



## *The Daedalean*

*Semper Discens*

*Monthly Aerospace Education Publication of the  
Connecticut Wing of the Civil Air Patrol*

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**The Daedalean is temporarily serving as the CTWG news periodical. We are searching for a new CTWG PAO Officer who will accept the responsibilities of the office. We also would appreciate any suggestions for a title for a new CTWG newsletter or magazine. In the interim, squadron PAOs should send items of interest to [srocketto@aquilasys.com](mailto:srocketto@aquilasys.com).**

### SCHEDULE

22 FEB-Wing Wide SAREX-HFD  
29 APR-Wing Wide SAREX-GON  
TBA-Commander's Cup Rocket Contest  
16 JUN-Tri-State SAREX (CT/RI/MA)  
23AUG-Wing Wide SAREX -HFD

### SQUADRON AEROSPACE NEWS

*Royal Charter Squadron-Hartford  
submitted by  
Lt April Krason*

Members of the Royal Charter Composite Squadron took part in the New England Air Museum's "Women Take Flight" event on Sunday, November 3rd. The Annual event sponsored by the Pettit Foundation & the Ninety-Nines

International invite women in various aviation fields to speak with area girl scout troops and visitors to the museum.

Members parked cars and informed the public about the role of CAP.

Among the speakers were Bee Haydu, a Women's Air Service Pilot (WASP) from World War II and author of *Letters Home 1944-1945!* She is 93 years old and one of the recent recipients of the Congressional Gold Medal awarded to the organization.

Another speaker was Jessica Cox. Born without arms, Jessica now flies airplanes, drives cars and otherwise lives a normal life using her feet as others use their hands. She is recognized as being the first armless person in aviation history to earn a pilot's certificate. Convinced that the way we think has a greater impact on our lives than our physical constraints, she chose to pursue a degree in psychology at the University of Arizona. Since then she has traveled to 20 countries sharing her inspirational message.

Other presenters represented aviation branches of the US Navy, US Air Force, and US Coast Guard as well as commercial aviation.



*LtCol Cihocki renews a friendship with Capt. Lucy Young of US Air. Both are former A-4 pilots who met at BDL years ago.*

On 10 November, the Royals took part in a joint search and rescue exercise at Camp Hartell with the Connecticut Canine Search & Rescue, (CCSAR).

CCSAR is a volunteer, nonprofit organization dedicated to providing a professional response to all emergency service agency requests for lost, missing or drowned persons and offering support for families of lost and missing persons.



*Cadets receive instruction on dog handling techniques.*

The unit consists of dog teams and support personnel. They train and certify to standards similar to those of many search and rescue units throughout the United States.

*C/SSgt Carlson checks the fuel under the supervision of O flight pilot, SM Skiff.*



***Silver City Cadet Squadron-Meriden***  
*submitted by*  
*Capt Ashley LaPlante*

On Saturday November 23<sup>rd</sup> and Sunday 24<sup>th</sup>, cadets and seniors from the Silver City Cadet Squadron braved the elements in the name of Emergency Services training. Both cadets and seniors participated in ground team training at various levels at Goodwin State Forest in Chaplin, CT. Air Ops were not a part of this training mission. However two pilots, Capt Constance Castillo and Capt Rob McQuire joined the ground team in the spirit of cross-training.

The schedule was packed. On Saturday, personnel from The Goodwin State Forest Conservation Education Center, Emma Lorusso, Naturalist and Steve Broderick, State Forester led a class called “Choosing Firewood,” which took

the group into the forest to explore which woods are best for burning and how to go about choosing them. Ground Team Leaders Capt Joe Kurcaba, Lt Col Janice Daviault and Capt Ashley LaPlante offered CAP specific training and guidance throughout the weekend.

Although the temperature dropped below freezing Saturday night and continued to drop Sunday morning, the group accomplished more training before returning to Meriden and conducting classroom instruction. Cadets and seniors alike look forward to more training weekends in the upcoming year.

The squadron works to integrate air and group ops in an effort to advance mission capabilities. Silver City is diligently working on cross-training and certification of personnel to reach the goal of preparing themselves to be of service to the community, state and nation.

***Thames River Composite Squadron-Groton***  
*submitted by*  
*SM Douglas Corrigan*

Thames River has completed the selling phase of its annual citrus fruit fund raiser and is awaiting deliver of the merchandise. The Squadron sold three tons oranges and grapefruit.

The Reverend John C. Fuhrmeister, 91, former member of the Thames River Composite Squadron, passed away on 19 October.

Maj Fuhrmeister served as an Air Force meteorologist during both World War II and the Korean Police Action. He held a graduate degree in physics from the University of Illinois, a degree in theology from the Princeton Theological Seminary, and held a doctorate earned at the Andover-Newton Theological School.

In 1999, while serving as Chaplain for Thames River, Fuhrmeister was promoted to major and cited for his service to the squadron.

The Squadron ran two emergency service exercises during the last month. An aircrew self-

funded a direction finding mission and on the following Saturday, cadets conducted academic training followed by practical work at Bluff Point State Park.

Six cadets completed orientation flights utilizing Simsbury and Willimantic as intermediate stops. Maj Noniewicz and LtCol Kinch flew to New Haven and in conjunction with Capt Mungo and Lt Hashimoto, conducted aircrew training.

LtCol Rocketto commenced self-funded G1000 training under LtCol deAndrade. They combined the training with a flight to the Wurtsboro, N.Y. glider port (N82) where deAndrade successfully passed his flight examination for the commercial glider rating and Rocketto completed his last two solo flights in preparation for his flight examination.



*The SGS-33 is a long way from the "Bone" which deAndrade used to fly and the 57/67 and C182 which he flies now.*

Capt Brandon Cox completed Level III and earned the Loening Award. Cox also earned a Master Rating in the Personnel specialty track.

## **HOW TO TAKE PICTURES FOR CAP** **PUBLIC AFFAIRS**

Photographs are a valuable addition to any new release about CAP activities. The Chinese are reputed to have said that a picture is worth 1000 words. A picture might contain 5 Mb of information. That could equal about 2,500 pages of text depending upon the format. The Chinese, if they did make such a claim, seriously understated the information content of a picture.

But information, *per se*, is not necessarily good information. It might be false, redundant, or excessive, all characteristics of what one might find in a web search.

So here are a few guidelines for submitting pictures for publication for CAP.

1. Proper uniforms should be worn and insignia visible should be correct.
2. The image must relate to CAP specifically. For example, a picture of a group of non-CAP visitors to a CAP event should not just show the visitors but might show a CAP representative explaining something to the visitors.
3. This leads to the next issue, group shots. Posed pictures of groups are nearly worthless for publication. What should be pictured is a few individuals engaged in some animated activity, even if only a conversation.
4. Which of course suggests that any actions which might be shown is a positive feature of a photograph.
5. Make sure that the photographs of people are flattering. Check the photo to make sure that the eyes are open and mouths are not gaping.
6. Supply captions for photos which name the people in some identifiable order or explain what is happening. Be careful of spelling names and CAP grades should be included.
7. Avoid a picture in which a lot of rear views of heads and bodies are shown.

Meeting the requirement of these guidelines can be very difficult and require some experience. When taking a photograph, take a series of them with a few seconds between. This will allow a selection of the best of the sequence to be made.

You may need to pre-plan the orientation of you, the photographer, to the subject and you may want to vary that orientation as conditions change.

Be careful of shooting into the sun. The subject will be darkened. Digital cameras have a setting to modify the exposure which you should learn to use. Some photo correction can be applied when you crop the photo.

Finally, make sure you have a camera and lens which will obtain a clean, well focused picture.

The following gallery illustrates some good photos and some unacceptable photos.

air on top are all separated due to their density differences.

### **WING AEROSPACE EDUCATION OFFICER POSITION OPEN**

The position of External Aerospace Education Officer is open to a qualified applicant. The applicant will be expected to complete duties assigned by the Wing Aerospace Education Officer: The candidate must

- Complete the Yeager Award or be working on completing it.
- Enroll in the AEO 215 Specialty Track or have completed it.

Duties may include the following:

- Direct the external aerospace education program.
- Recruit Aerospace Education Members (AEM) into CAP.
- Support AEMs with visits to their classrooms and by conducting aerospace education activities.
- Encourage AEMs to participate in the voluntary Aerospace Education Excellence Program.
- Encourage AEMs and other CAP teacher members to participate in the Fly-a-Teacher Program.
- Promote and assist with aerospace education projects such as workshops and seminars.
- Promote CAP aerospace education programs and educational materials in schools.
- Promote CAP's external AE mission to the regular uniformed CAP members.
- Establish and maintain contact with educational agencies promoting CAP AE products.
- Present AE lessons and activities in many different educational settings.

### **BOURBON AND BRANCH!**

Harry S Truman liked to sip bourbon and branch and play poker. But CAP pilots would not wish to gamble by having their engines sip water along with the more palatable 100LL aviation spirits.

The accompanying illustration shows LtCol Charlie Freeman photographing a sample of fuel drawn from an aircraft which he was preflighting. Note the three layers of fluid in the sampler. The water on the bottom, gasoline in the middle, and



A small amount of water had entered the fuel system of a CAP Maule. Col Freeman's preflight inspection detected the water and he was able to drain it out of the tank.

Even if water is not detected, an inspection of a fuel sample might reveal particle contamination so following the standard procedures for sumping tanks and gascolators is both prudent and in accord with regulations.

Section 23.971 of the Federal Aviation Regulations outlines the requirements for drainable fuel tank sumps and fuel system sumps. Basically, the capacity of the sump is established by the tank capacity and the location is determined by placing the aircraft in a normal ground attitude and placing the drain at the lowest point in the tank or system.

### **STEM KITS**

CAP has acquired Aerospace Education teaching kits under the auspices of the National Education Program. STEM stands for "Science, Technology, Engineering, and Mathematics" and the purpose of the program is to foster awareness and interest in these critical disciplines.

These kits are available to any CAP squadron. There are five types of kits: flights simulator, robotics, rockets, astronomy, or model aircraft & remote control.

Go to [www.capmembers.com/ae](http://www.capmembers.com/ae) and click on CAP STEM Kit Program near the top of the page.

Dr. Jeff Montgomery, national Deputy Director of Aerospace Education has announced that some 300 squadrons have already received one of these kits and he has hopes that more will apply.

Several CTWG squadrons have already done so and reports about them are very positive. Those who have not already done so are encouraged to study the material and order on of these useful modules.

### NOVEMBER RIFLE SAFETY AND MARKSMANSHIP PROGRAM REPORT

The third and last rifle program was held on the indoor 50 foot Carroll Range at the Quaker Hill Rod and Gun Club on 16 November. Thirty four cadets from six squadrons, East Granby, Meriden, Stratford, Danbury, Manchester, and Groton, took part in the all day activity.



*Former CAP cadet James Planeta assists a shooter making a sling adjustment.*

Final results for the year have been tabulated. Forty-eight cadets from six different squadrons participated. Approximately half of all cadets who participated qualified for medals. In order to qualify, a cadet must fire ten five shots on ten targets and score at a required level.

Pro-Marksman qualifications were achieved by Cadets Bailey Doolittle, Corey Magrath, Ryan Peers, Emily Hammer, Eric Sullivan, and Eric Hansen.

Marksman required scores of 25 on each of ten targets. The Marksman level cadets are Virginia Poe, and Vitya Conway.

A score of 30 on ten targets are necessary to earn Marksman First Class. This level was reached by James Chadukiewicz, Elias Bou-chaine, Joseph Waldron, Noah Stillman, Dylan Robinson,

Christopher Jaskiewicz, David Nolan, and Matthew Johnstone.

The Sharpshooter level, which consists of 10 stages has been earned by Michael Hollingsworth, Daniel Hollingsworth, John Meers, and Keith Trotochaud.

### QUALITY CADET UNIT AWARD

Col Kenneth Chapman, Wing Commander, encourages every squadron to meet the standards which earn a Quality Cadet Unit Award. The new award cycle is underway and it ends in September of 2014. Every unit with 10 cadets or more is eligible to enter. To qualify, a squadron must meet five of the following nine criteria:

- 1. Adult Leadership:** Unit has at least 3 Training Leaders of Cadets graduates on its roster
- 2. Aerospace:** Unit earned the Aerospace Excellence Award (AEX) during the year
- 3. Cadet Achievement:** 40% of cadets on roster have attained the Wright Brothers Award
- 4. DDR Participation:** 20% of cadets on roster have completed DDRx or unit participated in RRLA
- 5. Encampment:** 50% of cadets on roster have completed encampment
- 6. Enrollment:** Unit has at least 35 cadets listed on its roster
- 7. Growth:** Unit's cadet roster increased by 10%, or 10 cadets
- 8. Orientation Flights:** 60% of cadets on roster have participated in at least 1 flight
- 9. Retention:** Each unit must retain 40% or its members from the previous year.

A complete description of the program may be found at:

[http://www.capmembers.com/cadet\\_programs/library/quality-cadet-unit-award/](http://www.capmembers.com/cadet_programs/library/quality-cadet-unit-award/)

In 2012-2013, three CTWG squadrons earned the award: the Stratford Eagles, the 399<sup>th</sup> Composite Squadron and the 186<sup>th</sup> Composite Squadron.

## THE AEX AWARD

One criterion for earning the Quality Cadet Unit Award is to earn the Aerospace Excellence Award (AEX).

The program requires a squadron to complete six aerospace activities or science/technology/engineering/mathematics activities from one of the AEX manuals or supplementary CAP manuals such as Robotics or Radio Controlled Aircraft or Astronomy. Then engage in a two hour activity such as a rocket launch or field trip.

AEX is a first class enrichment program for any squadron. The cycle for this award has just started so squadrons have a year to qualify, apply, and receive a handsome award plaque.

During the last year, the following CTWG squadrons earned the AEX Award: the Stratford Eagles, the 169<sup>th</sup> Composite Squadron, Northwest Hills, Thames River Composite Squadron, New Fairfield 801 and New Fairfield 802 and the 143 Composite Squadron.

For further information, go to:

[http://members.gocivilairpatrol.com/aerospace\\_education/internal\\_specific/](http://members.gocivilairpatrol.com/aerospace_education/internal_specific/)

## THE YEAGER AWARD



CAP has three missions; Emergency Services, Cadet Programs, and Aerospace Education. One of these missions, Aerospace Education, is a duty of every member. Whether it be personal, internal to CAP, or external, promulgating the message of aerospace to the greater community, each member ought be engaged.

Earning the Yeager Ribbon requires that an officer take a 100 question open-book test based upon material in the book, *Aerospace (The Journey of Flight)*. The book is available on-line and in many squadron libraries. It's 26 chapters parallels the

six volumes of the cadet's *Aerospace Dimensions* and covers topics in aviation history, general and commercial aviation, astronomy, space exploration, meteorology, and the physics of flight.

At last count, sixteen CTWG officers earned the award in the last year and 47% of our officers hold the award.

For further information, go to:

[http://members.gocivilairpatrol.com/aerospace\\_education/awards/yeager-award/](http://members.gocivilairpatrol.com/aerospace_education/awards/yeager-award/)

## FREE MAGAZINES

Each month, the Aerospace Education Department places a varied collection of pertinent and current magazines on the table outside of the main office and to the left of the restroom door at headquarters. Squadron commanders are urged to take some of these back to their units for distribution of cadets and officers.

The magazines include *Aviation Week and Space Technology*, *Flying*, *Air Force*, *US Naval Institute Proceedings*, *Naval history*, *AOPA Pilot*, and *the Sport Aviation*, *Air Force Magazine*, and *Smithsonian Air and Space Magazine* to name just a few.

## AOPA AV8RS OFFER-FREE

The Aircraft Owners and Pilots Association is offering a free membership to aviation minded youth, 13-18 years of age.

They tout a free digital subscription to *Flight Training Magazine*, scholarship opportunities, access to on-line training information, and an AOPA AV8RS sling bag.

Go to [www.aopa.org/av8rs](http://www.aopa.org/av8rs) for more information.

## WRITING AN AWARD NOMINATION LETTER

Each year, squadron members should consider nominating a fellow officer or cadet for a CTWG or national CAP award. These awards are offered for practitioners in almost all specialty tracks.

Some are categorized as “officer of the year.” Others are for lifetime achievement. Others might be for extraordinary performance. They can be for an individual or for a unit. Whatever they might be for, they require a nomination letter.

CAP encourages this program. Members are volunteers and a plaque, a certificate, a medal or a ribbon are meaningful recognitions or achievement or special services, a way of saying “thanks” or congratulations.

A good letter of nomination has three parts: the opening statement, a description of the meritorious act or performance which should include specific examples, and a closing statement.

The nomination must be submitted on the appropriate form and before the date on which nominations close.

CAP has produced an on-line document which covers this process in great detail, provides suggestions as to proper phraseology, and suggests ways to improve a nomination. This document is available at:

[http://members.gocivilairpatrol.com/media/cms/P039\\_003\\_F66823F4021E0.pdf](http://members.gocivilairpatrol.com/media/cms/P039_003_F66823F4021E0.pdf)

Get it, read it, and start thinking about whom you wish to nominate in the upcoming award cycle.

### **AEROSPACE CURRENT EVENTS**

#### *China Aims for Soft Lunar Landing*

On 02 December, mainland China launched a Long March-3 space vehicle carrying a lunar rover and will attempt to make a soft landing on the lunar surface.

The payload, Chang'e-3, consists of a lander and rover, *Yutu*, will perform geologic surveys and set up a telescope to study the plasmasphere of the earth.

The names of the payload are those from an old Chinese myth. *Chang'e* swallowed magic pills and took her pet *Yutu* (Jade Rabbit) and flew to the

moon where she became a goddess.

This is the first Chinese attempt to make a soft landing on an extra terrestrial body.

### **AEROSPACE HISTORY**

#### ***THE WRIGHT BROTHERS***

*by*

***Stephen M. Rocketto***

*December 17<sup>th</sup> will be the 110<sup>th</sup> anniversary of First Flight at Kitty Hawk. (2<sup>nd</sup> Revision for CAP)*

Some dozen years ago, I got involved in a project tentatively titled "From Kites to the Wrights," a proposed interdisciplinary curriculum package for celebrating the centennial of flight in 2003. My involvement in this effort started in typical fashion. Gordon Schimmel, the Superintendent of Schools in Mansfield, CT called Ralph Yulo, Professor Emeritus of Education at Eastern Connecticut State University. He asked Ralph if he might recommend anyone and Ralph mentioned me.

I have always liked projects like this one. Even if they do not fulfill their expectations, enough good material can be developed to make it all worthwhile. Besides, the collegiality and fellowship of the other participants buoys my spirit and brightens my dour disposition. But this project was a real bonus. My earliest memories are entwined with things aeronautical. Flying, model building, and studying the history of aviation has diverted me from the mundane, emptied my pockets, and enriched my soul. So I eagerly seized the opportunity to minimize my sleep and complicate my life. Some people just cannot say "NO!"

One meeting led to another and the project has focused on developing a set of interdisciplinary modules centered on some sort of laboratory exercise or construction activity which is directly related to the experiences which Wilbur and Orville Wright underwent between 1895, when the first heard about the gliding experiments of Otto Lileanthal and 1905, when they produced the

improved model of their 1903 Flyer.



*In 1895, the Lilienthal glider was the first successful aircraft to receive a U.S. patent. This replica is on display at Long Island's Cradle of Aviation Museum.*

Emulating the Wright Brothers, I entered into a bibliographical search of the literature which might assist me in producing one or two useful segments for the project. I was especially interested in the convergence of talents, social conditions, and technology which contributed to the Wright's success in controlled, powered, manned, heavier than air flight; a goal which was eluding many notable scientists and experimenters. Four books proved especially helpful. The first was Tom Crouch's biography of the brothers, *The Bishop's Boy's* (A Life of Wilbur and Orville Wright). The second and third were Octave Chanute's *Progress in Flying Machines* and Orville Wright's *How We Invented the Airplane* (An Illustrated History). Both of these volumes were readily available in Dover Publications editions. As an aside, Dover should be commended for their consistent policy of producing inexpensive reprints of seminal writings in science, mathematics, and technology. The last book which I considered was Peter L. Jakab's *Visions of a Flying Machine* (The Wright Brother and the Process of Invention). This is another of the fine Smithsonian History of Aviation Series. The two historical reprints would serve as a "reality check" as I considered the theses offered by Crouch and Jakab.

The best recent biography of the brothers is Crouch's, *The Bishop's Boy's*. Crouch develops a detailed and coherent narrative of the unusually close relationships among the Wrights; the father Milton, the sister Katharine, and especially, the youngest brothers, Wilbur and Orville. One of their favorite toys was a Penaud helicopter, a variation of the familiar rotor on a stick, which

soars aloft when twirled by a sidewise motion of the hands or by the stored energy of a twisted rubber band. The 11 year old Wilbur tried, with little success to scale up this clever mechanism and exhibited a lifetime interest in building variations of this classic child's toy.

The earliest business ventures of the brothers involved the construction and utilization of a series of printing presses and for a number of years, they were involved in the dual business of publishing and press manufacture. But in 1892, the bicycle craze swept into Dayton and they swiftly transitioned from riders to sellers, repairers, designers, and manufacturers of the safety bicycle. They outfitted a machine shop, designed their own gas operated power plant, and engaged in the production of high quality machines.



*One of the Wright Cycle Shops at 22 South Williams St., Dayton. Their printing business was on the second floor. The Wrights invented the self lubricating hub and were also the first to machine left hand threads on the pedal crank arm to keep the arm from unscrewing.*

As the last five years of the century played out, Wilbur started to exhibit an interest in heavier-than-air flying machines, initiated by reading about the experiments in gliding which Otto Lilienthal had been carrying out in Germany. Wilbur read Marey's *Animal Mechanisms* and started to consider the problems inherent in building a flying machine. Both brothers were keen observers of animal flight and Orville stated that "If the bird's wing can sustain it in the air without the use of any muscular effort, we did not see why man could not be sustained by the same means." The use of the verb "sustain" indicates thinking beyond short glides, such as practiced by Lilienthal, to flights in which altitude is not constantly lost. They observed the wide variety of flying creatures and could not see any reason why, in principle, why many could not accomplish the same feat.

In 1899, the physicist Samuel Pierpont Langley was the leading experimenter in aerial enterprises

in the United States. Langley, Secretary of the Smithsonian Institution and a scientist noted for his work in stellar astronomy, had in 1896, first flown a steam powered model and two years later, received a \$50,000 grant from the U.S. Army for the development of a man-carrying version of his Aerodrome. Wilbur wrote a letter to Richard Rathbun, Langley's assistant, requesting information on the current status of aeronautical science. Rathbun sent Wilbur a collection of pamphlets and a suggested reading list which included Octave Chanute's *Progress in Flying Machines*.

Chanute was a remarkable man with a national reputation as a surveyor of railroad lines, bridge builder and inventor. In 1888, Chanute retired and concentrated all of his attentions on a 30 year advocacy, aeronautics. He compiled all of the experimental reports which he had collected during that time and published a series of articles which became the book *Progress in Flying Machines*. A perusal of this text reveals that the book is a comprehensive study of the research from Chinese kites and Leonardo da Vinci's ornithopter in 1500 to the 1890's trials of Hiram Maxim, Lawrence Hargrave, and Lilienthal. But Chanute was not merely a researcher and archivist. He and his assistant, Augustus Herring, conducted over 2000 gliding experiments on the shores of Lake Michigan. Research and experiment led Chanute to the conclusion that the development of a method for aircraft control was the key to practical flight. The Wright Brothers concurred.



*A Chanute Glider at the Museum of the USAF*

However, the eminent Langley and the inventive Maxim were convinced that the evolvement of a suitable power plant was the major problem to be solved. Furthermore, since most of the practitioners were doing their research with

models, stability was a highly prized characteristic of any design. The Wrights, taking their cue from Chanute and Lilienthal, eschewed stability in favor of controllability.

This difference in design philosophy foreshadowed the arguments in the manned space flight program over automatic systems or pilot controlled vehicles. The U.S. astronaut corps forced the engineers away from the "SPAM in a can" model favored by our designers and adopted by the Soviet program. The Wrights opened up a correspondence and a friendship with Chanute which was to continue until his death in 1910. Chanute personally visited their camp at Kill Devil Hill in 1901, 1902, and 1903 and served as their unofficial spokesman. Within several years, with Chanute's encouragement and assistance, the Wrights surpassed their mentor's achievements and Chanute saw the dream of practical flight achieved.

Orville's text, *How We Invented the Airplane*, is a succinct and profusely illustrated account of their adventure in invention. As might be expected, they were amateur photographers and carefully documented each step in the process of invention. The stark landscape of Kitty Hawk forms a dramatic backdrop. The poised figures at launch and the clean images of flight are a delight to the eye. Commentary is supplied by a Wright biographer, Fred C. Kelly. Their first personal account to the public, a 1908 article from *Century Magazine* is included as an appendix.

This brings us back to the question of why the Wright Brothers were so successful when so many other people failed. After all, neither of them had completed high school, they were not part of the elite scientific establishment, and they lived in the Midwestern backwater of Dayton, Ohio. Jakab's *Visions of a Flying Machine* subtitled "The Wright Brother and the Process of Invention" successfully explains their achievement by examining how Wilbur and Orville were guided by their mechanical skills, scientific skepticism, "Yankee" pragmatism, and the technical spirit of the time in which they lived. Whereas Crouch is somewhat diffident in analyzing their engineering aptitudes, Jakab's spares no ink in a close analysis of the technical issues which confronted them and

how they mastered each of them in turn. As a result, Jakab's book is more a philosophy of engineering rather than a discursive history of the process by which Wilbur and Orville built their Flyer. One can understand the Brothers as prototypical engineers and in their career, mark those qualities which are the hallmarks of good engineering practice.

They could clearly define a problem. In the case of their aircraft, they quickly understood, from their experiences with kites and bicycles and their technical readings, that control was the key to success. In order to produce an airplane one had to experiment with models and manned craft and if the craft were to be manned, they had to be controllable. In a clear vision of priorities, unlike many competitors, they postponed considerations of engines until they resolved the more fundamental issues. Basically, controllability and airfoil optimization could only be done by flying. This realization led to a series of experiments, in 1900, with kites and gliders.



*Wright Kite at the USAFM*

Operating at the remote site of Kitty Hawk, North Carolina, selected for its favorable winds, added logistical difficulties to their technical burdens. They developed the "wing-warping" technique for control but disagreements between the experimental values of lift measured and the theoretical values calculated from the standard tables of their precursors revealed that the traditional data regarding what we now call lift and drag were in error. They also encountered the problem of adverse yaw, a phenomena which caused an aircraft when banked in one direction to point its nose in the opposite direction.

By 1901, they were somewhat discouraged but Chanute visited with them for several weeks and convinced them that, for all their difficulties, they were far in advance of the field. They did not quit

and they modified their program to meet the difficulties which arose. Although the Wrights claim to have entered aviation as a sport, the "reluctantly entered upon the scientific side of it" and established a rigorous program for investigating the myriad variations of fluid mechanics such as airfoil geometries and pressure distributions. They then constructed simple devices for airfoil studies which culminated in their wind tunnel and by late 1901, had rectified the lift and drag tables and could find a rational relationship between their theoretical values and their experimental values.



*Above, a bicycle modified with a force balance and used by the Wrights to test airfoils, a converse wind tunnel. Below: A replica of a Wright wind tunnel on display at the General Thomas Stafford Aerospace Museum.*



Of paramount importance in their progress was their ability to visualize solutions. The "visions" in the title of Jakab's book refers not to some dream of a flying machine but to the specific mental constructs which allowed them to analogize between the abstract concepts of theory and the concrete products of the artisan's craft. It was once said of Kelly Johnson, the engineering genius of Lockheed's Skunk Works, that "he could see air." Likewise, Orville and Wilbur Wright could see, in their mind's eye, the relationships of

forces and mechanisms which they turned into a

wind tunnel, qualitative and quantitative

measuring instruments, and ultimately, a practical airplane. Jakab argues that a facility for nonverbal thought was a key element in the Wright's success and my experiences with first class engineers supports this conclusion.

Much of their equipment was made from off-the-shelf supplies as their facile imaginations saw new possibilities in old things. The addition of a rudder, whose movements could be coordinated with the warping of the wings, corrected the problem of adverse yaw. During this period another engineering asset, their skill with tools and their sensitivity for the materials of construction served them well since constant repairs were necessary to keep their delicate machines airworthy. Consequently, during the next year, they completed around 1000 glider flights and started to acquire the aviator skills and experience which are needed to maintain the equilibrium of the aircraft in flight.



*1902 Wright Glider*

Now they attacked the issue of motive power and did so in typical Wright fashion. They calculated how much power they required and then designed and built, with the assistance of their mechanic, Charlie Taylor, a 12 horsepower engine. Their past work with airfoils, and the ability to visualize that an "airscrew" was just an airfoil which rotated and followed a helical path allowed them to design and construct the first practical propellers. And so, on December 17th, 1903, Orville made the initial takeoff, flying a distance of 120 feet in 12 seconds. Three more flights were made that day, the final one piloted by Wilbur logged 852 feet in 59 seconds and the age of aviation was launched.

Within two years, they had perfected the original machine and, in 1908, Wilbur captivated Europe with his flying demonstrations and personality.



*The famous "First Flight" photograph. The photo was taken by John T. Daniels of the Kill Devil Hills Lifesaving Station.*

The period of time during which the Wrights grew up was a time of great technological and cultural change. The railroads opened up the west and telegraphy and telephony opened new possibilities in communication. Automobiles and bicycles gave people a new individual mobility. Everything seemed possible. High school educations were not common and neither of the brothers completed high school. But they were voracious readers, deeply curious, and possessed finely honed intellects.

The Wright Brothers Collection at Wright State University in Dayton and the list of books which they took to Kitty Hawk indicates wide reading in the mathematics and sciences including technical publications in French and German. Their biographers indicate that their readings extended into literature, history, and philosophy.

The Wright brothers were brought up to be confident and self-reliant and lived in an age when such characteristics were prized. They entered into heated debates with each other over technical issues in which the give and take of the dialectic would lead to a solution to the problem under discussion. Yet their close personal relationship did not allow for the rancor which might have developed otherwise. These cultural and personal circumstances, melded to their methodical approach to problem solving contributed to their efficacy as engineers and makes them worth studying as a model of what engineering is all about.