contribution.

Because the buyers insist on using the language of gifts, the recompense for the donor — from clinics, hospitals or brokers — is tiny. So only the poor and desperate are tempted. Profiteers increase the supply through coercion.

Protecting donors' anonymity enables buyers to turn a blind eye to the source of their flesh. And as Carney puts it: "The one-two punch of anonymity and donation means that profit-taking middlemen control the entire supply chain."

The global industry in body parts exploits the varied regulations and economic conditions in different countries. The fact that body parts have often travelled across continents also obscures their source. By the time an Indian child's papers reach an adoption agency in the United States, for example, there is often no easy way of verifying whether that child was given up voluntarily.

Banning organ commerce will not help, Carney says, because the red market would be driven further

"Every child, kidney or bag of blood should be labelled with the name of the person who provided it."

underground and the poorest would continue to supply it in return for risible fees. Nor will fully embracing the market work, as demand will rise alongside supply. Physicians will find new indications for transplants as more

organs become available, and as they hold out hope for ever-smaller improvements in the lives of very sick patients. A third option, to grow synthetic body parts, is appealing but remains science fiction for now.

Carney does argue that the market should be transparent, with every child, kidney or bag of blood labelled with the name of the person who provided it. The supply pool might shrink, but the criminal middlemen would be eliminated. The richer members of society — those creating most of the demand — could also learn to accept their mortality, and to question whether, in every case, the extended life that a transplant promises is worth the human suffering it costs farther back along the chain. It's not much of a sticking plaster, but *The Red Market* is a reminder that there are some problems that science alone cannot solve. ■

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An 1881 *Punch* cartoon satirizing Charles Darwin's body of work that connected humans with worms.

EVOLUTION

Darwin's other books

From geology to mould, the naturalist's publications form a coherent whole, finds **Eugenie Scott**.

Most people are familiar with *On the Origin of Species*, but few are aware of Charles Darwin's decades of productive work before and after its publication. Indeed, creationists present Darwin as a one-trick pony: a rich dilettante who loafed around his country manor until he stumbled across evolution by natural selection. So I was delighted to read Steve Jones's *The Darwin Archipelago* (published in Britain as *Darwin's Island*), an entertaining and thoughtful treatment of Darwin's other books.

Darwin was a respected scientist — and a recipient of the Wollaston Medal, the Geological Society of London's highest award — well before the *Origin's* publication in 1859. By then, he had eight books to his name, starting with *The Voyage of the Beagle* in 1839 and followed by three volumes on

geology and four on barnacles. Ten further books and monographs appeared after the *Origin*, including *The Formation of Vegetable Mould, through the Action of Worms*, which was published in 1881, the year before his death at the age of 72.

As in his earlier treatment of the *Origin*, titled *Almost Like a Whale* (published in the United States as *Darwin's Ghost*), Jones shows how Darwin's ideas have inspired and been augmented by subsequent research. And Jones shows his flair for a one-liner: a worm is an "animated intestine", and molecular biology is "no more than comparative anatomy plus a mountain of cash".

Jones notes that all of Darwin's work

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The Darwin Archipelago: The Naturalists' Career Beyond Origin of Species
STEVE JONES
Yale University Press:
2011. 248 pp. \$27.50

supports the principle that, driven by natural selection, small changes “given time, can produce gigantic ends”. Anatomy, behaviour, biogeography, embryology — so many characteristics of organisms can be explained by selection on precursors that gave some advantage to their possessors. The peculiar “contrivances” of insectivorous plants to attract and capture prey, for example, can be explained only by natural selection.

Darwin's works also show what his contemporary William Whewell referred to as “consilience”: the confluence of evidence from a variety of sources. As Jones puts it: “The great naturalist's lifelong labours generated an archipelago of information; a set of connected observations that together form a harmonious whole.”

Time and again, Jones's book caused me to reflect on how delighted Darwin would have been to have had some titbit of evidence discovered after his death — such as the fossilized bee found with a pollen sac attached, which sheds light on the evolution of plants, or the discovery of genes for olfaction in mice. This latter finding supplements Darwin's observations of the importance of urine marking in mice for choosing a mate and avoiding inbreeding.

The last chapter is depressing but important. Introduced plant and animal species sometimes spread at the expense of natives, reducing diversity, Jones notes. Similarly, our own species has become less diverse: as our ability to manipulate the environment has grown, the variance in human death rates and birth rates has fallen, and variation within and between populations has declined because of migration and intermixing. Yet this variation is the key to adaptation by natural selection.

What does this say for the future? We know that environmental pressures will require adaptation. “One day, [Darwin's] machine will take its revenge,” Jones warns. “We may well fail in the struggle for existence against ourselves, the biggest ecological challenge of all.” Natural selection bats last. ■

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Q&A Christiaan Zwanikken

The machinist

Dutch artist Christiaan Zwanikken makes computer-controlled mechanical sculptures, many of which use animal skeletons he has found. As a film about Zwanikken's work and life at an isolated Portuguese convent premieres in Edinburgh, UK, he discusses human relationships with other animals and machines.

Can you describe your artworks?

I take the remains of animals and plants and bring them back to life by means of computer-controlled motors, or servos. The sculptures can interact with people and each other. There is a strong natural element and a technological part; for example, one of my sculptures has two goat skulls that bang into each other using a pneumatic system. Another is a snake eagle that dives down from a height of ten metres to meet a Duracell bunny. There is a hare skull to which I gave a new copper face. And I have five masks with little tongues that repeat lines from the 1982 film *Blade Runner*, in which an android asks for a longer life.

How did you become interested in machines and animals?

My grandfather was an aeroplane technician, and as a child I worked with him in his basement full of exotic parts of aeroplanes. Then my family moved to an isolated convent in rural Portugal and I explored the natural surroundings. I had dreams of machines that could fly, jump and swim. When I was at art school I had three dog skulls in my studio, and I arranged them into a mechanical Cerberus, the many-headed dog that guards the underworld in classical mythology. People were really shocked by it.

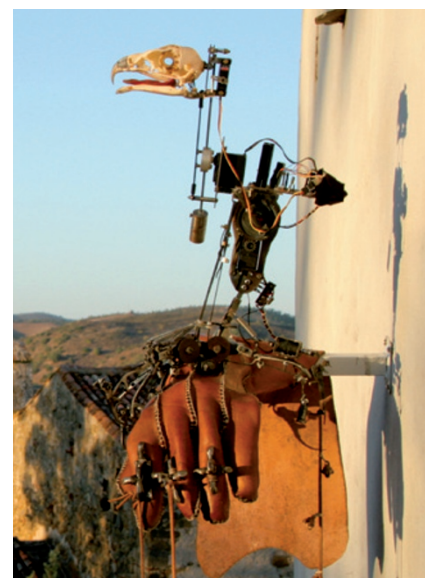
What technologies do you use?

I use old-fashioned materials such as cogs and wheels, clockwork devices, electromagnetic coils and servos, as well as radar and ultrasonic sensors. I create an illusion, but also give away my tricks by leaving the mechanisms exposed. Although computer-aided manipulation of materials is getting cheaper, I build my machines by hand. The biggest part of



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Mechatronics gives an eagle skull new life.

my work is programming them so that they seem to behave naturally.

What point are you trying to make?

I am trying to unravel humans' relationship with nature. We have rudimentary reactions to other animals, often a fight-or-flight reaction. There is a dark side to my work, perhaps a warning about the loss of species. But I also try to merge the worlds of animal and machine, so that they coexist peacefully. I try to make something that appears to be real, using technology to create a world that no one has seen before.

What is your most recent piece?

My installation *Scorched Earth*, on show until 15 August at an exhibition in Lille, France, is a post-apocalyptic landscape in which all flora and fauna are extinct and the remains of animals have been combined with machines to populate the world. The artificial animals are autonomous, intelligent and uncontrollable. Humans exist only as a memory. The morning it was finished, I saw the images from Japan after the tsunami. They seemed strikingly familiar. ■

INTERVIEW BY JASCHA HOFFMAN

C. ZWANIKKEN, MONSIEUR HOUDIN, W'OELEZ PAS VOTRE OISEAU! (2008)/PHOTO: J. ALTERMAN (CONVENTO)

J. ALTERMAN (CONVENTO)