



The New Pioneers

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Not long ago, the notion of any entity other than a government putting a payload—let alone a human being—into space seemed absurd to most people. After all, the space race had been between governments, and everyone knew that it took billions upon billions of dollars, and even then the rockets often failed. Who in the private sector could afford such an outlay on such a risky venture for such a seemingly small return? As a result of this understandable skepticism, in the early 1980s, the first few commercial launch startup companies had to persuade both investors and government regulators that they had serious and credible plans for building private rockets.

In 1984, the U.S. government acknowledged that there was potential for a private launch industry when Congress, at the behest of this new class of entrepreneurs and the Reagan administration, passed the Commercial Space Launch Act. For the first time, the government recognized the necessity of providing a predictable regulatory environment

for the private industry, to (at a minimum) soothe investors' qualms. But no one was yet seriously proposing private human spaceflight—the idea was still only to provide alternate means of launching commercial or government satellites. Even many in the launch industry couldn't fathom

a market for putting people into space, other than from NASA, which had the space shuttle for get-

ting its astronauts there. Given the doubts about the market and the concerns about affordability and safety, it's not surprising that the notion of private manned spaceflight suffered from what many in the emerging commercial space industry called "the giggle factor."

But in the last few years, the giggle factor has rapidly evaporated. First, a team led by engineer and entrepreneur Burt Rutan won the \$10 million Ansari X-Prize in 2004 by putting a man into space with two consecutive flights in as many weeks. Next Rutan's team made a deal with Richard Branson, the billionaire who founded Virgin Records, then Virgin Airlines, and now Virgin Galactic

Rocketeers: How a Visionary Band of Business Leaders, Engineers, and Pilots Is Boldly Privatizing Space

By Michael Belfiore

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Spacelines—which quickly took millions of dollars of deposits from prospective private space travelers. The new interest from investors and the readiness of customers to fly in space have reinvigorated a private spaceflight industry that had grown moribund in the early part of the new millennium after the prospective commercial satellite market collapsed in the wake of the dot-com bust. In fact, many of the investors in this resurgence of private space were themselves dot-com millionaires who had either gotten out before the bubble burst (such as Elon Musk of PayPal) or who had survived it and thrived (such as Jeff Bezos of Amazon and Paul Allen of Microsoft, the latter of whom underwrote Rutan’s prize-winning achievement).

This new manned spaceflight industry is now comprehensively chronicled for the first time by freelance journalist Michael Belfiore, a frequent contributor to *Popular Science*. *Rocketeers* gives a behind-the-scenes look at several of the new space companies, most of which formed in the 1990s and are only now hitting their stride, and a few of which are of the new millennium, including Musk’s Space Exploration Technologies and Bezos’s Blue Origin. Belfiore vividly depicts the spaceflights themselves, as described to him by participants like Brian Binnie, the pilot of Rutan’s SpaceShipOne during the winning X-Prize flight (and a former colleague of

mine at the Rotary Rocket company). Binnie’s experience, as relayed by Belfiore, reads like a brochure for one of the new space travel companies:

The instant the howling of the engine cut off, Binnie could take his eyes off the display that had commanded his attention since the drop, let his hands float from the controls, and just enjoy the view. And what a view it was! Ahead was the fathomless black void of space. He almost felt it as much as saw it: a “vast presence, looming and yawning through the spaceship’s little windows,” full of “menace and mystery.”

Belfiore, who clearly spent considerable time visiting a number of the so-called “NewSpace” companies and talking to their founders and employees, provides backgrounds and histories of the industry and its leaders. While Burt Rutan was fairly well known even before he won the X-Prize for projects such as his innovative kit planes of the 1970s and his design of the aircraft that performed the first non-stop trip around the world, Belfiore also spotlights other, less-known pioneers. He tells the stories of Jeff Greason, the CEO and one of the founders of XCOR Aerospace, a Caltech whiz kid who was the youngest project manager at Intel; Chuck Lauer, real-estate developer and marketer for space tourism vehicles and hotels; Tim Pickens, self-educated rocket

mechanic with his own rocket-powered bicycle and pickup truck, and a major contributor to SpaceShipOne's engine; and many others. This is a book not about just rockets and rocket planes, but about visionaries and their dreams.

Many of Belfiore's vignettes accentuate the difference between what you might call the government *modus operandi*, with its risk aversion and cautious analysis, and that of the entrepreneur in a hurry. He describes the design process at Bigelow Aerospace:

Putting preliminary designs into physical form isn't exactly the norm in aerospace engineering, and it took some getting used to for Schneider. At NASA, Schneider explained to me, "We would sit down and do all the engineering first before we ever cut any metal, period." When Schneider joined Bigelow Aerospace as a consultant, he was amazed by Bigelow's insistence on producing a machined part for every revision of a design—and the skill with which Bigelow's machinists turned them out in short order. . . . Schneider told Bigelow that he planned to "go ahead and design it right the first time" before spending a lot of time machining parts that weren't ultimately going to be used. But Bigelow would have none of it. "Well, I'm not used to that," he said. "I have to keep these guys busy out there because I don't want them

sitting around. So design it the best you can do in that two-day period, and when you come in the next time, we'll have one sitting on your desk." . . .

"So we redesigned it," Schneider told me, "and the next time I'd come, *Shoomp!*, it had evolved to the thing I and some of the other fellows here designed."

The point is not so much that NASA's way is wrong and Bigelow's right, as that, with so many new players doing so many things in parallel, this burgeoning industry is much more likely to find new approaches and innovation. The NewSpace approach has much more in common with the proliferation of aircraft concepts in the 1920s and 30s than it does with the monoculture of NASA's bureaucratic approach.

Belfiore was born too late to recall NASA's glory days firsthand—he was an infant when the last Apollo astronauts walked on the Moon—but he was still a space enthusiast from an early age. As he explains in the book's preface, he got hooked on science fiction, and particularly the work of Robert Heinlein. The reader of Belfiore's book gets the sense that his youthful passion for space has been rekindled. In his eagerness to delve into this new and exciting industry, Belfiore seems to have almost "gone native" in his enthusiasm and lost an objective, reportorial distance. The most notable example

is his description of the vision of Bob Bigelow, a Las Vegas hotelier who is developing inflatable space facilities for sale or rent as hotels or space research labs:

At forty-five feet long and twenty-two feet in diameter, the BA-330 would have more habitable volume than anything ever launched into space in one piece. These two mockups, linked end to end by a docking module as they might be in orbit, enclosed an interior volume larger than that of the then-current configuration of the International Space Station.

I found myself tearing up. “That is awe-inspiring,” I breathed. This guy was actually building real hardware, not just turning out the computer-generated concept images that aerospace companies seemed to love so much. Bigelow made no comment to my little exclamation, though this was surely the reaction that he’d hoped for.

Belfiore concludes his book with a projection of the state of the solar system in the year 2034. The first part of this account is reasonable—rocket planes are providing fast trips from point to point on Earth; private enterprise and foreign competition have finally chased NASA out of the market for delivering people to low Earth orbit. But then Belfiore digresses into a description of solar power satellites (SPS) providing abundant “green”

energy by beaming it from space to the ground. To be sure, SPS is an interesting concept, but there is no reason why he should focus on it to the exclusion of other potential future off-planet activities. While it is quite plausible to imagine large-scale human traffic to and from space, and even a vast amount of activity in lunar orbit, SPS is itself a step beyond that in terms of required technologies—and other terrestrial energy solutions (such as nuclear power or more effective ground-based collection of solar energy) are likely to come to the fore long before beamed space power becomes practical. Moreover, if beaming power from space becomes practical, there are many architectures more likely than the one Belfiore describes, which is of 1970s vintage and based on outdated technologies. (I can say this with some authority, having been a project manager of SPS studies at a major aerospace company.) It would have been far better had Belfiore spent more time imagining and describing the range of potential new activities and businesses that will be enabled by low-cost access to space—such as lunar tourism, asteroid mining, and private space exploration to other bodies and planets—instead of ending the book on this misguided and obsolete note.

In a field as dynamic as this one, any book about such recent history can be quickly overtaken by events. Already since its publication

in mid-2007, there have been some changes in the prospects of several of the companies described, with some setbacks and some advances. Consider these final thoughts a brief updated epilogue to the book.

On the downside, Rocketplane Kistler (RpK) was unable to raise the hundreds of millions of dollars needed to complete building the reusable orbital launch vehicle with which the company hoped to deliver cargo to the International Space Station to satisfy the requirements of NASA's Commercial Space Transportation Services (COTS) program. In failing to do so, RpK missed several scheduled milestones that were necessary for the company to receive progress payments from the space agency under the terms of its Space Act agreement. NASA waited patiently for several months but could not wait indefinitely, especially with other potential vendors (including the other COTS winner, SpaceX) champing at the bit to get ahold of the money intended for RpK. In fall 2007, NASA terminated the contract with RpK and reopened bidding, with an announcement expected early in 2008.

In another setback for the industry, on July 26, 2007, less than a week before the release of Belfiore's book, there was an explosion on a test stand at the Mojave Airport (and Spaceport), where Scaled Composites, Burt Rutan's company, was developing the hybrid (liquid oxidizer, solid fuel) rocket motor for

SpaceShipTwo, the successor to the rocket plane that won the X-Prize in 2004. SpaceShipTwo is the commercial vehicle that Richard Branson's Virgin Galactic intends to use for its space passenger flights. Three Scaled Composites employees were killed, and another three injured. With investigations underway, development of the motor is reportedly on hold, the (always unannounced) rollout schedule for SpaceShipTwo has been delayed, and there is uncertainty as to the future direction of the engine's development. As of this writing, there has still been no public announcement by Scaled Composites as to the cause of the accident, or plans for SpaceShipTwo propulsion. According to Virgin Galactic's Chief Operating officer, Alex Tai, all options are still on the table.

But there has been some good news as well. Since the book came out, Belfiore's most-admired entrepreneur, Bob Bigelow, has announced an acceleration by two years of his previous plans to launch his first inflatable habitable module. He plans to put it into orbit by 2010 on a Russian launch vehicle. Bigelow claims to have made the decision because launch prices were going up and he wanted to save money. Schedule slippage is endemic, and even expected, in the space industry. Schedule *acceleration* is rare—almost unheard of. This is a dramatic demonstration of the difference between a government program and one on

which private investors are spending, and striving not to waste, their own money.

The fast pace of change in this industry makes it a challenge for even dedicated bloggers to keep up, let alone the authors of books. But *Rocketeers* will stand the test of time as a useful snapshot of a particularly exciting period in the history of the pioneering effort to open up the cosmos not just for astronauts, but for the rest of us. Anyone who wants an entertaining and well-crafted

description of today's emerging private space industry would do well to read Belfiore's book. So, too, would anyone who wants to understand the impulse underlying this new space age—the entrepreneurial spirit that hints at better prospects for fulfilling the promises unmet by the old one.

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