

BOOK REVIEWS

Operational Flaws

The Hubble Wars. Astrophysics Meets Astropolitics in the Two-Billion-Dollar Struggle over the Hubble Space Telescope. ERIC J. CHAISSON. HarperCollins, New York, 1994. xii, 386 pp., illus., + plates. \$27.50.

This is an eyewitness account of the first 19 months of the Hubble Space Telescope in orbit, starting with its launch in April 1990. The author, Eric Chaisson, served as a staff scientist and director of educational programs at the Space Telescope Science Institute in Baltimore, which had been set up by NASA to operate the telescope once it had been launched and tested in orbit. In this role, Chaisson kept a record of daily events, which is the basis for the book.

Briefly, the story is this. The launch was near-perfect, but engineers soon found they could not focus the telescope. It was Chris Burrows, an Institute scientist, who first realized that the problem was not the focus but spherical aberration in the main mirror. NASA overreacted, declaring the main camera useless for real science, but Institute scientists set about designing algorithms to sharpen the image. Long before the Hubble repair mission in 1993, which enabled cor-

rective optics to be inserted in the light path, useful science was being routinely accomplished and discoveries were being made.

Chaisson is a first-class storyteller—in the same league as Tracy Kidder (*The Soul of the New Machine*). His account of the launch—the culmination of 13 years of effort and \$2 billion expended—is gripping. He was also there when the first images came up on the screen and when Burrows made his fateful announcement of spherical aberration. He was there when some astronomers who put their own data rights ahead of the welfare of the project “went ballistic,” and also when NASA’s chief scientist, beset by other mission failures and congressional threats to abandon the project, told a room full of project scientists, “The future of the space program is in your hands.” His accounts fairly sizzle, leaving indelible impressions of what went wrong with this ill-starred project.

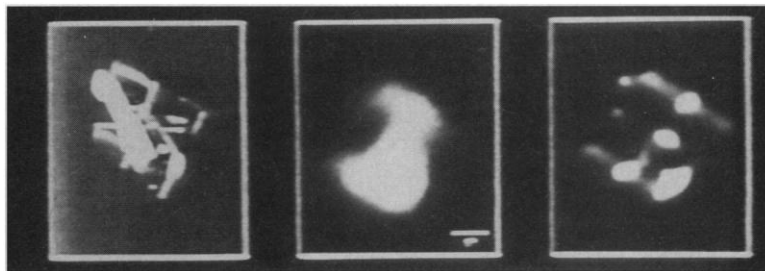
According to Chaisson, a problem that surfaced repeatedly was a lack of technical truth: at Perkin-Elmer, when technicians failed to carry out the most elementary tests that would have revealed the flaw in the mirror; at NASA headquarters, when, before launch, the telescope was hyped far out of proportion to its unique but nevertheless limited capabilities; at Goddard Space Flight Center,

when engineers, failing to focus the telescope, nevertheless issued daily reports indicating that tests were on schedule; and at the NASA Office of Public Affairs, when it insisted that only good images be released—and only those with NASA’s logo writ larger than that of the European Space Agency, a partner in the project.

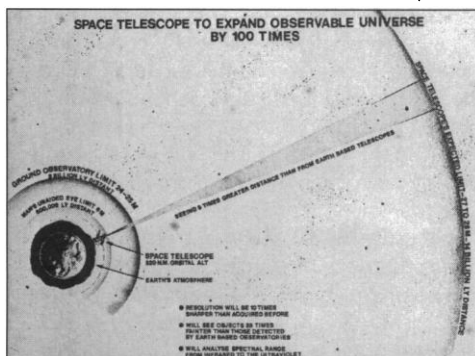
Chaisson is doubtless correct when he argues that lack of candor led to far greater disillusion in Congress and the White House than if an honest appraisal of the problems and potential solutions had been given right away. It is not so clear what ultimately saved the project from the budget ax. According to Chaisson, it was the release of “pretty pictures”—images of astronomical objects which the public could see were superior to anything ever seen before—such as the image of Saturn that President Bush passed around at a cabinet meeting. Chaisson’s version of events reflects well on the Institute in general, and Chaisson himself in particular, in his role as leader of the early image-release observations program set up to disseminate astronomical images interesting to the public. Had the telescope worked properly, this would have been a routine exercise; but as it was, because of the flawed telescope, it developed into a battle royal between those like Chaisson who wanted to share images with the public even if they were flawed and those at NASA who wanted to suppress any images that were not perfect. Scientists who insisted on deferring the imaging of their assigned targets until the telescope could be fixed only exacerbated the conflict. These “Hubble wars” are a central theme of the book. Though the angry clashes they engendered make entertaining reading, historians may hesitate to accept Chaisson’s eyewitness accounts as definitive until buttressed by in-depth interviews of others. Hence we cannot be sure that it was



“A wall of the author’s office at the [Space Telescope] Science Institute became an informal status board for the *Hubble* imaging campaign in the late summer and fall of 1990. Here, around the perimeter of a large, oval shaped map of the nighttime sky were displayed finding charts and guide-star plots in the vicinity of each of the early *Hubble* targets; as soon as the newly acquired *Hubble* images were in hand, they too were posted. This was major-league exploration, and great fun too—the way science ought to be—for a variety of cosmic phenomena were being examined much more clearly than ever before.” [From *The Hubble Wars*]



“Space Telescope can be clandestinely monitored by a formidable array of ‘national imagery’ systems. The central picture is a raw image of *Hubble* as seen from a reconnaissance asset on the summit of Hawaii’s Mt. Haleakala; in the right-hand picture, atmospheric blurring has been compensated for, thus showing increased detail. Both images were frame-grabbed from an infrared video of *Hubble* in orbit and the right one has been intentionally doctored, namely ‘fuzzed,’ so as not to reveal the full capabilities of the Air Force Maui Optical Site. The picture at left is an artist’s conception of Space Telescope, drawn to the same size, scale, and orientation as that shown in the other two frames. Absolute scale is intentionally unspecified.” [From *The Hubble Wars*; Lincoln Laboratory and The Strategic Defense Initiative Organization]



"Hype documented." This "sketch and several variations of it . . . were liberally used in many prelaunch NASA documents, briefings, and other materials meant for the press, educators, and the general public. It claims that our naked eye can see only relatively nearby cosmic objects, which is false since, for example, on most autumn evenings we can readily see . . . the Andromeda Galaxy millions of light-years away. The NASA diagram also claims that ground-based telescopes can study celestial objects only as far away as 2 billion light-years, which is false since long exposures with even moderate-size telescopes can reach . . . more than 10 billion light-years away. In truth, *Hubble* is designed to see cosmic regions more clearly. . . , but it cannot see to appreciably greater distances than can existing ground-based telescopes. . . . Many other publications picked up this misinformation and disseminated it throughout the public and educational domains." [From *The Hubble Wars*; NASA]

the release of "pretty pictures," with the public interest they engendered, that turned the tide of opinion and saved the project.

There are many fascinating astronomical images from Hubble reproduced in the book. Regrettably, some have such small print on and below them that superb visual acuity is required to appreciate them. The fact that coverage of the repair mission is minimal is also regrettable. Chaisson states that, contrary to press reports, not all of the "fixes" worked, and those that did were accomplished only by giving up other capabilities. Is this really a fair assessment of the upgraded telescope, given the discoveries it has made?

The technical descriptions are first-class. Although they are randomly interspersed with anecdotes of personal conflict and hence take time to track down, they provide a reference base that alone is worth the price of the book.

Finally, a word on the spy-satellite cousins of the Hubble telescope. Because of prior experience with military affairs, Chaisson is able to describe developments in that field, which, it seems, far exceeded the effort put into the Hubble telescope. For example, we learn that a decade before Hubble was launched Perkin-Elmer had already built a dozen space telescopes of the Hubble class as spy satellites. Also intrigu-

ing is the fact, noted in passing, that the TDRSS satellites used by NASA to communicate with Hubble are a mainstay of military communications, operated by a secretive company whose chief executive officer was killed by a car bomb. At least no one was killed in the Hubble wars.

In short, *The Hubble Wars* is an exciting account of what went wrong—well written, perhaps not completely accurate as a historical record, but definitely very enjoyable for anyone curious about Hubble, astronomy, and big science.

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Ant Invaders

Exotic Ants. Biology, Impact, and Control of Introduced Species. DAVID F. WILLIAMS, Ed. Westview, Boulder, CO, 1994. xviii, 332 pp., illus. \$74.85 or £55.50. Westview Studies in Insect Biology. Based on a conference, Galápagos Islands, Oct. 1991.

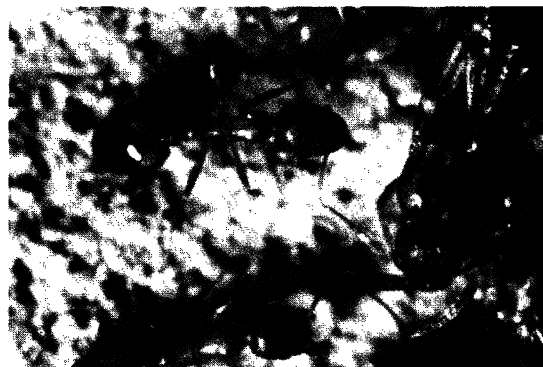
When the great voyagers of the 17th and 18th centuries arrived in the New World they likely had among their passengers Pharaoh's ants, natives of the Old World tropics that had already established themselves throughout much of Europe as a result of trade. Although the legacy of these early hexapod colonists is not as widely appreciated as that of their bipedal patrons, it has become increasingly relevant as a symbol of the destructive consequences of biological invasions caused by human activity. Pharaoh's ants (*Monomorium pharaonis*) now occur virtually anywhere humans do, nesting in our buildings and feeding on our food and wastes. Their colonies are transient assemblages of thousands of tiny workers and scores of queens that readily migrate, fragment, or fuse in response to newly discovered food items or disturbance. Their workers rapidly discover food sources (which include all manner of sweets and proteins, including soiled bandages in hospitals) and efficiently exploit them by laying chemical trails to recruit nestmates. Their queens have abandoned the hazardous mating flight of most other ants, preferring instead to mate (incestuously at times) within the safe confines of their nests.

Pharaoh's ant is only one of several species of "tramp" ants that, along with many exotic insects,

birds, plants, and fishes, have colonized locations far from their native ranges by means of commerce, travel, or intentional release. The result in many cases is the emergence of new pests that evade the population regulation previously imposed by their natural enemies. Exotics may build up enormous populations that negatively affect native species by means of habitat destruction, disruption of trophic webs, or hybridization, sometimes driving natives to local extinction or permanently altering their unique gene pools. Because ants are dominant components of most terrestrial communities, they can have particularly devastating effects when they come into contact with organisms with which they did not evolve. Thus exotic ants pose a serious threat to biodiversity, simplifying and homogenizing regional biotas that collectively constitute the unique signature of life on Earth.

Biologists study human-mediated biological invasions such as that of Pharaoh's ants for several reasons. One is to develop an ecological theory of invasion that can predict which species will be successful invaders and which communities are favorable to the establishment of invaders. Another is to refine general ecological and population genetic theories that apply to more "natural" situations. For instance, studies of contemporary biological invasions may shed light on the role of competition in structuring communities, the impact of species replacements on ecosystem function, or the effect of loss of genetic variation on adaptation and speciation.

This volume edited by Williams includes 25 mostly brief chapters, many of which discuss a specific exotic ant in a particular setting. Notable gleanings are the apparent consensus that island faunas are especially susceptible to disruption by exotic ants (Reimer; Meier; Fowler *et al.*; Haines *et al.*), the clear documentation in many systems of reductions in native ant species diversity following establishment of exotic ants (Tennant; Zenner-Polania; Fowler *et al.*; Majer; Jusino-Atresino and Phillips), and the demonstration that exotic ants exist within, and



Pharaoh's ants. [Animals Animals]