Great crested grebes performing head-shaking, part of their courtship ritual.

IN RETROSPECT

The Courtship Habits of the Great Crested Grebe

Michael Brooke reappraises Julian Huxley's pioneering classic of animal behaviour on its centenary.

As a scion of the family that produced 'Darwin's Bulldog' Thomas Henry Huxley, novelist Aldous Huxley and Nobel-prizewinning biologist Andrew Huxley, Julian Huxley (1887–1975) seemed destined to shine. He did, notably as an architect of the mid-twentieth-century evolutionary synthesis that merged Darwin's ideas on natural selection with population genetics.

Decades before that, however, he helped to pioneer the field of animal behaviour with his groundbreaking work on avian ethology, the 1914 *Courtship Habits of the Great Crested Grebe*. In it, he demonstrated how detailed observations of individual birds can prompt profound biological questions, and sometimes reveal the outline of the answers.

Huxley was keenly interested in

ornithology from his youth. In 1911, while away from lecturing duties at the University of Oxford, UK, he began observing the courtship of the redshank *Tringa totanus* in Cardigan Bay, Wales. He found that although female redshanks did not actively select a mate from among competing males, they had the power to accept or reject each suitor — supporting part of Darwin's theory of sexual selection. The following April, Huxley and his brother Trevenen spent two weeks watching the courtship of great crested grebes (*Podiceps cristatus*). They did so at a reservoir near the Hertfordshire town of Tring, now renowned as home to the matchless bird collections of the Natural History Museum. The result was a paper published in the *Proceedings of the Zoological Society of London* in 1914 and later, in slightly abbreviated form, as a pocket-sized book.

By the month of the brothers' observations, the grebes had already paired. Nevertheless, male and female, whose plumages are virtually identical, engaged in striking behaviours such as the "cat attitude" and the "penguin dance", as Huxley colourfully labelled them. These he interpreted as necessary to bring the two birds into what he perceived as the emotional synchrony needed for coition, nest-building and egg-laying. To achieve this, some behaviours have undergone a gradual change from useful action to symbol to ritual.

It was Huxley's landmark paper that identified this process of ritualization in animal behaviour (he organized a Royal Society symposium to discuss it in 1965). Huxley also realized that ritualization extended to mammals, including people. With a sprinkling of references to Dante, Plato and Shakespeare's *Romeo and Juliet*, he digresses to muse on how human courtship so often and so predictably proceeds from hand-holding to kissing to more. More formally, he realized that behaviours may be shaped by evolution.

Darwin conceived sexual selection as having two principal components. The first, which still prevails, was that males would compete among themselves for access to females — leading, for example, to the huge size of belligerent bull elephant seals striving to monopolize a stretch of breeding beach. Second, he thought that ornamentation in one sex, most often the male, might be favoured by a mating preference of the other sex.

Huxley found this concept more difficult because of the similar breeding plumage in both sexes of great crested grebe, and because courtship continues well after the birds have paired off. Huxley's difficulties barely surface in the book, although he does presage the idea of runaway sexual selection, in which female preference for a male trait leads to ever more extravagant male traits. This latter idea was subsequently developed by Ronald Fisher in *The Genetical Theory of Natural Selection* (1930). But in 1938, Huxley

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Julian Huxley in 1914.

published a paper in *The American Naturalist* that effectively poured cold water on any enthusiasm for female choice, and even more for mutual choice.

There matters largely rested until the early 1980s, when Malte Andersson showed that female choice did select for extreme male tail length in the African widowbird (*Euplectes progne*). Ten years later, Ian Jones and Fiona Hunter studied the crested auklet (*Aethia cristatella*), a monogamous seabird in which both sexes are ornamented. The parallels with the great crested grebe are obvious. Jones and Hunter showed that both males and females responded to accentuated models of the opposite sex with more frequent displays — confirming that ornaments in both sexes could be favoured by mutual mating preferences. Although beyond the scope of that study, it also seemed possible that ornament size influenced the likelihood of re-pairing the following year. That would have further undermined Huxley's reluctance to concede a role for sexual selection in any display after birds have paired for the season.

In 1946, Huxley became the first director of the fledgling United Nations Educational, Scientific and Cultural Organization (UNESCO), and he was instrumental in the 1961 founding of the World Wildlife Fund, now known as WWF. In the field of evolution, his overwhelming influence may have put a brake on the study of sexual selection, and his grebe-courtship observations have largely been superseded by those of zoologist Ken Simmons. But nobody has put two weeks' birdwatching in the spring sunshine beside an English reservoir to greater heuristic effect. ■

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COSMOLOGY

A few words on infinity

Lucy Fortson enjoys a slim primer on cosmology that uses a cleverly constrained lexicon.

When we think of cosmology, we might think of some of its most complex scientific theories, such as inflation or the general theory of relativity. Or we might consider its astounding discoveries, such as the twinned mysteries of dark matter and dark energy, which together comprise 96% of the contents of the Universe. We may then have the unsettling idea that the remaining 4% (including the stuff of which humanity is made) is insignificant in the grand scheme of things — a thought all the more remarkable when we consider the extent to which the bits of recycled stars known as humans understand cosmology.

The extraordinary story of the Universe and our journey to understand it is not an easy one to tell to the general public. But because it is the story that binds us all together, it is important to tell it in myriad ways to reach as many people as possible. *The Edge of the Sky* is an inventive, enjoyable and thought-provoking contribution to that effort.

Inspired by 'Up Goer Five' — an instalment of the webcomic *xkcd*, by former NASA roboticist Randall Munroe — theoretical cosmologist Roberto Trotta uses fewer than 90 pages to take the reader through a strange, yet sometimes compelling, exercise. He translates our current understanding of cosmology into the 1,000 most popular words in English (or as the book would say, "the ten hundred most-used words in our tongue"). Effectively, this approach demanded the invention of a new language through renaming of common objects: aeroplanes, for instance, become flying cars. It is as if we are reading a book by an observer on a different planet. Paradoxically, this simplicity of language encourages us to think outside the familiar.

So we follow a "student-person" (scientist) through one

The Antennae galaxies.

night of observation using a "Big-Seer" (telescope), and her reflections on the series of "Why? questions" (science) that have led her, and humanity, to the point of understanding as much as we do about the "All-There-Is" (Universe).

We move from early (Western) cosmology that the "old people" believed in, centred on "Crazy Stars" (planets), to the discoveries of planets outside the Solar System and today's search for new "Home-Worlds". We then follow a fairly conventional path with the usual suspects, including the "student-people" Mr Hubble, Mr Einstein and Mrs Rubin, as Trotta brings us through discoveries from the expansion of the Universe to Big Bang nucleosynthesis — all using a total of just 707 different words (and 42 names).

This linguistic constriction left me wondering about the intended readership. At times, the exercise feels like just that, yielding pained oversimplifications that give the impression of inaccuracy, such as "tired light" for redshift. We begin to wonder whether Trotta embarked on the project merely as an intellectual puzzle, proving to himself that he could write a satisfactory explanation of cosmology with an arbitrary constraint on vocabulary. (There are faint echoes here, for instance, of the French writer and filmmaker Georges Perec's experimental 1969 novel *La Disparition*, which excludes the letter e.)

In reading this book, do the cosmologically uninitiated really gain a clearer understanding of the workings of the Universe, and could they then explain this to someone else using ordinary terminology? Probably not. But, as with a well-told folk tale, perhaps some of the passion and poetry of this ultimate quest will be conveyed, inspiring a new student-person to ask the right Why? questions. This would be no small success. ■

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The Edge of the Sky: All You Need to Know about the All-There-Is
ROBERTO TROTTA
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