Morbidelli's *Modern Celestial Mechanics* (Taylor & Francis, 2002). These titles focused primarily on orbital dynamics, a topic that accounts for only about half of *Physics of the Solar System*, which manages to cover it clearly and succinctly by outlining many derivations rather than providing full details.

Preceding the orbital dynamics is an opening section that emphasizes the physical states of planetary bodies, including their rotation, gravitational fields, tidal distortions and heat budgets, and another that focuses on magnetospheres and atmospheres. The volume concludes with several chapters devoted to issues relevant for artificial satellites. The book is more focused and deeper than *Planetary Sciences* (Cambridge University Press, 2001) by Imke de Pater and Jack Lissauer, but is less broad, containing no chemistry and only a limited discussion of geological topics.

Physics of the Solar System is tightly written, fun to read and should appeal to experts in the field and new graduate students alike. Within its covers abound a wealth of interesting and little-known nuggets of planetary lore that, although available in the scientific literature, have not appeared in an accessible text before. For instance, it is well known that planets move along elliptical paths around the Sun and that these orbits precess (or rotate) slowly in space under the influence of weak gravitational perturbations from the other planets. What is less widely known is that these elliptical orbits do not always precess independently; those of Jupiter and Uranus, for example, oscillate about one another, while precessing at a common rate.

The book has a nice introduction to planetary atmospheres that starts from the concept of hydrostatic equilibrium. The authors show that an atmosphere of constant temperature continually loses gas molecules to space, and they make an analogy to the solar wind. Magnetic fields are treated in greater depth than is usual for a planetary textbook, but without the overwhelming detail of a text on plasma physics. The authors keep their focus on the Solar System by pointing out, for instance, that the energy source that powers Earth's magnetic dynamo is thought to arise from heat released as Earth's core solidifies. The lack of ongoing core solidification in Venus, rather than the slow rotation of our sister planet, is the preferred explanation for its lack of an active dynamo.

The authors provide a clear and insightful discussion of planetary gravitational fields. They describe how the dipole terms of an expansion of a gravitational field vanish with the choice of the centre of mass as the origin, and show that two of the five quadrupole terms disappear when the z -axis is chosen to point along the spin axis. They show that although geostationary satellites drift slightly relative to a fixed point on Earth's equator,

Inspiring: Antoni Gaudí's unfinished church, the Sagrada Família, dominates the Barcelona skyline.

there are two stable longitudes where this drift vanishes, thanks to a 1:1 resonance with the geopotential. These longitudes are defined by the minimum equatorial diameter of Earth, which pierces our planet near the Maldives and the Galapagos — true islands of stability in Earth's chaotic seas.

There is also a beautiful presentation of orbital-perturbation theory. It begins with a derivation of the perturbation equations of celestial mechanics based on changes to energy and angular momentum. Subsequent discussion applies the equations to the examples of atmospheric drag and Earth's quadrupole field. I follow the same scheme when teaching my undergraduate orbital-dynamics class.

Each chapter comes with a generous set of useful and challenging problems, making the text appropriate for a graduate-level course on the Solar System. One minor quibble is that the chapter on the space-time structure of the Solar System, which is a brief introduction to the general theory of relativity, is less well linked to the book's other topics than one expects from the book's subtitle. Even so, I strongly recommend making space on your shelf and time in your schedule for this lively, interesting and authoritative volume. ■

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Science and the city

Walks around the Scientific World of Barcelona

by Xavier Duran & Merce Piqueras
Ajuntament de Barcelona: 2003. 362 pp.
€19. www.bcn.es/publicacions

Jacqueline Reynolds
and Charles Tanford

The Spanish city of Barcelona dates back to the third century BC. It expanded greatly under Roman occupation from 27 BC to AD 14 but remained largely unaffected by the Moorish invasion that left its mark on so much of the southern Iberian peninsula. Barcelona's strategic location on the Mediterranean trade routes helped it to develop into an important industrial and commercial centre. Traditional guide books emphasize the city's beautiful architecture, much of it designed by Antoni Gaudí, along with the wealth of museums, the artistic tradition, the famous football team and the hosting of the 1992 Olympic Games. Knowledgeable travellers will probably associate the painters Pablo Picasso and Salvador Dalí with the city, but few would make any connection with science,

despite the prominence given to this field by today's media.

Barcelona's city council commissioned this beautifully produced guidebook to fill the gap between its artistic heritage and the less well known scientific and technological tradition. The citizens have a significant appreciation of scientists, and not just those associated with their city. Street names remind us of Pasteur, Archimedes, Descartes and Fleming, for example, and the hall in the Industrial School has walls covered with engravings commemorating scientists from all over the world and from many different disciplines. There is even a monument to the city's direct role in determining the standard metre. The French definition of this distance was one ten-millionth of a quadrant of the Earth on the longitudinal line passing through Paris; as part of this project, Jean Delambre and Pierre Méchain were assigned the task of measuring precisely the distance between Dunkirk and Barcelona.

This guidebook is divided into two major parts: the first describes the scientific and technological history of the city, and the second comprises suggested itineraries through the various geographical areas. There are also four excellent maps, as well as a multitude of colour illustrations. The book is so wide-ranging that it provides something for everyone. Outdoor types can use it as a guide when they view remnants of the old Roman aqueduct and a short stretch of canal that carried water to the city for several hundred years. A stroll along Notariat Street leads to the house occupied by the Nobel-prizewinning neurologist Santiago Ramón y Cajal during his tenure at the University of Barcelona. Botanical gardens of all sizes abound.

For the more traditional traveller there are museums dedicated to geology, ethnography, medical instrumentation, pharmacology and many varied types of technological applications. And when all this science begins to be a bit much, there is the Picasso Museum and the Museum of Catalan Art, both of which are highly praised by the ubiquitous Michelin Green Guide. Here one can enjoy not only the visual pleasures on display but also an entertaining discussion in this book about the relationship between the arts and science.

We have never been to Barcelona, but reviewing *Walks Around the Scientific World of Barcelona* has led us to consider making the trip from North Yorkshire to this marvellous city. The one caveat is that the book's excellent production quality has led to it being a somewhat weighty tome, difficult for those of us no longer in the bloom of youth to carry on our sightseeing tours. ■

Jacqueline Reynolds and Charles Tanford are authors of *The Scientific Traveller: A Guide to the People, Places and Institutions of Europe* (Wiley, 1992).

Up close and personal: images on giant screens oversee a virtual anatomy lesson in *Tulp, the Body Public*.

Performance

A visceral experience

Tulp, the Body Public

www.elision.org.au/projects/tulp

Carina Dennis

An anatomy lesson delivered over the flayed arm of an executed thief is the inspiration behind Justine Cooper's *Tulp, the Body Public*, an intimate and confrontational performance event that explores the theme of medical surveillance of the human body.

An Australian currently living in New York, Cooper weaves together a video collage of vox-pop narratives with fragments of baroque opera and contemporary music composed by John Rodgers and performed by ELISION, an Australian new-music ensemble. *Tulp* premiered last month at the Sydney Festival and will be performed at the Brisbane Festival on 23–25 September 2004.

Cooper collected anecdotes from members of the general public from a booth at the Art Gallery of New South Wales during the month before the performance. As a vehicle to intimacy, the volunteers had vascular ultrasound Doppler recordings taken, before being interviewed about their

attitudes to medicine, pain, life and death.

Close-up camera angles of volunteers' faces as they tell their stories capture some visceral experiences: one man's attempt at home surgery using insufficient anaesthetic, a woman's recovery from breast cancer, the torture of treatment for scoliosis, and a grandmother's experiences as a surrogate mother.

The 60-minute multimedia performance, — inspired by Rembrandt's painting *The Anatomy Lesson of Dr Nicolaes Tulp* — draws on baroque imagery, which is projected onto two giant latex screens on either side of the centre stage. The soft gurgling of the vascular ultrasound recordings is an audio backdrop to the contemporary compositions, periodically interrupted by improvisations in which the musicians 'dissect' their instruments — by analogy with medical interventions. The audio and visual stimulation is overwhelming at times, even to the point of distraction.

The audience is simultaneously watching and being watched. The soprano, who provides a link between the narrative and the music, carries a wireless camera strapped to her wrist. She sometimes directs it at the audience, projecting their images onto the central screen. ■

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