Kenneth W. Cowans. Inventor

Working At Hughes Aircraft Company

In May 1957 I graduated at the head of my class as a Mechanical Engineer, Aeronautical Option from North Carolina State College (NCSC) in Raleigh. How I got there is a story in itself. I started at RPI in New York, my home. Later I continued at Stevens Institute in New Jersey. Then, in 1952 the US Army claimed me for two years. After my discharge my parents lived in North Carolina, making me eligible for free tuition at NC State.

Republic Aviation had hired me after discharge. This filled me with an urge towards aviation as a career. My experience there also landed me a part-time job at Bensen Aircraft Corporation as a draftsman/designer. This helped me financially. The experience on the Gyrocopter there was invaluable. I saw Dr. Igor Bensen in that unit's first flight: The engine crapped out and he then crashed. The aircraft came down in the pine forest surrounding the Raleigh airport. The crackup made a great noise but Bensen was not seriously hurt. The design has subsequently seen many applications.

I worked at Hughes Aircraft Company (HAC) during the cold war with the Soviet Union. Immediately after graduating as an engineer I traveled to California with a new bride, JoAnn. It was an exciting honeymoon trip across the country. Exciting in conventional terms until our car broke. We unsuccessfully tried to fix it in the town of Maybelle, Colorado. We arrived in Los Angeles by bus.

The environment at HAC was stimulating in s sense that has not been repeated in my career. Advancing technology was the thrust. Consideration for cost was at a lower level than I have experienced since.

It's important to realize that HAC paid attention to aircraft only in the name. HAC made none during my time with them. Advanced electronic systems was our main work: The Huey helicopter was the output of our neighbor, Hughes Tool Company (HTC). They were our neighbor in that they were located next to us in Culver City; financial organizations were something else. HAC was part of the Howard Hughes Medical Institute (HHMI) a non-profit corporation based in Maryland. The tool thing was founded by Hughes, senior based on his drill, which invention discovered most of earth's petroleum. This drill was the origin of Howard's wealth. I never understood the relationship between HAC and HTC. We used their library profitably since they shared the installation. I guess their employees used the HAC cafeteria.

The work was exciting and uninhibited. Management interfered less than I have encountered since. My ultimate boss, William Craven, often stated his disdain for profit: System performance was his interest. The Air Force at Dayton, Ohio funded R&D whether it worked or not. The systems worked well most often.

As I said the work was exciting. When I left NCSC it was as a Hughes Fellowship student in post-graduate work at UCLA. HAC would provide part time engineering work and financial school support. NCSC had one of the world's first nuclear reactors. They fed my enthusiasm for theoretical physics. At UCLA I thought to learn this subject.

My part-time work at HAC first led me to a transient thermal analysis of the sapphire dome at the front of a missile fired at Mach 1 speeding to Mach 3. The rapidly changing heat input from air accelerating at these speeds could break the dome, I analyzed this. It was an exciting project. It involved an advanced form of mathematics named Laplace transforms. These were used for transient

heating problems. I was given the job because I was the only mechanical engineer in the organization. The rest were all electrical engineers.

I should mention that my undergraduate work was biased towards nuclear physics. It was my choice to drop all courses in heat transfer to allow time for physics. Heat transfer was boring. Subsequently, it was pointed out to me that Albert Einstein noted that heat transfer was too complicated to be fit into any model; only experimental results were usable. The task analyzing the sapphire dome was stimulating enough that I lost all interest in the theoretical.

My work was in an infrared group. Infrared describes that portion of the radiating spectrum, which describes heat radiation, from short X-rays to long-wavelength microwaves. Briefly, visible wavelengths are centered around 0.5 micrometers (one millionth of a meter or 0.5 microns) which is the radiation from the sun. Infrared starts around 1 micron. A jet tailpipe radiates 3-5 microns and room temperature around 12 microns. As can be seen, the hotter is an object the shorter is the radiation wavelength emitted. Our sun, for example, emitting the visible is well over 10,000°F.

Initially all my work centered around 3-5 microns for air-to-air missiles. The missiles then used a detector cooled to around -300°F; about the temperature of liquid nitrogen, argon or air (N_2, A or N/O). At the time the Sidewinder missile used a Joule-Thomson (JT or Joule-Kelvin after Thomson was knighted as Lord Kelvin) cryostat. All gases exhibit a JT cooling effect on expanding near their liquefying temperature: For the gases mentioned above this usefully extends to over 300°F.

The basis for the JT cryostat is a heat exchanger (HEX) of the counter-flow variety. The JT cooling effect is the temperature difference that drives the HEX. The small (about 1 or 2 millimeters) detector is mounted in a vacuum insulated flask called a Dewar vessel. The flask is about an inch

diameter by some inches long. The HEX itself is about 1/4" diameter and a tight fit inside the Dewar. Gas at high pressure flows in then expands, thus cools, before flowing out in *counter-flow*. If everything is designed right the expanded gas cools to a liquid state. The high pressure gas is cooled, by the HEX, to around -250°F and the expanded output is part liquid: This cools the detector to around -280°F (≈100°Kelvin).

At the time (ca. 1960) missiles aboard an aircraft were cooled constantly, while flying, from a store of high pressure gas. This required such to be supplied to the front line. If the detector could be cooled in less than 4.5 seconds such logistical supply would be unnecessary. The result; I was given the task to develop such a fast JT cryostat.

It was an exciting project. I was given the job because I was the only mechanical engineer (ME) in a laboratory of electrical engineers (EE). I didn't realize at the time but it was not expected to succeed. The need was real and the Air Force at Wright field would fund any worthy project with a real need. Success was not needed; patents were. Such were funded to HAC.

We exceeded the demand. Eventually we got a JT cryostat that would cool a detector from boiling water (212°F) to liquid argon at no warmer than -274°F (100°K) in under 1.5 seconds. It was supplied from a store, on the missile, of argon gas at 12,000 psi.

During the project I learned what inventing was all about. Teamwork is needed for success. A mechanical designer (one Art Chapman) was required to create the valving, storage and auxiliary parts. Theoretical work was supplied (Dick Genoud) and I learned to accept setbacks. After finding the best HEX material was silver, we machined small fins (fins 0.001" thick on 0.005" centers, 0.015" deep in silver tubing 0.05" diameter; 12" long). The machining work-hardened the silver so the HEX

material was sent out to be annealed...it was melted in this process. After spending weeks with my nose in a spray of wintergreen oil (the only lubricant found suitable) the small puddle of silver alloy was depressing. Eventually, the HEX was produced in multi thousand quantities. I decidedly learned patience along with how to write patent applications.

The work progressed from there. We created closed cycle cryostats (electric power in, cooling out) at temperatures to -450°F output. Eventually we made them work a long time (up to 18 months unattended in spatial orbit) by resurrecting a 1914 US patent by Rudolph Vuilleumier, a Swiss immigrant. In the course of doing this I tied a PhD. in HAC research laboratory for the most patents at HAC and wrote a design book for engineers in the cryogenic department, which group was founded on my work.

2016 is the 400th anniversary of Shakespeare's death. In 1964 I received an invitation to present a paper in London from an organization of physicists. That year was the 400th anniversary of his birth. JoAnn was to meet me in Paris after I attended to business in France, England and Germany for a European vacation. We had hotel reservations in London, Paris and Rome. The story of the vacation was more complicated.

To begin, my business in Germany took longer than planned and I missed my flight to Paris. Picking up my young wife at the airport in Paris was a complicated high speed automobile drive through Germany and France...without a map. One was not available that time of night. At the time there were no speed limits on the open European road. I pushed my rental car to its limit. Crossing the border was unusual in that the guard spoke no English nor French...my German was limited to 'ja' and 'nein'.

I did get to practice my fractured high-school French on a flower girl in Paris. I remember distinctly the look she gave to my question as to the location of the Champs-Élysées. You are very close (tout pres) she responded. Turned out it was a block next to where I had been driving frantically looking. She was obviously very amused. I knew the route from there to the airport and quickly drove it...only receiving a single toot from a gendarme while cutting across one traffic circle. JoAnn was quite relieved when I showed up.

Paris delighted us so much that we cancelled our trip to Italy. We visited the Jeu de Paume several times. It was a wonderful collection of impressionistic paintings. The last trip brought tears to JoAnn's eyes. She found much inspiration there for her own 'plein-air' painting. That museum closed two years later.

After leaving Paris; extending our stay there at another hotel instead of traveling to Rome, we took a motor tour in England. On this we stopped at Stratford-on-Avon to experience the celebration of Shakespeare's birth. On entering a room, we heard Laurence Olivier recite the same sonnet 29 we planned for our wedding ceremony. It begins; "When in disgrace with fortune and men's eyes".... it was one delightful coincidence.

Eventually I left HAC in 1968 to found Kinergetics, Inc. making life support units for divers to 1,500 feet underwater as well as helium speech audio units in television cameras to accompany the divers. That is another story.