



FIGURE 1

## **LIFE AT “THE SPACESHIP FACTORY”**

***WHATEVER ONE MAN IS CAPABLE OF CONCEIVING, OTHER MEN WILL BE ABLE TO ACHIEVE. JULES VERNE***

Like many others in the Aerospace Industry, Jules Verne helped lead me to the worlds of science and technology. To have in one’s lifetime the opportunity to not only witness but also contribute to that incredible history is a very fulfilling experience. I am asked many times what it was like to be part of our manned space program. Let me share my story with you.

# LIFE AT “THE SPACESHIP FACTORY”

## OUR COSMIC CAMELOT

### MY ROOTS

As a native Californian, I grew up in the land of the California sunshine. The sun shines differently here on the southwest coast. That's what we believed. Reflecting back on that time, there were problems and challenges but the culture was such that you saw them as something to be solved. This is the same culture you see in most engineers. I went to parochial school which not only focused us on academic learning but ethics, values and faith in ourselves. Science was also a significant part of the curriculum. There was a strong influence in the home on a work ethic that focused your attention toward accomplishment. Whether it was getting chores done, finding a job or just doing together. Until the first TV technology came into our homes we relied on interacting with family and friends. At first the novelty of television just reinforced our belief in the magic of the future and the role that technology would play. The first subtle effects of this technology were noticed when we began to adjust our schedules around the “regularly scheduled programs”. Had to be home not to miss the next match of Gorgeous George with Dick Lane!

Four years at a state of the art Technology School was my ticket to a job at North American Aviation working on the X15 and XB70 Programs. Things moved fast in this desert by the sea, Los Angeles. I graduated from Tech School at 17, was employed in the Aerospace Industry and was married by 19. My first child was born when I was 20.

My Career at NAA El Segundo was short lived when congress decided to cut the funding on the XB70 Program. But by now President JFK had committed the nation to the Apollo Lunar Program and I transferred to the NAA Space and Information Systems in Downey, Ca. From a Mach 3 Bomber to spaceships to the moon, Southern California what a town, a real Camelot!

## SPACE RACE IN SOCAL

The late 50's and early 60's in southern California was like a “Cosmic Camelot”.

The air was filled with “can do” and a future of “Rocket Fever”. We had captured the German rocket technology and would make it better, we had the promise of Hollywood Sci-Fi for a better tomorrow and JFK promised this

nation the Moon. We had the promise of a future and the commitment of a nation to go where no man had gone before.

TECH RULES!

## THE PLACE

The Spaceship Factory is like most any other factory filled with dreams, designs, machines and people but there is something else special you do not see, you feel it. It is a spirit of direction, goal, challenge, accomplishment. Even after the factory was long closed and the people and machines gone, as I walked through the empty buildings you could sense and feel the spirit of the place and the past histories.

The Downey NASA Site was 160 acres, the same size as Disneyland in Anaheim. It was considered a small city within a city. We had our own Security, Fire Department and Medical facilities. At the peak of the Apollo Program in 1965 there were 25,000 plus employees on site working 24/7. The greatest challenge facing a new employee was keeping from getting lost. We had a grid system that allowed you to find your location based on compass coordinates. N10W10 put you at the front door of the rotunda main entrance. It worked fairly well but a phone call and milestones still got you to your destination.

Work was clustered by departments and similar activities; Engineering had offices and drafting rooms, Finance and accounting had offices, Manufacturing had the shop floor. Then there were the support groups, maintenance, cafeteria, mail room, Quality and Inspection and tool cribs and supply centers. An emergency command center provided security and fire control services. As the new computer technology migrated into the work environment Information Technology or "IT" was born.

Because of the vast layout of the plant one could get a full day of exercise just walking from location to location. I measured my distance once at about 5-7 miles per day, good exercise. There were some jobs like the computer encoders and tool crib operators who did not get out much but were tied to their work stations.

Another unique characteristic of this factory was the program art. From even the earliest days of the programs large art panels depicting the designs and dreams of success were hung on the walls in the halls. There was even a special gallery that ran from the west side of the main Building 1 to the east side, about 300+ feet. It was called "Legacy Hall" and depicted a timeline of the companies program history from the early aircraft days to the projected future space concepts. Posters and art were commonplace throughout all areas of the facility many reminding workers of rules and safety items as well as encouraging teamwork. Manned flight awareness was always promoted with employees and became even more prevalent after the Apollo One fire accident. Most of the original art work has been preserved by the Aerospace Legacy Foundation and the Columbia Memorial Space Center.

We tended to forget that the factory in Downey was a government facility and as such was bound by strict DoD rules and regulations. The government would periodically remind us with surprise audits. Because of these security regulations we seemed to forget that the general public was not apprised of what happened on site. The most common comment I get from people when we talk about the site is that they remember walking or driving by and wondered what happened beyond the fences and guard shacks. It wasn't really a mystery; we were just building the spaceships to take men to the moon.

## THE PROGRAMS

When I first came to the Downey Spaceship Factory I was assigned to the Quality Labs working in Building 4 south of Imperial highway. That Building is now part of the Los Angeles County School District. I was doing fluid analysis on hardware systems to determine if they were clean enough for use on our spacecraft. I was also doing forensic lab analysis on hardware failures. We were contracted to build the second stage of the Saturn V Launch rocket and the Apollo Command and Service Modules. The two most interesting aspects of that work was first these were hardware design and development programs, which meant there was no “follow the blueprint/specification”, we had to write them. We were inventing the technology as we went along. The second part was the “failure” and mistakes, and we made a lot of them, but we controlled them in the labs and on the test sites. When the final spacecraft was ready to be delivered we knew everything there was about its planned performance and risks.

The challenges of the SII was its huge size, over 20 feet in diameter and almost three stories high. We had to use the Navy facilities in Seal Beach because of these huge components. This meant working from our offices in Downey until we could build a facility near the Navy Station. Learning to work at multiple off-site locations would become a large part of the Spaceship factory routine.

The Apollo Command module and service modules were more manageable and could be handled at Downey, however we still needed a production and test integration facility so we built Building 290 a marvel for its time in 1963. It was the largest cleanroom facility in the world – for 6 months, then the Russians built a bigger one, well it was a space race. Building 290 had four ground stands to accommodate a mated Command and Service Modules. Here we could install systems, test, power them and checkout all functions before shipment to the Kennedy Space Center. The building had a High Bay ceiling that was over 60 feet and a Low Bay at 40 feet. It was larger than a football field in area and it was climate and particulate controlled. It was a remarkable place to work. It looked like a spaceship factory.

We built over 27 Boilerplate vehicles several mockups and 18 spacecraft for the Apollo Program. The anticipated follow on production for the program was never realized so after the last mission and a detente mission with the Russians the future of the factory was in the hands of our proposal team for the new “Reusable Space Transportation System” the “Space Shuttle”. In early 1972 North American Rockwell was awarded the Prime Integration and Orbiter contract. The Spaceship Factory would move on to a new generation of spaceships.

The contract award celebration is a story of legend. After the announcement of our win came, the proposal team and anyone else around rendezvoused at the Tahitian Village in Downey to celebrate. A proposal manger filled a pickup truck with ice and champagne and parked it outside the hotel. The rest of the stories of that day and night are told after hours at shared reunions.

The Space Shuttle was even more challenging than the Apollo. It was technologically more complex and while it did not have to travel as far to the moon, it had a 100 mission or ten-year reusable service life. Much of what we had learned on Apollo and Saturn would be invaluable but in many cases we were starting from scratch. The most significant of the design challenges was the thermal protection

system. NASA and Lockheed had developed a new “glass” tile they wanted to use. This TPS was a remarkable material but a fabrication/operation challenge.

The other issue was that 80 percent of this contract needed to be subcontracted which made management and communication a nightmare. We also could no longer consider the Downey site for assembly and integration once again because of the vehicle size. So Palmdale became the assembly and integration site some 50 miles north of Los Angeles in the high desert.

When you look at the major contributions made by the Downey Spaceship Factory, high on the list is are the integration tools created to develop and manage such a complex program as the Space Shuttle. Customers spread between Texas and Florida, over 2500 subcontractors across the US. And working staff spread over the same areas. Then there was also the “tons” of documents and paper supporting the program. The computer technology had been developed during the Apollo Program but was still a work in progress at the start of the Shuttle Program The first production vehicles of the Orbiter Program were still utilizing the earlier Apollo technology tools and paper intensive data processing. The good news was we were learning faster.

The Downey site still had production obligations; the Orbiter forward crew module section and the Aft Main engine compartments would be built and integrated a Downey. They were then transported by truck to Palmdale for final installation and integration. There would be a constant stream of workers between LA and the desert, we even had our own regularly schedule airline between the sites. By the time we were into the middle of Orbiter production everyone began to understand the scale of this work and its technical complexity. All focus became mission success and safety. With the Challenger accident we were reminded of the risks of mistakes and short cuts. The Space Shuttle was a development vehicle not an operational production hardware item. The Spaceship Factory was a custom tailored build shop creating one-of-a-kind spaceships. Each of our seven orbiters are distinctively different from each other. The atmosphere at Downey was one of perceived craftsmanship. Everyone was committed and dedicated to doing their best work. A system of checks and balances helped us achieve these craftsman goals.

In the mid 90's the factory environment began to change with the Boeing acquisitions. We now confronted first the culture shock of combining our resources and philosophies with a previous competitor's culture. Every attempt was made to assure a smooth transition to the new combined corporate environment. The transition would take over 5 years and none of the organizations would be the same again.

The Shuttle Program continued to survive for a number of years with a split management between JSC Houston and Boeing HB.but it was the crisis of leadership in Washington and NASA that would doom the program to cancellation. Once again as with Apollo a new strategic direction was deemed necessary at NASA and the Orion and Mars initiatives were targeted for the future.

## THE PEOPLE

Any reflection on the people history of the Spaceship Factory must logically begin with “Stormy”, Harrison Storms, the leader of the “Storm Troopers” his in house team which successfully captured the Apollo contract for Downey in 1962. After winning the contract from NASA, the Downey site doubled in size, from 7000 to 14000 employees. It was a gathering of the best and brightest from around the country. That was the easy part they now had to meet an arduous schedule and performance demand from their new customer NASA.

Besides dealing with all the operational challenges of a rapidly expanding factory site and new technology demands, there was a continuing lack of customer design definition. The NASA was also learning about this new manned spacecraft stuff. The single biggest problem was the constant design change request that kept flowing in to the factory. It was not unusual for a single spacecraft part to have hundreds of design changes before it got to the shop floor, if you were lucky they came in before the part had been made. This created a waterfall effect on schedule and costs. The frustrations of these conditions caused serious friction between Downey and Houston. In retrospect the two principals Stormy and Joe Shea became the victims of the fallout.

In spite of this leadership challenge at the top the Factory survived because of the tenacity and growing team building going on throughout the design centers and shop floor. The people working on this program “got it!” They knew no one could possibly do this alone and success would only come from a team effort. Meetings would be heated and loud but it was out of concern and commitment to success.

As with any large organization there was a stratification of roles and responsibilities. It started with the payrolls. There was the hourly, who punched the clock, then exempt who filled in their time, then the salaried. The other layers were management, professional staff (engineers), then there was the administrative and clerical. The system worked. You knew where you fit in and you had opportunities to move over and up. This contributed to a functional working environment. Most management had some idea as to what their role was and subscribed to the teamwork strategies.

The Spaceship Factory was a pleasant, almost fun place to work. You would look forward to going to work and the new challenges that might lay ahead. There was a higher than average divorce and health failure rate among the personnel mostly due to the long hours and job stresses. Extensive travel always took a toll among the staff.

There was a self-correcting effect from this working environment. Because of the program and job complexities sharing skills and resources was an imperative. Those who did not share while meeting with some short term success, would end up creating a dead end for themselves that would eventually remove them from the team.

You always felt like you were part of this very important project that was going to be successful. We wanted it to be successful, and we would make it happen

## EPILOG

As with Camelot,

Each evening, from December to December,  
Before you drift to sleep upon your cot,  
Think back on all the tales that you remember  
Of Camelot.

Ask ev'ry person if he's heard the story,  
And tell it strong and clear if he has not,  
That once there was a fleeting wisp of glory  
Called Camelot.  
Camelot! Camelot!  
Now say it out with pride and joy!

Yes, Camelot, my boy!  
Where once it never rained till after sundown,  
By eight a.m. the morning fog had flown...  
Don't let it be forgot  
That once there was a spot  
For one brief shining moment that was known  
As Camelot.

Alan J. Lerner – Camelot, Musical

1960

From 1962 to 2000, There was a Spaceship Factory in Downey California that served as America's Cradle for the Cosmic Age. This was our "Cosmic Camelot". People from all over this nation came together to explore beyond our world, not to make weapons of war but the tools of learning and discovery. Spacecraft, to take us to new worlds and new possibilities. A great team was formed that rallied around our nation's leader and his vision of what we could do with our resolve. We met that goal and went beyond with even greater dreams. Dreams that have been forgotten and replaced with visions of new priorities. The stories remain with those who know the tale and made that history not so long ago. But for one brief shining moment we were a global nation of one sharing in that magnificent accomplishment that came from the "Spaceship Factory" .

Gerald Blackburn

Spaceship Factory Engineer

1962 – 2003

**Figure 1:** *Apollo Block I Command Module No.009 in Building 290, Apollo Final Assembly and Checkout. Courtesy Aerospace Legacy Foundation Archives.*