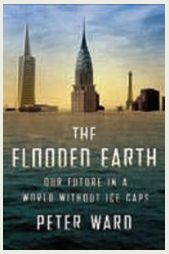
BOOKS IN BRIEF

From ocean swells to heartbeats, waves are all around us. In *The Wavewatcher's Companion* (Bloomsbury, 2010), Gavin Pretor-Pinney marvels at undulations of all types, sharing an obsession that began while standing on a sea shore. As with his previous bestseller, *The Cloudspotter's Guide*, he peers with a perceptive eye at the phenomena of everyday life to reveal the science that underlies them. Along the way he ties together a vast range of topics, from the wiggle of a snake to the ripples of the Big Bang.



The unavoidable impacts of sea-level rise are imagined in astrobiologist Peter Ward's latest book. In *The Flooded Earth* (Basic Books, 2010), he cautions that the swelling of the oceans by up to 4 metres by the end of this century will be the most profound consequence of global warming. In coming decades, the ice caps will disappear, high salt levels will render prime agricultural land barren, and coastal cities, including Amsterdam, Miami and Venice, will have to be abandoned. Ward also notes the species extinctions that will result.

Mathematician Joseph Mazur examines the science of gambling in *What's Luck Got to Do With It?* (Princeton Univ. Press, 2010). From the dice-playing of Neolithic peoples to modern lotteries and casino capitalism, he tracks the history of placing bets. He explains both the mathematics of chance and the psychological and emotional factors that entice some people to risk it all to win that improbable jackpot.

A life both kind and strange

The Price of Altruism: George Price and the Search for the Origins of Kindness
by Oren Harman
Norton/Bodley Head: 2010. 464 pp. $27.95/£20

COURTESY OF THE PRICE FAMILY

George Price in 1974, the year before his death.

The population geneticist George Price (1922–75) is an exception to the rule that scientists' lives make for dull reading. In *The Price of Altruism*, science historian Oren Harman lays bare the colour and pathos of Price's varied life, demonstrating that this irascible, unpredictable and self-centred man is worth a full-scale biography for his science as well as his psychopathology.

Price is best known today for his equation that extends William Hamilton's formulation of the genetic basis of kin selection — the tendency for individuals to foster and benefit from the reproduction of close relatives. Yet few evolutionary biologists know how altruism ultimately shaped Price's fate.

Price was, as Harman puts it, a real-life Forrest Gump, present at important historical turning points — the atomic bomb, the transistor, the computer — but never at the centre. He obtained a chemistry degree and a PhD at the University of Chicago, Illinois, and worked on the Manhattan Project during the Second World War. Afterwards, he drifted between academic and industrial jobs. He did some biomedical research, got on the bandwagon early for computers and transistors, and tried to salvage the theatre lighting company that his long-dead father had started. Having published articles on science in popular magazines, he fancied that his main career was science journalism.

Price drifted personally too. His marriage, which produced two daughters, broke up after seven years, and he never had another stable relationship. Nor were his religious beliefs consistent. Only late in his life did he find out that his father was Jewish. For many years he was violently against religion, but in 1970 he became obsessed with reading the Bible.

By then, he was living in London. He had gone there in 1967 with no plans, but with money in his pocket from an insurance claim on a botched thyroid operation. The surgery left him with permanent incapacity and pain. This afflicted him in his later years, especially when he began to live rough after giving away all of his belongings in a fervent desire to help down-and-outs in London — the ultimate exercise in religious altruism. His few possessions had been accumulated through a remarkable event that changed the trajectory of his career.

Price spent his first months in London reading up on the evolutionary origins of altruism. He applied his mathematical skills to Hamilton's theory of kin selection, building into it a more general notion of evolutionary fitness. He took his results, uninvited, to Cedric Smith, then director of the Galton Laboratories at University College London. Smith was so impressed he gave Price an honorary association with his department and obtained fellowship support for him.

During the next few years, Price worked with geneticist John Maynard Smith to extend his application of game theory (based on the famous 'prisoner's dilemma') to natural selection. He derived the concept of the 'evolutionarily stable strategy', by which populations adopt strategies that maximize their capacity to deal with complex interactions between members of the group. Price developed Hamilton's kin-selection theory further, becoming especially close to him. Both Maynard Smith and Hamilton came to Price's funeral, the only mourners save for a few outcasts whom Price had befriended.

Price's standing in evolutionary theory is now secure, but he never lived to see this acceptance within the scientific community. He was accustomed to having his papers rejected by journals — including *Nature*, although most of his later ones were published there — and in receiving polite and perfunctory replies when he contacted the giants of disciplines that interested him. Harman makes good use of Price's

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correspondence, which was rescued from his flat and office by Hamilton.

Harman's account is remarkable for interweaving Price's life with the history of evolutionary theory, including the debates about group selection and altruism in nature. Price had no inkling of how his work on altruism would later influence evolutionary theory. He had links to two men in particular who provided the framework for the evolutionary biology of the 1960s and 1970s: R. A. Fisher and J. B. S. Haldane. Price formalized Fisher's fundamental theorem of natural selection and shared connections with Haldane through University College London and his friends Hamilton and Maynard Smith. Harman's description of the nexus of debts and rivalries between these and others in the field reveals that altruism was not always present in the actions of those working on it.

Eponyms in science are becoming rare, but the Price equation is still with us. Evolutionary biologists who use it have no excuse not to know what manner of man devised it, or how — at some point between the evening of 5 January and the early morning of 6 January 1975 — that man took a pair of scissors, put them through his carotid artery and bled to death. ■

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Moving in elevated circles

Antonio Santucci's great armillary sphere reveals how patrons sought immortality through science, explains **Martin Kemp**.

Big science has always needed big patronage, from rulers, rich aristocrats or state organizations. A striking example is the huge armillary sphere by the sixteenth-century astronomer Antonio Santucci. The sphere, now splendidly restored, resides in the Museo Galileo — formerly the Museo di Storia della Scienza — in Florence, where it forms the centrepiece of a display of astronomical devices and globes.

A mechanical representation of the scheme of the cosmos according to the Earth-centred view of Ptolemy, the sphere stands about 3 metres high. It is meticulously crafted from gilded and painted metal and wood. The vertical and horizontal axes of the outer celestial sphere support a nested series of seven inner spheres, each of which traces the motion of a planet. The large central Earth, with its tilted rotational pole, Equator and tropics, is marked with the continents and seas as they were then known. Particular care has been lavished on the band on which the 12 signs of the zodiac are painted, reflecting astronomers' duty to provide astrological charts. The ensemble stands on a sculpted base, perhaps a later replacement, of four female sea creatures with bifurcated serpentine tails. Their puffed-out cheeks suggest that they signify the four cardinal winds. A handle was provided to set the model in motion.

Santucci was a little-known astronomer from Pomarance, a small town in the province of Pisa. Probably of humble origins, he excelled in making magnificent instruments and rose to become professor of mathematics at the University of Pisa.

Santucci flourished under the patronage of Cardinal Ferdinando I de' Medici in Rome, who sent another of Santucci's armillary spheres to Philip II of Spain. It is now in the Escorial museum near Madrid. Santucci moved to Florence in 1587 when Ferdinando became Grand Duke of Tuscany, manufacturing this even larger sphere in 1588–93.

The instrument is a sumptuous demonstration piece rather than an observational tool. Its lavish ornamentation reflects the power and magnificence of the Medici family as well as the wonder of the heavenly array centred on God's Earth. It is crowned by an orb and cross, a symbol of divinely ordained rule and of Christ as saviour of the world. The disc below the orb depicts God the Father, blessing the Universe he has created. God is painted with great professional skill, possibly by the artist Ludovico Cigoli, author of a treatise on perspective and a friend of Galileo Galilei. The discs marking the spring and autumn equinoxes are each adorned with two angels supporting the shield of the Medici and Christine of Lorraine, Ferdinando's wife. Four more Medici shields are distributed around the celestial equator, lest we forget who is responsible.

The Medici family had an impressive record of supporting astronomers. The stakes in astronomy were huge, both in practical terms and in that it promised a kind of immortality. Cosimo I, the first Grand Duke and father of Ferdinando, brought the astronomer Ignazio Danti to Florence. But after Cosimo's death in 1574, Danti eventually moved to Rome and worked on the reform of the calendar that was eventually decreed by Pope Gregory XIII. Had Cosimo lived longer, we might now have a Medicean calendar rather than a Gregorian one.

Santucci's reputation, like those of other Medicean and papal astronomers, has been cast into the shade by the giant figure of Galileo. Galileo himself provided testimony of the late conversion of Santucci to the Sun-centred view of the cosmos. In a letter to Christine of Lorraine in 1615, he reported that "the late mathematician of the University of Pisa … undertook in his old age to look into the Copernican doctrine". Santucci "found himself persuaded", Galileo wrote, "and from an opponent he became a very staunch defender of it".

It is poignant that the maker of the grandest of Earth-centred armillary spheres changed his mind shortly before he died. Santucci's immortality lay not in being right, but in being a great designer and maker. ■

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MUSEO GALILEO – INSTITUTE AND MUSEUM OF THE HISTORY OF SCIENCE, FLORENCE

Santucci's gilded creation represents Ptolemy's Earth-centred cosmos.

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