Can fish count? by Brian Butterworth, pp. 373, £20 (hard), ISBN 978-1-52941-125-6, Quercus Books (2022)

This fascinating book gives the general reader access to a wide variety of academic research on the mathematical abilities of members of the animal world, including humans and, of course, fish. It starts with reflections on the fundamental place of mathematics in our world, including the assertion by Galileo that the universe is written in mathematics and we cannot read it unless we become familiar with the characters in which it is written.

In the sections of the book relating to humans, the author explores number vocabulary (some of which, in many languages, including English, is linked to the names of various parts of the body), number systems, and counting and recording devices. An intriguing series of experiments, initiated by the author and an Australian-based colleague, demonstrated that Aboriginal children whose language included no number or counting vocabulary could perform as well as English-speaking children on simple counting and calculating tasks.

Evidence of non-human animals' ability to make use of the mathematics of the universe in their efforts to satisfy hunger, to mate and to avoid danger is given in the descriptions and interpretations of many ingenious studies, some of which the author was and is personally involved in conducting. There are chapters discussing experiments with and observations of apes and monkeys, other mammals, birds, amphibians and reptiles, fish and even invertebrates. Bees and ants, for example, demonstrate the ability to pass mathematical information about the location and size of sources of food to other members of their groups.

Particularly interesting for me was to find out why turtles don't always end up in exactly the right place, why Clever Hans the horse was clever but not in the way that was originally thought, and the extent of the capabilities of Alex the parrot, who learnt to use number words with apparent understanding and to calculate with digits.

An added bonus is that the author of this book is an expert in dyscalculia and in one of the introductory chapters there is a brief but welcome discussion of the disadvantages, to individuals and to the economy, of poor numeracy and, worse, dyscalculia. Humans and animals alike benefit from being appropriately mathematically competent.

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ANNE HAWORTH
120 Park Road, Great Harwood,
Blackburn BB6 7RW
e-mail: *annehaworth@mac.com*

Irrationality and transcendence in number theory by David Angell, pp. 242, £59.99 (hard), ISBN 978-0-367-62837-6, Chapman and Hall/CRC (2022)

Although it is easy to prove that e is irrational, the proof that π is also irrational is rather challenging. Historically, the result was first established in 1761 by J. H. Lambert using the continued fraction expansion for the tangent function. In 1873 C. Hermite introduced radical ideas which could be used to establish the irrationality of various numbers related to the exponential and logarithm functions, leading in more recent times to some slick proofs that π is irrational. Indeed the ideas were developed further to deal with the much deeper problem of the transcendence of similar numbers, and the method naturally becomes correspondingly more difficult. One has to know the underlying reason for the seemingly mystical construction of complicated auxiliary functions in order to appreciate the method for the proof. The