Against the Grain

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Collecting to the Core--Advanced Astronomy Texts

Dianne Dietrich
Cornell University Library, dd388@cornell.edu

Anne Doherty
CHOICE/ACRL, adoherty@ala-choice.org

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very suspiciously, clicking windows closed every time someone came near, stealing furtive glances all about him. After he left, I checked the history on his computer. Not only had he been surfing child porn, but he had also filled out an application for a middle school not two miles from us. Did I waver at all about his privacy or hesitate while I read the Library Bill of Rights? Not even a second. Both the campus and local police were called.

Some will argue that my case and the **Farook** case are two different things. But both perpetrators broke federal and state laws, and both had some expectation of privacy. My view is that if you break laws, you revoke your rights because you choose to steal the rights of others, and especially when you steal the ultimate right to life, to say nothing of liberty and justice. The state should bring to bear upon you its power in pursuit of justice. No, you can't beat confessions out of those whom you suspect. But you should be able to have at your disposal at least as much power as criminals have at theirs. If they use a phone to plan and/or commit murders, the state should have the right to examine said phone to bring about justice and perhaps prevent or deter others from using that shield again. Yes, we must watch the watchers, but *lex est tutissima cassis*, after all: there is no better shield than law.

If we make any of our Bill of Rights absolute, we run the risk of making them useless for justice, let alone this Republic. One would think that after so many years of trying to make the First Amendment absolute, we'd have learned a lesson. First Amendment absolutists have made possible the Internet pornography that we are currently awash in, among other things.

And now it would appear that the absolutists are going to try to win another argument for the right of **Apple** to make phones and keep them locked away from government. Meanwhile, **Apple** will continue to collect big data and protect evildoers from the prying hands of a government that seeks to wrangle them to justice. It's a brave, new and now very dangerous world, made all the more dangerous because absolutists view privacy and security as a precedent over people.

If successful, this is the way the world ends because this center really cannot hold.

Column Editor's Update: *Just as we were preparing this issue for publishing, the* ***FBI*** *successfully unlocked the phone without* ***Apple's*** *assistance. While this particular issue is now resolved, the larger one discussed here still remains. —* ***MH***

Collecting to the Core — Advanced Astronomy Texts

by **Dianne Dietrich** (Digital Projects Librarian, Cornell University Library; formerly Physics and Astronomy Librarian, Cornell University Library and Astronomy Editor, *Resources for College Libraries*) <dd388@cornell.edu>

Column Editor: **Anne Doherty** (*Resources for College Libraries* Project Editor, CHOICE/ACRL) <adoherty@ala-choice.org>

Column Editor's Note: *The "Collecting to the Core" column highlights monographic works that are essential to the academic library within a particular discipline, inspired by the* ***Resources for College Libraries*** *bibliography (online at* ***http://www.rclweb.net****). In each essay, subject specialists introduce and explain the classic titles and topics that continue to remain relevant to the undergraduate curriculum and library collection. Disciplinary trends may shift, but some classics never go out of style. —* ***AD***

In order to secure support for the tremendous amount of resources required to do research work, astronomers generally must also excel at outreach, convincing the public that astronomical exploration is interesting and essential for society as a whole. Astronomers often succeed in this task by tapping into a collective curiosity about the universe. It is fitting, then, that the *Resources for College Libraries* essential undergraduate collection in astronomy includes works that help the non-scientist understand the beauty of the night sky and introduce students to the enriching study of the universe's mysteries. Many of the selected titles provide an excellent descriptive background for historical and current astronomical research, providing value to any liberal arts education. By design, many undergraduate works contain a far less rigorous treatment of the underlying physics and mathematics than professionals need to conduct research in the field. Accordingly, a comprehensive undergraduate collection ought to also include advanced material that supports those students planning to pursue graduate study in astronomy. Students interested in doctoral research in astronomy are advised to have a solid grounding in physics; in fact, many often major in physics rather than astronomy. How then, does one determine the essential *astronomy* titles that support undergraduates for advanced study in that field? One way is to consider what is essential to graduate education in astronomy and select those works that remain accessible to undergraduates. In considering selections from the *RCL* Astronomy collection to highlight in this essay, I consulted the "Classic Astronomy Texts" list, developed by **Cornell University** librarians in collaboration with astronomy graduate students in 2009.[1] The works in this list identify those titles astronomy graduate students consider essential to their education. Not surprisingly, only a few of the titles are also in the *RCL* core collection in astronomy. The works that do overlap, however, span a range of topics within the discipline. Many were written for graduate students at the beginning of their careers and though these works are likely to be demanding for undergraduates, this does not mean they are impenetrable.

Astronomical research often invokes mesmerizing images of faraway galaxies. Authors **James Binney** and **Scott Tremaine** note that while galaxies are worthy of study on their own, the techniques used to understand galaxies can also be leveraged in physics research. In *Galactic Dynamics*, the authors provide students with the background needed to pursue research in galactic structure and evolution, using only a prerequisite of undergraduate physics coursework and no prior astronomy coursework.[2] The book is not as mathematically rigorous as other advanced and professional-level textbooks and difficulty rankings help users assess which of the included exercises they might solve.[3] In fact, advanced undergraduates may already have some of the background needed to appreciate this text. The second edition of the book includes major revisions to incorporate more current research and theory in the field. In the preface to the second edition, the authors note that galactic research "carries the student to the frontiers of knowledge faster than almost

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any other branch of theoretical physics.…" **Binney** and **Tremaine** help undergraduates comprehend what is currently under investigation by researchers and, perhaps in understanding the questions researchers are pursuing, the enterprising undergraduate may discover a topic for graduate school admission essays.

The Physics of Astrophysics by **Frank Shu** consists of a two-volume set (*Volume 1: Radiation; Volume 2: Gas Dynamics*) and encompasses nearly all of the physics and mathematics training graduate students need to pursue research in astrophysics.[4-6] These volumes, while likely formidable for undergraduates, may serve as motivation to continue study in astronomy and astrophysics. One of the great strengths is how each of the topics flows from one to the next, emphasizing to students that the study of the universe should not be thought of as discrete subfields, but as one interconnected system where techniques and insights from all research areas contribute to understanding.[7] **Shu** writes his books for the thoroughly engaged student; for example, one section concludes with a recommendation to conduct a literature search — a daunting task for graduate students, much less undergraduates. In the preface to *Gas Dynamics*, **Shu** reiterates that while the primary audience is first-year graduate students, the material should be accessible to "well-prepared seniors." Yet **Shu's** high standards are not without reason: his stated aim is to give students the necessary background for deeper research, noting that there is often simply not enough time to obtain this background through coursework alone. A broad treatment of the material gives students a solid understanding of the breadth of potential research topics and inspiration for those pondering post-collegiate careers.

Forming stars, planets, and black holes all involve accretion disks, where material orbiting a gravitational field spirals inward as it loses energy. When *Accretion Power in Astrophysics* was first released in 1985, information about accretion disks in astrophysics had not yet been collated in any single textbook.[8-9] It is likely that only active researchers knew how to locate the original research papers and synthesize the state of the subject. Authors **Juhan Frank**, **Andrew King**, and **Derek Raine** provide an overview of the field suitable for graduate students and researchers, though the authors note that it may be accessible to advanced undergraduates with a solid physics background. Now in its third edition, the updated text incorporates new developments in the field. Similarly, active galactic nuclei are part of a body of research that is fairly recent, though interested upper undergraduates may want to know more. **Donald Osterbrock's** *Astrophysics of Gaseous Nebulae and Active Galactic Nuclei* updates the author's original text on nebula from the 1970s.[10] Now in its second edition (co-authored with **Gary Ferland**), it has been tailored to reflect the changing backgrounds of incoming graduate students, meaning it may be accessible to advanced undergraduates.

While some astronomical research deals with distant objects millions and even billions of light years away, *Solar System Dynamics* by **Carl Murray** and **Stanley Dermott** explores objects "closer" to home — that is, in our own solar system.[11] Like the authors of *Accretion Power in Astrophysics* discussed above, **Murray** and **Dermott** pull together topics previously found only in the subject literature so as to guide beginning researchers. Since the authors admit that the text was largely drawn from graduate-level lecture materials, this monograph may be quite challenging for undergraduates. Even if the mathematics is just slightly out of reach for even ambitious undergraduates, the authors' appreciation for their chosen material is evident. Far too often, science is depicted as dry and boring, which ignores the creativity needed to excel as a scientist. Readers may be pleasantly surprised to find selections from **Shakespeare** at the beginning of each chapter. These literary headings may spark inspiration in an aspiring undergraduate student.

When **Frank Shu** set out to write an introductory astronomy textbook, there were countless other books on the subject. Why, then, was he compelled to add another volume to an already expansive collection? Most textbooks, he argues, tend to focus on select picturesque objects in the universe and sacrifice mathematically rigorous explanations of those objects. Instead, *The Physical Universe* offers the undergraduate student a solid understanding of how astronomy connects to the physical world around us.[12] **Shu** notes that the book "emphasize[s] the deep connections between the microscopic world of elementary particles, atoms, and molecules, and the macroscopic world of humans, stars, galaxies, and the universe." Indeed the book's organization reflects this, starting with chapters that offer a foundation for the advanced astronomical concepts that are explained later in the text. The book begins with these "basic principles," including a historical perspective and necessary concepts from mechanics and physics. Next, the text examines stars, galaxies, cosmology, the solar system, and planetary science. The volume concludes with several chapters about life on Earth, connecting astronomy with related areas of scientific inquiry including molecular biology and even anthropology, as well as the search for life elsewhere in the universe. While the text includes sample problems that are intended for the science major, **Shu** points out that non-science majors will find value even without working through the questions. Ultimately, **Shu's** text engages all students — irrespective of their ultimate career path — and fosters an understanding of why scientists are motivated to pursue research careers, making it an essential title for undergraduates considering graduate study.

As more college students participate in research, undergraduate library collections should expand to include works to support them. Introductory graduate-level texts can position advanced undergraduates for the rigor of postgraduate study in a scientific field, whether they are considering applying to graduate school or perhaps enrolling in graduate-level courses during their senior year of college. All of the referenced textbooks here would be valuable additions to an undergraduate collection supporting a range of students, including those considering research careers in the astronomical sciences.

Endnotes

1. "Classic Astronomy Texts." *Physical Sciences Library, Cornell University Library.* Accessed January 13, 2016. *http://physicalsciences.library.cornell.edu/classic_texts/grid/title/all-astronomy*

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5. **Shu, Frank H.** *The Physics of Astrophysics, Vol. 1: Radiation.* Mill Valley, CA: University Science Books, 1991.*

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8. **Osterbrock, Donald E.** Review of *Accretion Power in Astrophysics* by **J. Frank**, **A.R. King**, and **D.J. Raine**. *Science 233* (1986): 582-583.

9. **King, Andrew R.**, **Juhan Frank**, and **Derek J. Raine**. *Accretion Power in Astrophysics*. 3rd ed. Cambridge, UK: Cambridge University Press, 2002.*

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11. **Murray, Carl D.**, and **S. F. Dermott**. *Solar System Dynamics.* Cambridge, UK: Cambridge University Press, 1999.*

12. **Shu, Frank H.** *The Physical Universe: An Introduction to Astronomy.* Mill Valley, CA: University Science Books, 1982.*

*Editor's note: An asterisk (*) denotes a title selected for *Resources for College Libraries*.