

workforce — which is frequently located in deregulated special economic zones that are cut off from their surroundings — constitutes less than 0.5% of India's total workforce of some 450 million, 92% of whom survive as labourers, farmers and street vendors. According to a 2007 Indian government report, 77% of Indians live on less than 50 cents a day. In 2010, only 366 million Indians had access to modern sanitation (for comparison, India has 564 million mobile phones).

Nadeem gives vignettes of life in four unnamed outsourcing companies in Bangalore, Mumbai, Chennai and New Delhi, where long hours, graveyard shifts and stressful monitoring regimes without doubt damage the workers' health. These snapshots, combined with the start-ups that have failed to live up to their promise, and widespread corruption in Indian business and politics, give the 'dead' in *Dead Ringers* — which initially refers to call-centre workers' dubious mimicry of Western accents — a more ominous significance as the book progresses.

Nadeem concludes that outsourcing is a new form of colonialism, with an insidious appeal for young Indians in thrall to American mass consumerism. Although that is essentially true, his simple explanation skirts the internal impetus that has been given to Indian technological

**"The brave new IT world documented in Nadeem's interviews disturbs more than it shines."**

innovation. After India became independent in 1947, its first prime minister, Jawaharlal Nehru, did much to establish the country's scientific higher-education system, including the Indian Institutes of Technology, and to build up its technological sector, on which the success of the IT industry rests. Nadeem neglects this crucial background and seems to endorse an unnamed Indian executive's dismissive comment: "The only thing that Nehru gave us was education. That allowed people to be in a good position when the knowledge boom came."

There is more variety and originality in Indian IT than *Dead Ringers* implies. Nonetheless, for all the wealth and political prestige that outsourcing has brought to India, one cannot help agreeing with the author that the brave new IT world documented in his interviews disturbs more than it shines. ■

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## ASTRONOMY

# Finding other worlds

A survey of exoplanetary research shows how the field has come in from the cold, finds **Chris Tinney**.

When I began my career as a graduate student in astronomy in the late 1980s, it was clear which fields were considered hot, which were not, and which were outré. Cosmology and infrared astronomy were hot. Galactic dynamics and most stellar astronomy were staid. And the search for planets and brown dwarfs — the class of objects intermediate in mass between planets and stars — was definitely outré. How things have changed.

In *Strange New Worlds*, astronomer and one-time journalist Ray Jayawardhana surveys how 15 years of exoplanet discovery has changed astrophysics. From a small base, in terms of personnel and funding, exoplanetary science — the search for and study of planets orbiting other stars — has grown rapidly and now sits at the core of modern astrophysics. Its findings have overturned many established ideas.

To show how far we have come, Jayawardhana relates a telling incident from the late 1980s: a distinguished astronomer strode out of the room when a pioneer of exoplanet searches, Gordon Walker, rose to speak about his work. As Walker remarks, it "seems hard to believe now".

Nonetheless, a few brave souls continued to work in the field. Advances in astronomical detectors, instrumentation and analysis techniques meant that in 1995, hundreds of years of observations finally bore fruit and the signatures of orbiting planets were discovered in the spectra of other stars. In the years since, hundreds of exoplanets have been found. The change in the landscape of astronomy and planetary science has been profound.

Entirely new fields have come into being or come into their own: exoplanetary science, and astrobiology, which explores the possibility of life elsewhere in the Universe. New research groups have popped up around the globe, backed by governments through major scientific strategies. The first sentences of the executive summary of the 2010 US National Research Council's astronomy decadal survey highlight this shift: "Our view of the universe has changed dramatically. Hundreds of planets of startling diversity have been discovered orbiting distant suns." Astronomy's old hierarchies have been overturned.

The title of Jayawardhana's book reflects the



**Strange New Worlds: The Search for Alien Planets and Life Beyond Our Solar System**

RAY JAYAWARDHANA  
Princeton University  
Press: 2011. 288 pp.  
£16.95, \$24.95

major scientific finding of all this activity: exoplanets are much stranger than we expected. Very few of the planetary systems found around other stars resemble the architecture of our own Solar System. Most exoplanet orbits are highly elliptical and near-circular orbits are rare, occurring only when gravitational tidal effects make them so. Gas- and ice-giant planets are located in places where they could not originally have formed,

indicating that they have moved great distances since formation. This migration seems to be the dominant driver of the exoplanet architectures we observe.

Some exoplanets are much denser than expected; others are much less dense. Some systems host many ice-giant planets in tight orbits, whereas our Solar System has only one tiny terrestrial planet (Mercury) so close. Others host no giants at all. Evidence is beginning to emerge that Earth-like, or terrestrial, planets might not be the norm. The Copernican principle — that Earth is not special or unusual — may not hold after all.

Jayawardhana's presentation of the research is remarkably even-handed. This is a fast-moving field in which groups have often clashed. Nonetheless, he provides a survey of the subject without giving the protagonists anything to complain about. His lucid and effortless prose makes for an engaging read.

*Strange New Worlds* anticipates the major results that can be expected in exoplanetary science in the coming decades: the imaging of exoplanets orbiting nearby stars; finding the first habitable Earth-like planets; the detection of biomarkers that suggest the existence of life outside the Solar System. These and much more will continue to make this field not just fashionable, but very exciting. No one is walking out of the room any more. ■

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