

Rocket Ranch

The Nuts and Bolts of the Apollo Moon Program at Kennedy Space Center

**Also by Jonathan H. Ward
for Springer-Praxis**

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Jonathan H. Ward

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Fred Cordia, one of the senior managers on Rockwell's S-II stage, likewise took painstaking time and effort to immerse me into the life of a launch vehicle stage contractor. One of the serendipitous joys of writing this book was putting Frank and Fred back in touch with each other for the first time in many years.

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x Acknowledgments

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On April 22, 2013, my good friend the Rev. Meghan Froehlich said to me, “You need to write a book.” I was non-committal, as I couldn’t imagine what I would possibly write a book about. Little did we know that she planted a seed that day that insisted on being cultivated. Special thanks to Holly Williams for coaching me through the book writing process and keeping me from feeling overwhelmed. Without her, I might still be trying to get started. Thanks also to Martin Impey, Rick Swegan, W. David Woods, Francis French, Colin Burgess, and Susan Roy for their encouragement and sage advice during the writing and editing process. Their books have places of honor on my shelves. I appreciate the support provided by Emily Carney, Rebecca McWhirter, and other members of the Facebook “Space Hipsters” group. Thanks also to Maury Solomon and Nora Rawn at Springer for their excellent advice and patience with a new writer navigating the publication process for the first time.

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And many thanks to you, kind reader, for your curiosity about Kennedy Space Center and the days of Apollo and Saturn. All of the people I interviewed were deeply grateful that there are people interested in the Apollo era and what went on at KSC. You honor them and their legacy when you read this book. I hope that my writing conveys some of the thrill I experienced in hearing their stories.

*This book is dedicated to the nearly
24,000 men and women of Kennedy
Space Center who assembled, tested,
and launched America's Apollo/Saturn missions.*

About the Author

American author Jonathan Ward spent several years of his childhood in Japan, but he considers the Virginia suburbs of Washington, D. C., to be his hometown. Although he has a wide variety of interests and has worked in many fields, space exploration is his lifelong passion. His joy of bringing the space program to life for the general public began in high school, when he served as a volunteer tour guide at the National Air and Space Museum during the Apollo 15 and 16 missions. He continues his public outreach today, as a Solar System Ambassador for the Jet Propulsion Laboratory, as a frequent speaker on space exploration topics to interest groups and at regional conferences, and as an author for Springer-Praxis. Jonathan is also a frequent contributor to online space exploration forums.

Jonathan brings a unique perspective to his writing that marries a systems view of the topic, fascination with the technology, passion for space exploration, and deep respect for the people who make it all happen. He holds an MS in Systems Management from the University of Denver and a BS in Psychology from Virginia Commonwealth University. He is professionally certified as an executive coach by the International Coach Federation and serves on the adjunct faculty at the Center for Creative Leadership. His professional experience includes extensive work with leadership teams and several years with Boeing on the Space Station Freedom program.

Jonathan and his wife Jane now reside in Greensboro, North Carolina. He is fiercely proud of his two grown children and their families, and he wishes they lived closer to him. He maintains a web site at www.apollo-saturn.com to document his research on the Apollo era at Kennedy Space Center. He collects and restores artifacts from the Apollo era, including several control panels from the Firing Rooms. Jonathan also notes that he might possibly be the only current author about manned spaceflight who has appeared on two GRAMMY-winning albums, which were recorded during his years as a Bass II section leader, soloist, and eventually president of The Washington Chorus.



Foreword

I'm honored to introduce this book about our Apollo and Saturn team at Kennedy Space Center. You will learn the inside story of what it was like to be part of Project Apollo at KSC, what I consider to be the greatest achievement in human history. I'm convinced this story is a winner, one that needs to be told.

We are a product of our environment. In the Apollo days, we had great leaders, we had smart people who were willing to try new things, and we took responsibility for making bold decisions. That's what made Apollo succeed.

When President Kennedy made his challenge on May 25, 1961, the NASA organizations were on the level of a mom-and-pop grocery store. And the next day, we suddenly had to be General Motors or Walmart. Fortunately, we had strong leaders at each NASA Center: Bob Gilruth, Wernher von Braun, Kurt Debus, and others. Of course, they all had their own ideas, and they fought for them fiercely. But we had strong NASA management in Washington. Jim Webb was one of the best administrators we ever had. He knew how to work the Congress, he knew how to work the executive branch of the government, and he knew how to get resources.

Webb called in Dr. George Mueller, who brought in General Sam Phillips as program manager. When you were a program manager, you got money. And if you got the money, you got the power. Dr. Mueller and Gen. Phillips drew up a plan, and they told each NASA center, "Here's what you're going to do, and this is the way we're going to do it."

There'd still be some infighting, but they worked it out. With the time pressure we were under, we couldn't get a committee together and study the situation for months. They had a 5-hour meeting in Washington one day and decided, "Here's how we're going to the Moon." And what is the flight hardware, the booster going to look like? And von Braun had some strong ideas on that. And then you had to design that hardware and write contracts. And how are you going to launch that baby? That's where Dr. Debus figured out what the Launch Complex 39 should look like. We had people like Don Buchanan at KSC to do the design work. He was one of the sharpest guys out there. It all worked beautifully.

And I can't say enough about Rocco Petrone, the director of launch operations for Dr. Debus. I am not sure many people know or appreciate what Rocco meant to the success of the Apollo Program, but we never would have gotten to the Moon on time, or maybe never got there at all, without Rocco. I attended Rocco's staff meeting every morning and I observed what he did to shape up not only KSC but also Houston and Huntsville. A lot of evenings, I don't know how it happened, but I'd end up in Rocco's office, and Rocco would sit there and just talk about the whole program. He had vast knowledge. If there were problems they were having back at the factory with the command module, or the S-II, or the engines or whatever, Rocco knew as much or more than the guys at Houston or Marshall. If you were straight up with him that you didn't have all the answers, that's okay—just go get them. But you should never try to fool him. Chances were that he already knew more about a situation than you did.

When we started off, we had advantages we weren't aware of. We were all young. In the space exploration business, that's a tremendous advantage, because when you're young, you're not afraid of failure like you are when you're older. That's true of an organization and of a person. I've got two little great-grandchildren. They try to walk around. They tumble, and we all laugh. It doesn't bother them. They get up and try again. And now here I am, and I want to get to the top of the stairs. To me, that's a challenge. And I think Man is like that. Early Man always looked to the stars. In the early space days, we were trying to get up that next step, and we weren't afraid. We failed, and we'd pick ourselves up and try again.

On *Redstone 3*, the rocket went up a few feet, crashed down, and blew up on the pad. That's when you learn. You don't learn a whole lot if everything goes like the book. We learned and regrouped and went ahead. I think that was a tremendous advantage. When you're young, you accept responsibility.

When we started out, there was no paper. The countdown procedure was maybe three sheets of paper. And we didn't pay much attention to that! We'd say, "Milt, turn your gyros on when you're ready." As the program grew, we accumulated more paper and bureaucracy. You reach a point in your growth when you've got to make a big decision, and you start to worry: "How am I going to look if this fails?" The fear of failure makes you form a committee. The worst thing you can do is to get a committee to make a decision that should have been made quickly.

When we started NASA, there was no set of rules or regulations. They didn't exist! And so you did things sometimes where you didn't know any better if there was a regulation against it or not, so you just went ahead and did it.

At the end of my space career, I was with USBI for about 10 years. One of the last things I remember was that we wanted to build a concrete pad that we were going to put a trailer on where we hot-fired the gas generators. The environmental impact statement for that tiny little pad took months. I'll bet you there was more paper generated on that pad than there was to buy the land for Kennedy Space Center.

Apollo was built with 1960s technology, with relays, stepping switches, and moving parts. Moving parts by their nature are less reliable than solid state. Some of us still remember the old car radios with vacuum tubes. In earlier missiles, we had tape recorders.

And it's still amazing to me that we had so many countdowns and such a success with the Saturn, because we had relays and moving parts everywhere.

We were the first, as far as I know, to do checkout and launch work with automation. It's no exaggeration to say that in the early days, our computer was down more than it was up. It could be downright dangerous, because it had a failure mode where it would issue about half its commands when it shut down. We really fought that thing. In the first Saturn V countdown demonstration test that we tried, it took us 17 days to finally get the green lights to say yeah, we could have launched. It was amazing that we could get the subsequent countdowns off on time like we did.

Just seven and a half years after President Kennedy said, "Let's go to the Moon," Frank Borman was circling the Moon and reading from the Book of Genesis. Seven and a half years! In the atmosphere during Apollo, you just thrived on problems, and you had pride that you could accomplish things that at first seemed impossible. It was a real can-do attitude. Now we're talking about maybe going to meet an asteroid sometime about 2030. In my opinion, we've lost something along the way. I think this is a nationwide issue, not limited to space exploration. You couldn't do Apollo today. I think it would be totally insurmountable. We don't have the attitude and perseverance that it took to make it happen back then.

When I grew up, there was a woman that was our cook and housekeeper. And every time I went back home to Alabama, I'd go and see Johnnie Mae. The first time I went back home after *Apollo 11*, I went to see her, and she was in her front yard with a lot of people. She pulled me aside and said, "Mr. Ike, I want to talk to you. I want you to tell me about how you all faked that thing about going to the Moon! I know the Lord, if he wanted somebody up there, He'd have put them there! Now I want you to tell me how you all did that!" I said, "No, it's real!" She said, "No, no. You tell me! You can trust me, you know me!" I said, "Johnnie Mae, it's real!" And we went back and forth like that. And she never would believe me. And it's one of the regrets I have, that not long after that exchange, she died. And I sometimes wish I'd made up some fake story, because she died thinking that I didn't trust her enough to tell her the truth.

But it was the truth. We really did put men on the Moon.

We recently had the 60th anniversary of the launch of the first Redstone, August 20, 1953. I remember standing outside after the gantry moved back on that Redstone. It was 5 ft in diameter, 70 ft tall, and I was thinking, "Man, this thing is too big to fly! They'll never get this off the ground!" And 15 years later, Frank Borman is circling the Moon. The following summer, Neil Armstrong is walking on the Moon. It's incredible! You can't hardly conceive it.

As the years go by, the memory of what Kennedy Space Center did in Apollo is fading away. I appreciate Jonathan's enthusiasm for documenting a part of our space history that has not been told. I suspect it would never be told without Jonathan's effort because, let's face it, time is running out. I'm 91 years old now. These days, I go to too many funerals of good friends and hard workers from KSC, people who never asked for or got recognition for doing everything it took to launch the best space vehicle that ever flew. It's time they got their due.

xx **Foreword**

I always tell people that I never worked a day of my life at the Space Center. I think that if you enjoy what you're doing, it's not work. This book tells the story about people who enjoyed what they were doing, and did it really well.

Titusville, FL, USA
September 2014

Isom A. "Ike" Rigell
Launch Vehicle Operations
Kennedy Space Center

Preface

My earliest memories include my fascination with space. I have always been consumed by the love of space travel, rockets, and astronomy. As a child of the mid-1950s, I had the outstanding good fortune to develop consciousness just as America's space program got off the ground. I watched TV coverage of Alan Shepard's first flight when I was 4 years old. I was a fourth grade student living in Okinawa when Neil Armstrong and Dave Scott's Gemini VIII capsule made an emergency landing nearby. In a very real sense, I feel like the space program and I grew up together.

The astronauts of that era were exceptional people in my mind. Although I sat in more than my share of cardboard box space capsule cockpits, I knew that my being overweight and colorblind meant that I would never actually fly in space. Even my 10-year-old self knew that it made no sense even to dream of being an astronaut.

But working in Mission Control or the Launch Control Center—that was a different story. I was fascinated with control panels, tubes, radios, knobs and switches, and indicators and dials. What could possibly be better than sitting at a console, wearing a headset, and pushing an important button at the critical moment?

Cape Canaveral and Kennedy Space Center seemed like a magical place, where huge rockets blasted off in the morning sun on epic journeys of exploration. I dreamed of going there, but our family travels never included Florida. My father, a career civil servant, participated in a management course that took him to NASA facilities at Langley, Houston, and Kennedy Space Center in August 1969. This was less than 2 weeks after the Apollo 11 astronauts had returned from the Moon. The Saturn V rockets for Apollo 12 and 13 were stacked in the Vehicle Assembly Building at KSC, being made ready for missions before the end of 1969 had Apollo 11 failed to make a lunar landing. Dad returned with slides of his brief trip, and I looked at them every chance I could. I would have traded anything to be able to make that trip with him.

Fast-forward to the spring of 1988. I had witnessed the *Challenger* disaster live on TV 2 years earlier. Now, as a 31-year-old, I was working for Boeing on a support contract the Space Station Freedom program. Just a few months on *Freedom* were sufficient for me to wonder how NASA's bureaucracy ever got a rocket off the ground. (And sure enough,

Freedom never flew.) My family and I drove from the Washington, D.C., area to visit my now-retired father in Miami. On the way, we made a brief stop at KSC. The shuttle *Discovery* was still in its hangar, out of public sight, being prepared for its September return-to-flight mission. We saw the rusting remains of a Saturn V on display in the VAB parking lot. It was a difficult period to be a space enthusiast. Nothing seemed to be moving. Things feel very much the same today, as we wait for manned launches to resume—“someday soon”—from KSC.

Fast-forward another 15 years. With the advent of online auction sites such as eBay, I was astonished to find bits and pieces of actual Apollo-era hardware come up for sale. I developed a particular interest in Apollo-era access badges and items associated with the Launch Control Center at KSC. I felt compelled to research items to learn more about how they had been used and by whom. Every badge had a story to tell about someone with an interesting role during Apollo. Many of the items came from people selling off a deceased relative’s estate. When I inquired about the person who had worn a given badge, I frequently received replies such as, “My uncle worked for NASA, but I have no idea what he did, and he didn’t leave a diary or memoirs.” I thought this was a crying shame.

I obtained a few control panels from the Apollo-era firing rooms. How could I possibly have foreseen as a child that such a thing would be possible—that I would actually have some of those control panels in my own hands? I located fellow collectors and learned about their relics. I put up a web site documenting some of my research into the Launch Control Center during Apollo days. I had the good fortune to begin corresponding with former NASA engineer Frank Bryan in late 2011, after Frank saw the web site. Frank was gracious enough to let me pick his brain about KSC hardware from the 1960s. His recollections provided intriguing behind-the-scenes insights into what it took to get the mighty Saturn V off the ground.

About the same time I met Frank, I briefly corresponded with Bob Sieck, who was a project engineer on the Spacecraft side of the house during Apollo, and who went on to become Director of Shuttle Operations. Bob was gracious enough to exchange letters with me and answer a few questions. The more I learned from Frank and Bob, the more I wanted to know, and the more I wanted to let everybody else know about the amazing work that was done at KSC in the Apollo era.

There are many outstanding books, most notably the classic “Moonport,” which tell in exhaustive detail the history of the facilities at Kennedy Space Center. I would not presume to improve upon those books, but I also believe there are gaps that need to be filled. After all, it would be impossible to provide a full accounting of what 24,000 people did at KSC for the better part of a decade. At the other end of the spectrum are books that focus entirely on the “human” side of the story, usually told from one participant’s perspective. They are filled with fascinating and humorous anecdotes, but they often leave the reader with the impression that “you really had to be there” to get the joke. Moreover, they lack a broader perspective of the myriad facets of work at KSC.

Given my background in systems management, what I really wanted to examine was how all the pieces fit together across KSC. How did the spacecraft, launch vehicle, and ground support equipment work together? How did the organizational structure support the work? What was it like to be one of 24,000 people working there—each worker relatively small in the overall scheme of things, yet still vitally important to the success of his

or her particular component or process? The hardware and facilities were unlike any others on Earth, but they were useless without humans to run them. My story had to include both sides of that equation.

Armed with this idea, I asked Bob Sieck and Frank Bryan for their opinions. They both thought it was an interesting and workable approach. Then I took a big gulp and asked if they would be willing to introduce me to some of their colleagues so I could start filling in the blanks. After the first few interviews, everything snowballed. Every interview ended with the person saying, “Let me put you in touch with...”

My objectives were to put as much meat on the bone as possible, while keeping the detail at a manageable level, so that everything fit into one book. These turned out to be mutually exclusive goals. After reading my first manuscript, my wise editor at Springer advised me that a book over 700 pages long would prove too daunting for most people. She suggested that there were actually two books trying to emerge from this material. I resisted that notion at first, but she was correct.

This book and its companion (“Countdown to a Moon Launch: Preparing Apollo for Its Historic Journey”) both focus on Kennedy Space Center during the Apollo era. Their topics are distinct and complementary. Each is complete in itself and can be read on its own. My hope is that you will find that both of them together tell an even more compelling story.

In researching these books, I devoured in excess of 1,200 source documents and conducted over 300 hours of interviews with more than 70 people. I know that I have only scratched the surface. Piecing everything together into a coherent saga was occasionally challenging but never frustrating. It was the most fun I’ve had in a long, long time. Other than seeing my kids become flourishing adults, I consider this work to be the most important and rewarding thing I’ve done with my life.

There are so many photos and figures I wish I could have included, but details in some photos and diagrams would be lost by shrinking them down to book size. My web site (www.apollo-saturn.com) contains supplementary information to accompany this book, and it will be kept up to date. There will also be a place to post errata and corrections for this book. Please visit the site and check back often!

So, that’s the story of how this book came to be. I hope you will enjoy reading it, and that you will experience some of the joy I feel in celebrating wonderful people who accomplished amazing things at an incredible place in a magical time.

Greensboro, NC, USA

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