other species, wrangling over a resource such as food, territory or mates. Each displays their quality and assesses the other's. The result is that the one least likely to win backs down. Trivers argues that if one individual thinks that they are bigger and stronger than they are, they will display as such — and in a way that makes them more likely to fool others.

To examine this idea, Trivers brings together neurophysiology, behaviour, immunology and psychology. Behavioural data show that some classes of individual are more likely to misjudge factors such as their own intelligence or sexual orientation. Neurological data suggest that the conscious mind has a positively biased view of self, relative to the subconscious mind. Immunological studies show that deception has costs to immunological function. And psychological studies suggest that biased memory, denial and projection are common.

Trivers relies heavily on data obtained by methodologies from brain scans to immunological assays to plethysmographs that measure organ volume. He aims to stimulate research and debate, raising more questions than he answers. How might we model self-deception from an evolutionary perspective? How do we distinguish the psychology of deception from that of self-deception? Could we test for it in non-humans? What are the competing hypotheses? How do we test the costs and benefits? What are the psychological consequences?

A common theme in his examples is that deception has been selected because of its benefits at the individual level, but that this can lead to disastrous consequences at, say, industrial or national level. Trivers offers much food for thought on these topics, in chapters that are likely to provoke controversy. He suggests that self-deception has a major role in the initiation and justification of wars, the development of false historical narratives and the existence of religion.

Deceit and Self-Deception has broad appeal and a well-structured narrative. Trivers adds numerous anecdotes, such as what to do when being searched by the police (look away), or why you should avoid walking with him near squirrels (in case he makes a sudden lunge, provoking an attack).

Trivers touches on wide-ranging issues: the role of evolutionary biology in the social sciences; the placebo effect; lie detectors; genocide; the scientific method. But he conveys a powerful and focused message: if we can learn to recognize and fight our own self-deception, we can avoid negative consequences at levels from the individual to the national, and live better lives. ■

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PARTICLE PHYSICS

A question of mass

The struggle to find a theory of the weak nuclear force reveals intriguing personalities, finds **Edwin Cartlidge**.

The Higgs boson is an expensive quarry. Finding this as-yet-unseen elementary particle, thought to endow others with mass, is the headline aim of the Large Hadron Collider — a venture costing billions of dollars and involving thousands of scientists at CERN, Europe's high-energy physics lab near Geneva, Switzerland. Just why the Higgs is so significant is laid out in Frank Close's fascinating book *The Infinity Puzzle*, which chronicles the hunt to pin down the fundamental forces of nature, and the human triumphs and failings along the way.

Close, a particle physicist, offers a compelling history and sociology of modern particle theory. We discover the motivations and achievements of a rich cast of brilliant individuals, and get enough of the science to grasp what they were trying to do. Where Close really shines is in exposing the fraught process of recognition in science, focusing on key players such as Pakistani theoretical physicist Abdus Salam and the man after whom the famous boson is named, British physicist Peter Higgs. We get a feel for what has been called "Nobelitis" — the preoccupation with claims to discovery that can afflict pioneers in their fields.

The book's focus is the search, starting in the 1950s, for a theory to describe the weak nuclear force, which is responsible for radioactive decay. The challenge was to devise a theory that was consistent with the strange laws of quantum mechanics, but that did not predict absurd infinities for the values of some particle properties.

An analogous problem had arisen when physicists tried to describe electromagnetism using a theory known as quantum electrodynamics (QED). Julian Schwinger and Richard Feynman found a solution to it in the late 1940s; they bypassed the infinities by calculating the electron's

The Infinity Puzzle
FRANK CLOSE
Oxford University
Press: 2011. 416 pp.
£16.99, \$28.99

properties relative to known values of its charge and mass (a trick known as 'renormalization'). Unfortunately, no such mathematical feat was evident in the more difficult cases of the weak force or the strong nuclear force, which holds protons and neutrons together in atomic nuclei.

In 1954, Chen-Ning (Frank) Yang and Robert Mills used the mathematics of group theory to put forward a description of the strong force that was analogous to QED. Later, their work would form the basis of successful theories for both the strong and weak forces. But it was dismissed at the time because it predicted that particles transmitting the force have electric charge but no mass — particles that are not found in nature.

The solution to the quandary of these massless particles, it turned out, was 'symmetry breaking'. According to this idea,

all particles were equal and massless in the very hot early Universe, and it was only as the Universe expanded and cooled that this symmetry broke down and particles with different masses condensed out. Sheldon Glashow, Steven Weinberg and Salam were

awarded the 1979 Nobel Prize in Physics for incorporating symmetry breaking into a description of the weak force, thus creating the 'electroweak' theory that united the weak and the electromagnetic forces. In 1999, Dutch physicists Gerardus 't Hooft and Martinus Veltman won the Nobel for proving that the electroweak theory ▶

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► could be renormalized. It is now hoped that the Large Hadron Collider will show whether particle masses in nature really do arise because of symmetry breaking, and whether the Higgs or some more exotic mechanism is responsible.

Close points out that the decades-long search for a theory of the weak force is full of “wrong turns, partial answers, and mislaid arguments”, with a liberal dash of Nobelitis. Glashow, sensing the prize was close, had an “acute” bout of it towards the end of the 1970s, whereas Salam had a “chronic version spanning many years”. Close asks whether Salam — who, he suggests, seemed to recognize the importance of symmetry breaking in the context of the weak force only after ‘t Hooft’s work was published — was as deserving of a share of the prize as the others. He also asks whether Salam’s long-time collaborator, British physicist John Ward, deserved greater credit. According to

Close, Salam and Ward had a lesser claim than the others. He argues that Glashow deserves the credit for first laying out the basic theory; Weinberg for incorporating symmetry breaking; and later ‘t Hooft and Veltman for putting the theory on a solid mathematical footing.

Other stories emerge from this minefield. We learn how Salam’s colleague Ronald Shaw arrived first at a theory like that of Yang and Mills but didn’t publish. Regarding Higgs, Close does not say whether he would have a bigger claim to a Nobel than the five other theorists who published papers on symmetry breaking at around the same time. But he does point out that Higgs was the only one who explicitly refers to a mass-giving boson in his paper — and hence deserves to have his name attached to it.

Close’s history of the field is engaging

and gives insight into how great theories are created. So it is regrettable that on the last page, the author inserts unnecessary hyperbole, claiming that discovering the Higgs boson may allow us to answer a question that has so far been asked only by philosophers — why is there something rather than nothing?

It is hard to see how the Higgs discovery, or any other breakthrough in physics, will be able to tell us why we are here, and why the laws of physics are the way they are. But it could, as Close says, help us to understand why nature’s particles and forces have the properties that they do. Although less grand than explaining our existence, this knowledge would be a handsome reward for the time and money spent battling infinities. ■

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► **NATURE.COM**

Frank Close reviews
Ian Sample’s book on
the Higgs boson:
go.nature.com/ewtcuv

NEW IN PAPERBACK

*Highlights from this
season’s releases*

What Technology Wants

Kevin Kelly (Penguin, 2011; \$17)

The founding executive editor of *Wired* magazine, Kevin Kelly, looks at the relationship between humans and technology in a book described by reviewer Zaheer Baber as “original and timely” (*Nature* **468**, 372–373; 2010). Kelly argues that the increasing complexity of technology means that we have less control over how mechanical systems evolve. Although this “technium” is neither alive nor sentient, Kelly warns that it may develop its own wants.