Native has a hand in moon landing, sky lab and bombing systems

Wallace Kern

EDITOR'S NOTE:
Wallace Kern could easily have put his engineering talents to work on the Frankenmuth farm on which he was raised, but his curiosity took him to a more techincal field.

Kern, a 1958 graduate of Frankenmuth High School, is a senior engineer for McDonnel Douglas Corp. and participated in man's landing on the moon and on Skylab.

The following text is from a speech he gave last Thursday to the Frankenmuth Rotary Club.

It gives me great pleasure to be here today - to share with you the dream of a farm boy from Frankenmuth that have come true and gone beyond - to share with you some of the rapid advances in "technology in the aerospace field" and finally the "weapon delivery design work I'm presently involved in."

My presence here today is coincidental with the 25th year renuion of my confirmation class at St. Lorenz this weekend. My work is highlighted by two recent national news stories the past month; that of the deorbiting of Skylab and the tenth anniversary of the landing on the moon. Toward both of these NASA programs I contributed many years of my life and energies. However, I was only one of many tens of thousands to make these programs possible.

I commend your chairman, Mr Jim Kern, on his program of bringing natives from this community to, in a sense, bring home the work they left to do. It will give you first hand information and insights on how former residents work on projects and questions of state, national and international importance.

Before I go further I would like to define what engineering is or what is meant by an engineering problem. An engineering problem implies the desire for a solution to a problem. It could, for the time being, be a curiosity. The solution is to have certain functions - a building of something. As examples: it could be to build the Mackinaw Bridge to span the lower and upper peninsulas to enhance the motor vehicular traffic between the peninsulas or to build a new fighter aircraft with certain characteristics. This "problem" gets broken down into smaller problems to the point where one to several people can work on it. In the building of spacecraft and aircraft usually the lastest state-of-the-art is used. In some disciplines such as electronics the state-of-the-art may even have to be advanced to solve the engineering problem at hand.

My interest and the naturing of my engineering is deeply rooted here in Frankenmuth. It goes back to the early residents of this community who settled in the forest with near swamp conditions. They had to solve their every day physical problems by their own ingenuity.

As an example, my grandfather, a first generation born native in Frankenmuth owned and lived on the farm on which I was raised. I saw many evidences of engineering there. The one that impresses me is the problem of drainage from the fields. Without drainage it would be difficult to grow respectable crops. Since wooden conduits were often used and short lived due to rotting in the ground, my grandfather designed a machine in the early 1900's to make concrete drainage tile. He obtained a patent on this from the U.S. Government.

Similarily he designed and built farm implements and other farm utility devices, many of which while I was a child. Both my father, a farmer, and uncle, a steam engine engineer, continued the creativity of my grandfather. There was an element of curiosity and inquisitiveness in their lives. This encouraged my creativity.

Certainly every child asks endless questions of why, how, when, and who as he becomes aware of the world around him. I can remember many of my questions. How does a radio work? How does one obtain a photograph from a camera? How do airplanes fly? Among others. No one then could provide satisfactory answers to me on these. My life to a great extent has been devoted to seeking answers to questions such as these three. I have been able to find answers to the three in great depth. In turn they have led to new questions.

As some of you know I was a photographer at the Frankenmuth News while in high school. This resulted from my hobby to learn the answers to why and how of photography. This was a very exciting job and time of my life - not only from the view point of the excitement of learning, but learning about life in the city and life away from the farm.

this era and so did most of you. You may remember having to deal with these questions. You know what the answers are today.

Another native of this community, Ken Fischer, was invovled in the same process as I. He is a friend and classmate of mine. Ken and I pondered these questions during the high school years together at great lengths. This was an exciting time. In a sense we were in the grandstand watching the races and at the same time thinking of our future. We bought whatever literature we could get - magazines, etc., on ballistic rockets and space travel. We wanted to be a part of this. Both of us worked professionally on space programs that led to man setting foot on the moon. Both of us feel that we had a part in this effort. Ken worked on the ignitor for the engine of the SIVB rocket - the rocket that gave the astronauts the final boost to leave earth orbit and go to the moon. I was a test engineer to test the electrical power system of the Gemini spacecraft used to develop rendevous and docking techniques for going to the moon. Gemini also was used to prove that man can be in space in a small vehicle for the duration necessary to go to the moon.

In my work on Gemini, I was involved in the checkout of each spacecraft before it left for Cape Kennedy. We put it through a series of tests that simulated each phase of flight - prelaunch, launch, and orbital insertion through splash down with the astronauts there that were to fly the spacecraft. This series of tests verified that the spacecraft operated properly. After each test we had a debriefing with the astronauts to go over any problems there may have been. I personally was involved with the testing of experiments that were carried onboard the spacecraft to verify they were operating properly on the spacecraft and were not interfering with the operation of the spacecraft. Among them was a frog egg experiment in which frog eggs were carried into orbit and fertilized in orbit to observe the effects of weightlessness on cell division. The development of the eggs was stopped at various stages in orbit and then studied after return from orbit.

After Gemini, I became knowledgeable of various electrical power sources that can be carried onboard spacecraft. These included various batteries, fuel cells that are powered by hydrogen and oxygen, solar cells, and nuclear power generators. This allowed me to participate in advanced design studies to determine which power source and in which manner it is suited for a proposed spacecraft.

This effort led me to participate in the design of the electrical power system for the Airlock Module built by McDonnell Douglas for Skylab. In this power generation scheme, solar cells produce electric power from the light from the sun. About 10 to 14 percent of the sun's light can be converted to electricity. A spacecraft orbiting, normally travels trhough alternate periods of day and night. While there is light the nickel cadmium batteries are charged such that when the spacecraft is in the shadow of the sun, the batteries alone supply the electricity. In this manner it was possible to continuously produce an average of about 5,000 watts of electricity - almost enough for an average home. This is the largest electrical power system ever obtained by the United States. It worked until the reentry of Skylab a few weeks ago.

These were - these are - the days of what I call a great technological explosion. In the technological work that I am involved the data to solve engineering problems are not in textbooks and often not even in scientific journals. By the time material appears in textbooks, it usually is obsolete. Education then is a continual process. An example of technology that has affected my professional life greatly is computers. I remember in the late 60's doing a set of hand calculations with the aid of a slide rule and math tables that would take me a week to do. Then after a study of the results it was decided to make several changes and it took another week of calculations. This went on for some time. Now, with the aid of computers and initial programming, it would take several minutes to get the ansers! The engineering hand caluclators that sell for $50 to $200 can do more than electronic or mechanical calculators 10 years ago that cost $2,000 to $15,000. Every engineer now can have his own calculator as a tool at one percent of the cost 10 years ago in terms of today's dollars.

Another example is the use of computers at McDonnell Douglas in which aircraft parts are designed on cathode ray tubes (TV screens) connected to a computer which then can be used to command a numerical controlled machine to accurately machine a part.

With computers, complex engineering systems can be modeled. Of particular interest, in my work, is the simulation of an aircraft in flight. Here there are two types. The first is an all digital version - in other words all the answers come out on paper output. The second is where there is an aircraft cockpit with all the instruments connected to a computer. A pilot or engineer sits in the cockpit and flies the aircraft although it never leaves the ground. We use these tools to make bombing runs, to do aerial dogfights and evaluate the effectiveness of new weapon and aircraft systems.

This leads me to my present work - the design of advanced weapon systems - specifically bombing systems for tactical aircraft. The building of weapon systems is an unfortunate fact of life. Peace is maintained from a position of strength - the strength of a superior defense to deter agression. The national defense problem that confronts this country is that of the potential agression by the Warsaw Pact countries in Europe - the invasion of Germany and other allied NATO countries. The scenario there as depicted by military strategists is one of massive movements of tanks and armoured vehicles, supported by aerial weapons, into NATO countries. This is the scenario we use to design many new weapon systems, particularly aircraft weapon systems - again I want to repeat this scenerio is not a prediction but one used to design new fighter aircraft. Included in this scenario is the weather which is overcast, rainy and foggy, much more than in this country. This affects flight of the aircraft and the acquisition of targets. Of course, the engineering problem is much more complex than stated - so I will attempt to break it down to smaller pieces.

'Fighter bombers, which are called tactical aircraft, are much more versatile than a bomber by itself in that it can be used for both types of missions. It is an element of uncertainty for the enemy since it will be more difficult for them to determine which carry the bombs and which are the escort aircraft... **Wallace Kern**

During the post World War II years many technological events and fantasies fascinated me, such as: the introduction of jet planes, planes going faster and higher, the breaking of the sound barrier, television, rockets, atomic bomb, hydrogen bomb, going into orbit, people going into orbit, and people going to the moon. Certainly the Stalin/Kruschev communism threats had a big impact - the thought of the use of intercontinental ballistic weapons - with atomic bomb spilled over into a race to orbit the first man made object, a race to orbit the first person, a race to put man on the moon.

Isn't this enough to catch the imagination of an impressionable youngster, enough perhaps to catch the imagination of adults? There were many questions - technical, political, moral and even religious. Can a man-made object really be put into orbit? Can man really survive the great stress on his body in the ascent to orbit? Can he survive in orbit? Will God allow man to tinker with the solar system in this manner? Will He allow man to go to the moon? Will He punish mankind with disasters, etc., to show his displeasure? Or did God not only put us on this earth but put us in the solar system and universe to explore, to discover, and to appreciate his handwork - his creation. I lived through

The role of present day tactical aircraft is to secure air, land and sea. Thus, the repetoire of weapons that a single tactical aircraft may carry consists of a gun for air-to-air combat and for use against ground targets, missiles for use against aerial targets, rockets for ground targets and bombs against ground targets. In today's aerial warfare, missiles are preferred while the gun is like a bayonet on a rifle for last resort use.

Fighter/bombers, which are called tactical aircraft, are much more versatile than a bomber by itself in that it can be used for both types of missions. It is an element of uncertainty for the enemy since it will be more difficult for them to determine which carry the bombs and which are the escort aircraft. Even then, the aircraft carrying bombs can dump them and fight. Generally speaking, tactical aircraft are more maneuverable and faster thus have a better chance of returning safely - of surviving the attack. Tactical aircraft are small enough so they can be launched from aircraft carriers.

The early tactical aircraft used iron sights, such as a sight on a gun. The sight was set for given aircraft speed, wind conditions, dive angle and release altitude for a specific bomb. Thus the pilot had to go through manuals and computations before flight to set the sight and, subsequently, had to drop the bomb with those conditions to hit the target.

With today's digital computers this has greatly changed. Today, digital computers can be carried onboard aircraft. This allows a computer to be programmed to do many sophisticated computations. It allows the computer to make all the computations that were in the manuals and the computations the pilots made before flight. In fact, these computations are made about twenty times a second. Thus bombs can practically be released under any flight conditions, the imaginary sight is set about twenty times a second for the present flight conditions and the system is much more adaptable to unplanned targets. What an improvement and also at the same time greatly improving bomb delivery accuracy!

The bombing problem consists of the following parts:

1. **Location and Identification** of Target - This can be a very difficult task. This can be done visually, if the weather is relatively clear, by a radar, by a TV camera, or from coordinates set in from a map. All of these have accuracies associated with them.

2. **Obtain Data Related** to Bomb Release - This includes measurements from sensors onboard the aircraft which provide data: such as: aircraft position, target position, aircraft velocities, target velocities, altitude above target, and wind.

3. **Develop Aircraft** Steering Commands - Based on the data of velocities and positions, the bombing system computes steering commands which are displayed on a head up display which the pilot can see while looking out the windshield. Thus the pilot can steer the aircraft such that he will follow the proper trajectory to release the bomb.

4. **Develop Signal** to Release Bomb Again based on data of velocities and positions, a time-to-go can be computed to provide a cue to the pilot for a manual bomb release or an automatic release.

5. **Survivability** - It is of utmost interest, that by the design of the aircraft and maneuvering tactics, to bring both the pilot and aircraft back in a functional manner. This is against the threats of SAMS (surface to air missles) and antiaircraft guns. Aircraft maneuvering can provide a trajectory that is difficult to predict for antiaircraft weapons.

The keys of building a bombing system are first to have proper instruments on board the aircraft to provide good data required for bombing and second to design the system such that optimal use is made of the data. I say this because measuring devices always produce data with some error but with sophisticated manipulation it can be greatly improved. This is especially possible with the use of onboard computers.

My work in weapon delivery has been centered around the independent research and development, and advanced design work performed by my company. This has included assisting in the development of a set of generic ballistic equations for use with onboard computers to deliver bombs from 40,000 feet and supersonic speeds up to 1.4 times the speed of sound. Normally bombs have not been released supersonically or at much higher altitudes than 10,000 to 20,000 feet.

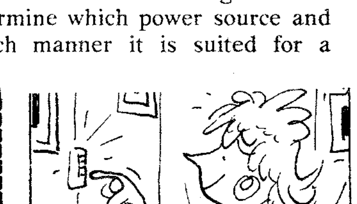
I have worked on the computer simulation of bombing systems - a simulation of bombing encounters with an aircraft. I have worked on the computer simulation of Soviet antiaircraft guns against U.S. inventory aircraft to obtain aircraft survivability data in bombing encounters. I have assisted in the development of a maneuvering attack bombing system in which the aircraft follows a curvilinear path rather than a straight-in approach. This is to increase aircraft survivability.

Since last September I have been on a program called Integrated Fire Fight Control. In this program there is a maneuvering bombing system - the first ever that will be put on an aircraft. For the last several seconds before bomb release, the steering commands from the bombing system will be fed directly to the aircraft flight control system, essentially bypassing the pilot. This should provide better bombing accuracies. This will be flight tested at the Air Force Flight Test Center in California. One of the key interests in this program is aircraft survivability.

The end product of building a tactical aircraft is to deliver weapons such as bombs. My hope is that these weapon systems will never be used particularly on our soil or that of our friends. That it will deter any potential agressor. But, if required, that we have confidence that we have the best we know how to build.

What does one say who left the farm, who left Frankenmuth to work in high technology areas? Certainly the fascinations, the dreams, the questions of my childhood have led me to the participation of exciting and challenging work. Although this work is in some ways more technical than farm work it is of no greater importance than the production of food. Don't be afraid to ask questions even if they seem to be childlike - don't be afraid to suggest non-conventional approaches especially if the problem has been solved before. The key words to describe these are "dreams" and "creativity". Let these take one where they may. The trip is adventurous, exciting and rewarding. God has placed us here to explore and appreciate his creation.

I want to thank you for the privilege of sharing with you the thoughts and work experiences of a native from Frankenmuth. I thank you for the privilege of being the first speaker in this series of your program.



Lowering your thermostat from 72°F to 69°F can mean as much as a 10 percent fuel savings in a house. Reducing it another five degrees can increase savings another 10 percent.