



FINAL FRONTIER: Diversity and

I am not a serious Star Trek fan. No dressing up, no conventions, I can't do the Vulcan greeting salute and I really can't say that I've watched many of the latest iterations spawned by the original 1960s television show. But one thing I always admired about Gene Roddenberry's vision of "Star Fleet" was that space exploration and humanity's future would be an adventure shared by everyone. Back when the original program was airing in 1966-67, NASA was the real space program but it was one that looked very different from the multicultural bridge of the *Enterprise*. Aerospace engineering and the astronaut corps were predominantly a white male culture.

Nearly four decades later, today's NASA is arguably the most diverse agency of the federal government. Most of the current generation that comprises the NASA workforce grew up watching the halcyon days of the Apollo program on television or the first flights of the space shuttle. For many, while they were fascinated and inspired by the space program, it was difficult to picture themselves working in, on, or for space.

NASA's current diversity is reflected not just in the myriad of jobs and programs but in the stories of the people that carry on that work. They come to work to explore the origin and evolution of the universe, to develop new technologies, organize huge databases, fly into orbit, organize finances and answer telephones. Every NASA field center is filled with fascinating people whose personal journeys are at times courageous and inspiring. They are the multihued threads that make up a rich tapestry but all share a common bond—they love the work they do. There are thousands of people that work for NASA. This story provides but a glimpse of the lives and careers of a few.

RECEPTIONIST TO THE STARS

Nestled into an arroyo at the base of the San Gabriel Mountains, NASA's Jet Propulsion Laboratory looks more like a college campus than a typical sprawling field center like those found in

Texas and Florida. But it is here that some of the most cutting edge research and exploration in the world (and off it) is conducted. If you visit or have business to attend to—your first encounter with JPL will probably be with a cheerful and enthusiastic receptionist named Bobbie Fishman.

An African-American woman going through divorce 23 years ago, Fishman was working in professional development when the chance to work at JPL presented itself. "I wasn't very happy at the time and frankly, my attitude toward men was rather negative. But being here, with these wonderful people changed my life," said the exuberant receptionist. "Some of the most decent men in the world work here and it really has been 23 years of the most wonderful, incredible life."

Fishman's warm and positive attitude are necessary attributes for someone who has to screen all visitors to JPL. "It's my job to greet and screen all visitors to the lab," she explains. "It really is exciting because I've met people from every walk of life from royalty to movie stars and school groups, scientists and world leaders." Fishman fondly recalls one such episode that took even her by surprise. "It was back in the 1980s and I was putting some lotion on my hands when this man walked in. He just kind of carried himself like he owned the place and when I glanced at his name tag—lotion went everywhere and I dropped a folder of papers all over the floor." The visitor was Neil Armstrong. During her tenure, Fishman has also greeted such luminaries as Carl Sagan, Nichelle Nichols ("Uhura" on the original *Star Trek* series), Gene Roddenberry, James Michener and more names than could be dropped at the swankest Hollywood party!

Active in all of JPL's social affairs, Fishman has served as a leader of the JPL campus community, working as MC for their Arts and Crafts Fair and has even written and performed in plays for the community of scientists and engineers. During one production of *South Pacific*, Fishman played Bloody Mary and was particularly taken by the charming leading man named Dick that she was on stage with.



Bobbie Fishman
Receptionist
JPL

Today's NASA

Later her husband informed her that she had been acting alongside the legendary physicist Richard Feynmann. “That’s the wonderful thing about the scientists here, especially the ones that I get to know. They are so brilliant and I don’t understand half of the stuff they do—but they take the time to explain it to me. I’ve learned so much working here!”

THE WIZARDS OF PASADENA

Indeed, some of the brightest young minds in the world are drawn to work at the famous laboratory in the Southern California foothills. From here, spacecraft like *Voyager* and *Galileo*, *Viking* and *Mars Odyssey* have plumbed the depths of the solar system. While the “golden age” of planetary exploration was funded by the large budgets of the Apollo era, a new breed of young engineers and scientists is working on plans for future explorations of the Moon, Mars and beyond. Two young Latino men exemplify the interesting and exciting work being done at JPL.

Alberto Behar was a year-old infant when his parents decided to leave Fidel Castro’s Cuba in 1967. Members of the island’s Sephardic Jewish populace that was unable to worship freely under the communist regime, Behar’s parents emigrated to Venezuela for a year before coming to the United States. As a child, Behar was fascinated by space. “When I was about seven or eight, I wanted to be an astronaut,” said Behar. “I checked out all of the books on space I could at the library and that’s when I first remember learning of JPL. The Viking missions in 1976 really turned on my interest in space science.”

Growing up in Florida, Behar was selected for a special class in robotics in high school and then went on to earn his BS in Engineering at the University of Florida. With the goal of shooting for a NASA career, Behar decided to attend Rensselaer Polytechnic Institute. The New York College was ranked as one of the top engineering schools in the nation and a feeder program for NASA’s engineering corps. Like many of his generation, fate took a hand in the form of a national tragedy. Behar had hoped

to join an IBM-sponsored cooperative at the Johnson Space Center in Houston but the program was cancelled in 1987 while NASA was reeling from the *Challenger* disaster. Finally, at the ripe age of 24, Behar found himself a NASA employee when he was picked up by JPL for Artificial Intelligence work. “I was working on intelligent tutors but what I really wanted was to go into robotics,” recalled Behar. “After transitioning into the robotics group at JPL, I went to the University of Southern California to earn my Ph.D.”

BY DAVID SCHLOM

NASA’s current diversity is reflected not just in the myriad of jobs and programs but in the stories of the people that carry on that work. Every NASA field center is filled with fascinating people whose personal journeys are at times courageous and inspiring.

Wanting to work on cutting edge research, Behar returned from a year in Japan, a brilliant postdoc looking for his next project when one of the JPL managers he had worked with, Lonnie Lane, gave Behar an exciting new direction. “He told me, ‘I’ve got this thing for you—get a jacket’” The next thing the young engineer knew, he was on a plane bound for Antarctica. For three months, Behar and his team worked in the closest environmental analog to Mars that can be found on Earth. His work on the Antarctic Ice Borehole Probe Project helped to lay foundational work for future sensor probes that might plumb the secret depths of



Alberto Behar
AI Engineer
JPL

the Martian polar regions or unlock the secrets of the frigid oceans on the Galilean satellite Europa. His glaciological investigations will also be important for the proposed mission to have a cryobot with sensors to investigate the North Polar region of the red planet in 2007.

While Alberto Behar is investigating the use of sensors and robotics in extreme environments, a fellow Hispanic scientist has been working with a team on the cutting edge of supplying energy to future space travelers as well as those of us who remain bound to this planet. Thomas Valdez, a brilliant young chemical engineer, has had a steady but unconventional path to scientific renown at NASA. Like most of the persons interviewed for this story, Valdez found his inspiration at a young age. "I was in third grade on a field trip to JPL when we got to see Columbia's maiden flight back in 1981," said Valdez. "I remember thinking I wanted to work at something like that."

Good science educators who encouraged the young Hispanic student in his inquiries and a famous mathematics teacher laid the foundations for his future in the space program. At Garfield High School in East Los Angeles, Valdez found himself enrolled in Jaime Escalante's rigorous mathematics classes for three years. Escalante's passion for teaching Latino students was made famous in the movie *Stand and Deliver*, starring Edward James Olmos. "Mr. Escalante helped further my love for science by helping me to see the deeper meanings of my experiments in the data. He helped me in data analysis and taught me discipline as a student."

Valdez story is reminiscent of a famous Hollywood actress who was discovered at a soda fountain. He literally went from working at McDonald's to JPL overnight. "I was accepted into a program that took students from underdeveloped and represented minority communities and that was a great opportunity for me. After receiving his degree in material science from the University of California at Irvine, Valdez has continued to work at JPL and is currently pursuing his doctoral degree from USC. With dogged determination he learned from teachers like Escalante and his science teacher Art Callahan, Valdez is the youngest person with the most experience at JPL. He has turned his considerable talents toward solving a problem that could make space exploration more practical.

"I am working on a team of scientists and engineers that are developing the next generation of fuel cells," explains the engineer. "They are called PEM (Polymer Electrolyte Membrane) fuel cells." Instead of converting hydrogen and oxygen into water and

electricity like the fuel cells currently used by NASA, the JPL's new fuel cells convert carbon dioxide gas into methanol. The result is that both a usable fuel and electricity are produced. "This has tremendous implications for the future because you eliminate the need (and cost) of having to take so much hydrogen fuel with you and you are recycling the waste gas (carbon dioxide) that is produced by respiration." In a recent demonstration for the national media, the group demonstrated a cell phone powered by PEM technology.

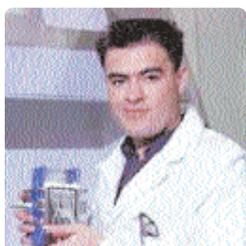
For Valdez, diversity has presented opportunities rather than barriers to his success and he hopes to inspire young Hispanic students to pursue careers in science and technology. "In science, diversity is our strength," said Valdez "It seems like everyone in the sciences is from different races and you hear lots of accents and languages but the language of math and science is universal and you are truly judged by the quality of your work."

A DIVERSE CENTER BY THE BAY

NASA's Northern California field center, Ames Research Center in Mountain View, is reflective of the cultural diversity of the Bay Area. One of the world's most brilliant atmospheric scientists is currently working there and her tale is one of triumph over the most precipitous of cultural barriers. As a little girl growing up in Iran, Azadeh Tabazadeh was fascinated by nature and particularly loved working with her chemistry set. The instructions were in German and she couldn't understand them but by studying diagrams and reasoning it out, she began to conduct her first experiments. But under the fundamentalist Islamic regime in power, her chances of ever putting her interest and potential to work were severely limited.

"It is disgusting, the oppressive way of treating women in Iran," said the Ames scientist. "But opportunities are not there for men either. Not many get to attend university."

At 17 years old, Tabazadeh, her older brother and cousin (who were about to be conscripted into the war with Iraq in 1982) escaped Iran with a few thousand dollars in cash. It was a journey her father (who now resides in Torrance, California) was originally against because of the inherent danger. But by car, motorcycle and foot the young Iranians escaped with the help of smugglers over the mountains into Pakistan. Eventually, they made it to the United States and an opportunity for the young woman to use her brilliant mind for the benefit of science. After learning English, Tabazadeh's dream came



Thomas Valdez
Chemical Engineer
JPL

true as she found herself studying chemistry at the University of California-Los Angeles.

Tabazadeh found herself under the brilliant tutelage of UCLA atmospheric chemist Richard Turco and also met her future husband, who is currently a civil engineering professor at Stanford. Tabazadeh was immersed in studying one of the hottest areas of atmospheric science, the mysterious ozone hole over Antarctica. Her pioneering work on the phase changes of particles at the molecular level helped to unlock the secrets of the physics involved in the polar stratospheric environment. Now the mother of two young children, Tabazadeh balances the hectic life of a young mother who also happens to be an award-winning scientist at the cutting edge.

Ozone depletion and global warming are two of the most serious environmental science issues confronting NASA's scientists, and along with Owen B. Toon of the University of Colorado-Boulder, Tabazadeh and her colleagues have made tremendous strides in our understanding. Working mostly at her computer, Tabazadeh has modeled mechanisms that show, contrary to the claims of some, that chlorine pumped into the upper atmosphere by volcanic eruptions is washed out by precipitation before it reaches the stratospheric ozone, indicating that the phenomenon is most likely the results of human industrial chlorine use.

For her work, Tabazadeh has been awarded a prestigious Presidential medal and recently received the James B. Macelwane medal during a meeting of the American Geophysical Union. Her colleagues describe her as tenacious, stubborn and extremely nice. She is also grateful for the opportunities she has received in this country. "This is a great country," said Tabazadeh. "The people in Islamic countries want to be like this but the education is not there. It is very sad really."

For one other NASA employee at Ames, making sure that opportunities in math and science are available for youngsters in *this* country is a prime directive. Sheila Johnson is a community relations coordinator whose many duties includes organizing VIP tours for the center. During her tenure, she planned Ames sixtieth anniversary party that traced the Moffett Field's roots back to its days as part of NASA's precursor organization, the NACA. She hosted President Clinton and has had her picture taken with current NASA administrator Sean O'Keefe. But political luminaries and Hollywood stars are not what drive Johnson; it is the underrepresented youth in her community that she actively seeks to draw into the NASA culture of education and literacy.

"NASA encourages volunteerism," said the African-American woman. "I have been involved with the National Coalition of 100 Black Women to help bring young ladies into math, science and technology." Johnson has helped a program to provide scholarships for young girls in grades four through six to attend Space Camp and other math and science related activities. Ames is reflective of the United States' demographics as only four percent of Ames employees are African-American. When looking at the scientists and engineers, the figure drops to two percent. This is not surprising when once considers the culture of poverty that most young black Americans grow up in. Other than Native Americans, African Americans have the highest percentage of children growing up in poverty at a staggering figure of 33.1% nationally. Johnson is not only a role model for youngsters but also a person who is working hard to create opportunities.

"It is disgusting, the oppressive way of treating women in Iran, But opportunities are not there for men either. Not many get to attend university."

Azadeh Tabazadeh, Atmospheric Scientist

Ames Research Center

"I was working for the L.A. Unified School District when I attended a Department of Defense job fair," as Johnson describes how she came to work for the agency. "I was recruited by NASA and have been here for 22 years. I love my work because it is so fascinating and exciting. I get to meet foreign dignitaries, celebrities, and people from all walks of life. The most amazing thing is that the people that work here are so talented in their private lives they are multifaceted—multidimensional."

While Ames no longer hosts a Space Camp, Johnson is still reaching out to young people, especially African-American girls in her community. "We are fund raising for scholarships to send youngsters to math and science camps at places like Stanford and Santa Clara University. I have always tried to be involved and give back in my community."

At the end of her busy days, Johnson reflects on



Sheila Johnson
Community Relations
Coordinator
Ames Research Center

the lot of a public servant working for a high profile agency like NASA. "People tend to forget that government employees are just like them," Johnson mused. "It's not about the money, it is about the work that you do. I met the Minister of Science and Education of Japan the other day and that was quite a thrill. Once when William Shatner visited here the scientists and engineers were like little kids in a candy store. They were so excited by this man who isn't a scientist but who obviously is fascinated by *them*."

DESKTOP EXPLORATIONS

For one little girl who grew up in Roanoke, Virginia, watching *Star Trek* and *Star Wars* and other portrayals of the Final Frontier led to an interest in science at school and a lifelong passion to learn more about space. Like so many, she dreamed of becoming an astronaut, found that she probably wasn't best suited to wear a space suit and wound up unlocking the mysteries of deep space from her computers at NASA's Goddard Space Flight Center in Maryland. Beth Brown is the first African-American woman to obtain a doctorate in astronomy, from the University of Michigan's prestigious Department of Astronomy.

"I was the only black woman there at the beginning and graduated in 1998," said the Ph.D. "Where I grew up in suburban Roanoke you really couldn't see the stars very well. I was in a summer program in Junior High when we were taken to a small observatory. I remember seeing M-57 (the Ring Nebula in Lyra) and thinking 'is this real?'" Brown pursued her interest in college by studying Physics at Howard University before ending up at Michigan. After serving a pair of internships at Goddard during her college days, Brown wound up as a NASA astrophysicist with truly awesome responsibilities.

At Goddard, the National Space Science Data Center is the permanent data acquisition and storage facility for NASA's space science missions. With missions such as the Chandra X-Ray Observatory constantly helping astronomers to revolutionize their understanding of everything from Black Holes to colliding galaxies, the job of maintaining and acting as a bridge to other researchers is Brown's main duty. "I had no idea when I began my education that this is what I would be doing," said Brown. "I work with everything including data from the 1970s to the most current missions." Her area of research is in high-energy studies of elliptical galaxies that shine brightly in the x-ray region of the electromagnetic spectrum. "I love my job because I get to work on different things and space continues to fascinate



Beth Brown
Astrophysicist
National Space Science
Data Center

me. Like any job it can get frustrating but I see myself staying here for a few years." Brown is also a former Administrative Executive Officer for the National Society of Black Physicists.

Keeping track of NASA's burgeoning databases is one of the most daunting tasks facing the current generation of NASA managers. Maria So came to be one of the agency's ultimate number crunchers despite the fact that she began her academic life with an interest in the arts. From the Chinese University at Hong Kong, So was accepted as an exchange student at the University of California at Berkeley where she earned her degree in Fine Arts. From there she was accepted to the Brooklyn Polytechnic Institution where she began to more deeply pursue her minor in math and statistics. It was one of So's professors that gave her a piece of sage advice that would lead her eventually to America's space program.

"A professor of mine told me that I should find a rich husband if I wanted to continue with art," So recalled. "He encouraged me to pursue computer science and I'm glad I did. Her ex-husband was working at Goddard and she became more and more interested in working for NASA. "When I came to work for NASA it really was a dream come true."

So went to work managing the databases for the National Space Science Data Center and was a contractor section manager on the Hubble Space Telescope program. She was responsible for the payload database that sent commands to the orbiting observatory and helped in the building of the information system used by Hubble. "I worked under Dr. John Campbell (currently the center director for Wallops) and he really inspired me and provided great direction," said So.

Under her tutelage, So has transformed the NASA technology inventory database that keeps track of more than \$1.6 billion of technology development. Her work enables managers, scientists and engineers to identify trends in technology and is critical in the decision-making process for making policy decisions. Along with this tremendous responsibility, So also feels a need to be an inspiration to others, especially Asian-Americans. "I would like to inspire the other Asian-Americans at our centers. There is the stereotypical misconception that Asians only want to work in technology but that isn't true. I see the future getting even better for people like me in management positions. So is currently the Asian-American Advisory Committee chairperson at Goddard, overseeing the well-being concerns of the center's diverse population.

Nurturing NASA's diverse population of workers is a key element at Goddard and Sharon Wong is one of the people who oversee that mission. She is the assistant to the Director of Diversity at the center. The philosophy behind the center's diversity goals has been to move away from the traditional concept of affirmative action. "We look at it more from a perspective of inclusion," explained Wong. "We want to broaden our spectrum to include all ages, ethnicity, race and sexual orientation. We are looking for people who work hard and want to be a part of our team."

Wong and her department are championing activities that institutionalize workplace diversity. "It takes many forms," explained Wong. "We have over 3,200 people working at the center but usually, when people are looking to solve a particular problem they look to the same people they have always sought out. Why not look for new people? You still need the people you've worked with before but many times you can get a more innovative solution if you look outside your usual network of contacts." Wong adds that there is a strong case to be made for diverse solution from a business point of view. By looking for solutions from a greater range of possibilities, there is a better chance of solving the problem in a cost-effective way.

DIVERSE LEADERSHIP

At NASA headquarters in Washington, D.C., an African-American is also looking to help the agency find innovative solutions by utilizing small, minority-owned businesses. From a field of 84 applicants, Ralph Thomas emerged as the assistant administrator in charge of business utilization. Under his watch, NASA has tripled the number of awards to minority-owned businesses and with tremendous benefits to the agency. "It's easy for the Lockheeds and Boeings of the world because they have the resources to get in front of the smaller businesses," said Thomas. But the administrator, who has been cited by President Clinton and more recently Bush for his efforts, knows that the main reason for seeking out these contracts is to improve the space program. "We once had the *Atlantis* orbiter in the vertical position at KSC when we had some mechanical problems that needed to be fixed," recalls Thomas. "Normally in that situation we would have to drain fluids out of the system in order to effect repairs in the horizontal but there was a minority-owned small business that came up with a different solution. They found a way to 'freeze' the fluids instead of drain them. We wound up launching on

time and saved the program millions of dollars."

Thomas can point to many other examples where his advocacies of small, minority-operated firms have come up with solutions to difficult problems. The *Pathfinder* mission to Mars had a battery life expectancy of one month—the batteries designed by one of Thomas' contractors lasted three. "There's also the example of the Lunar Prospector website," explained Thomas. "It received numerous awards and many called it the best mission related website ever designed. It received 15 million hits in three days! It was designed by a small minority-owned company." The Harvard Law School grad is proud of his accomplishments at NASA and looks to a bright future. "I never anticipated working here but I was working with the Congressional Black Caucus on the issue of using minority businesses for government contracts. I love my job here and hope to stay because we've made a lot of history here. We are the best government agency when it comes to utilizing minority businesses," said Thomas.

"We want to broaden our spectrum to include all ages, ethnicity, race and sexual orientation.

We are looking for people who work hard and want to be a part of our team."

**Sharon Wong, Assistant to the Director of Diversity
Goddard Spaceflight Center**

Of course, when most people think of NASA, images of the two glamour centers usually pop into consciousness. Kennedy Space Center, America's spaceport; and Johnson Space Center in Houston, home to the Manned Spacecraft Center, were traditional bastions of a nearly uniformly white male culture during the glory days of the 1960s and '70s. "And that too is part of our diversity now," says Steve Gonzales, a Manager Branch Chief in Advanced Technologies in Houston. "It is important to understand the richness we have in diversity—not just of race but age as well." Gonzales is a passionate leader of Puerto Rican descent who

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predominately white males but I hope someday
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the Director of KSC.”**

Ken Newton, Independent Assessment Engineer

Kennedy Space Center

grew up in the New York–New Jersey area. “I remember asking Santa for a Saturn V rocket for Christmas in the second grade,” Gonzales reminisced. “By the eighth grade I knew I wanted to work at NASA.” So did a lot of school-aged kids. But Gonzales had the right stuff to stick to his dream and found a job at Houston during one of NASA’s toughest times, the post-*Challenger* period of 1988. Gonzales is working on technologies that will make the shuttle and future spacecraft more intuitive, intelligent and interactive in their command and control. In short, Gonzales’ goal is to make the flight decks look more like those seen in *Star Trek* and kids video games than the traditional panels of switches and readouts.

In these days of funding cutbacks and uncertain policy goals, Gonzales has had to also work hard at keeping his passion alive. “I mix my own religious beliefs and inner drive to keep my hopefulness,” said Gonzales. “My goal is to lay the foundation so that we can return back to the dream of space exploration. Of breaking boundaries—from pitching a tent to hauling in the wagons—a more permanent place up there.”

Growing up in Florida, Ken Newton remembers watching launches from the Space Coast about an hour away from his home. “I remember thinking that it would be amazing to work in that firing room,” recalls Newton. “But I didn’t really see many people who looked like me.” Growing up an African-American in a southern state, Newton drove himself to pursue a career in engineering. “I remember my first Calculus book and looking in the back of the book at the answers thinking, ‘There’s no way I can do this.’” But Newton took it one page at a time and found himself working as an intern at a power plant as part of his University of Florida at Gainesville education. A couple of weeks after graduation, Newton found himself a job

through a NASA job fair. Now he is part of the team that he couldn’t picture himself being part of during his youth.

“At first I was so wowed by the whole experience, all the cool acronyms and then I was struck by the relative primitiveness of the computer technology,” said Newton. Indeed, his college courses had more ubiquitous computer technology than what Newton found at KSC in 1989. “Just a few years before they were still using punch card technology and there were maybe three computers to every forty people working here. Now of course, everyone has a PC on their desk.” As an independent assessment engineer, Newton plays a critical role in the assessment of third parties like contractors to be certain that launch operations go off smoothly. Of course, there are always problems that crop up during the critical days and hours leading up until a launch and with the International Space Station construction, launch operations is a busy place to work. But even after many a launch, Newton maintains his sense of excited wonder. “I remember my first launch,” recalled the engineer. “I was standing next to the VAB and the massive structure was shuddering with the concussions of sound. I thought the whole thing was going to rattle down. It was pretty exciting and still is!”

Newton would like to see NASA continue its trend toward a more diverse work force. “I did two months in the education office here and it was great to reach out to educators and young people to give them the vision that they could look into the future and be a part of it,” said Newton. “There are still some barriers to overcome. Launch directors and test directors are still predominately white males but I hope someday that someone like me can be maybe even the Director of KSC.” Newton knows that if we are to ever go to Mars and utilize space to its fullest potential, diversity is the key. “What will it really take to get to Mars and live there? You need the advantage of a diverse group of people attacking a problem like that.”

For every person profiled in this piece there are literally hundreds of other equally diverse and compelling stories. Diversity in the workplace at NASA isn’t about filling a quota system or providing advantages to the undeserving. It’s about recognizing genius and talent and drive and turning those human qualities to work on humanity’s great adventure. When we do return to the Moon or travel to Mars, it just might be a guy like Ken Newton that gives the final “go” and a ship with controls designed by people like Steve Gonzales that gets us there. 