The AMA History Project Presents:
Autobiography of JEF RASKIN

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Started modeling around 1947
AMA #L88

Written and submitted by JR (2002); Edited and transcribed by SS (05/2002), Reformatted by JS (01/2010)

Career:

- Started building models with his father at the age of four
- Built some of the first RC slope soaring models starting in 1968
- Built the Western Wind, an all-cardboard slope soarer, in 1974; sold 2,500 models
- Began writing articles for modeling magazines in the late 1960s and continues to do so
- One of the first employees of Apple Computer; he developed the idea for the Macintosh computer in 1979
- Designed a series of models called the Anabats in the early 1990s
- Runs an annual model plane contest in conjunction with the science fair at a school in his area
- Was selected by the U.S. Forest Service to build a model airplane to survey the unique ecosystems in the top of 250-foot trees in the Pacific Northwest in 2001

Preflight

To the rest of the world I am best known for having invented the Macintosh computer when I worked at Apple Computer Inc. I am also known as the author of the book "The Humane Interface" (Addison Wesley, 2000) which discusses, among other things, how to improve Radio Controlled (RC) transmitter design. But to my friends in the model airplane world, I am better known for having designed a few commercial kits, for having written hundreds of articles, many of which were about model planes and aerodynamics, as a flyer and competitor, for having founded two model airplane companies and for working with kids and encouraging them to learn physics and to fly model planes. I am AMA life member L88, a number I chose because it reads the same upside down – I love to fly inverted. I am also a contest director and leader member in the AMA and have been a member of the San Francisco Vultures (founded in 1939 and still going strong) for 28 years. I was its newsletter editor for over a decade.

Being a modeler has taken me on some unexpected and rewarding paths, some of which I relate here.

Takeoff

My fascination with airplanes started about two years after World War II ended, when my father decorated the sky-blue ceiling of my bedroom in our Brooklyn, New York brownstone with

airplane-spotter training silhouettes. Even though I was just 4-years-old, he let me help build them. That was my first taste of the miracle of putting together a pile of unpromising flat parts to make a three-dimensional model. A few years later, an aluminum-winged glider that came in a box of cereal allowed me to learn about control-surface settings – until the plane landed forever on the roof of a summer cottage at Lake Ronkonkoma, Long Island. My family moved from Brooklyn into the suburbs for a reason long forgotten, but it did bring me to where there was more room to fly.

My father was a fine wood carver (I still have some of his handsome work) and he made a few solid models for me, unfortunately now long lost. My first stick-and-tissue model, a Guillows' F4U Corsair, was framed up except for the stabilizer and was looking promising when my mother accidentally set a hatbox on top of it. The framework was crushed beyond repair and I was heartbroken. My parents sympathized, and immediately got me another kit, this time a rubber-powered sheet-balsa model of a Stinson Voyager, which I built and flew. It could fly about 30 feet as I recall.

Not knowing what rubber power could do, I was delighted, and built many more sheet models (adding moveable surfaces and details like opening doors) as well as stick-and-tissue models, which were much harder to do and tended to be less successful. When my brother was eight or nine, he started building models, too, and we'd have contests to see who could make the best landing, or we'd play airplane golf. Hinging the control surfaces with aluminum foil, or making aluminum foil tabs so that the planes could be adjusted to fly a curved path or go over a bush and recover on the other side, we'd try to get from one point to another in our yard, going around the house or over obstacles, in the fewest flights.

This taught us a great deal about trimming models. Unfortunately, we had no experienced modelers to guide us. I dreamed of being able to operate the control surfaces while the plane was flying; I was dreaming of Radio Control, but I did not know it. It is only in the past few years that RC systems have become small enough to fly the models of my childhood.

Long Island was a center of aeronautical activity in the 1950s, and I would bicycle to various airfields, small and large. Grumman was a favorite destination, and many grass strips came into my bicycling range by the time I was in ninth grade. I witnessed the changeover from propellers to jets. A little flying strip, on the border between the towns of Brentwood and Central Islip (a strip that became an electric company equipment yard) held the rotting skeletons of a few old aircraft. An especial favorite was a Jenny with almost no fabric left. We'd climb into a cockpit and move the stick, and see how the cables operated the controls. I could also trace how the rigging held the framework rigid. I didn't know that I was getting a lesson in structural engineering as I figured out that the rigging was under tension, that the struts worked in compression and both compression and tension were resisted by the spars. I built structural models to test my understanding, loading them until they would bend or break.

Surviving Rough Weather

It was when I was in junior high that my experience with model airplanes made a crucial contribution to my education that was to shape my intellectual life then and forever. My teacher

was explaining how planes fly. I was deeply interested and followed his explanation with full attention. He told us about Bernoulli's law (the relevant portion of which states that the pressure exerted on a surface by a fluid flowing over it decreases as the fluid moves faster). He then drew a flat-bottomed airfoil on the board and said that because the molecules that parted at the leading edge of the wing had to meet again at the trailing edge, the ones on top had to go faster because the path was longer. Because they went faster, there was less pressure on the top of the wing, which is why planes stay up.

This seemed to satisfy the class, but to me it was obviously wrong. First, I knew that planes could fly upside down. I had seen a plane do an outside loop upward at an air show, for example. When flying inverted, I reasoned, the curve would be on the bottom and the plane would be dashed into the ground if what my teacher said were true. Second, I had some good-flying planes whose wings were just single curved sheets of balsa. The lengths of the top and the bottom were equal, and therefore it shouldn't be able to fly. Lastly, some of my gliders, and my paper airplanes, had flat wings. And they flew.

So I raised my hand. When recognized, I gave my counter-examples. To the first, he said that I must have been mistaken in what I saw. He dismissed my experience with models out of hand. So the next day I brought in a simple balsa glider with dead-flat wings. Setting the elevators slightly toward the fin it flew right side up, set them away from the fin and it flew upside down. I demonstrated this for him at the beginning of the class. He promptly sent me to the principal's office: flying paper airplanes was not allowed! Of course, this plane wasn't paper and I had been making a scientific demonstration, but I never got a chance to explain that to the principal. I got detention.

I went to my favorite teacher, who taught physical education and math, and he couldn't tell me what was wrong with my argument. Wisely, he sent me to the library. I was horrified to find that all the books agreed with my science teacher! Most still do. But it was clear to me that I was right, and that's a difficult situation for a youngster: You know that your teacher and all the books are wrong, and you can't convince anybody because they all trust the printed authorities and refuse to think for themselves, but neither can they find anything wrong with your reasoning.

The books were wrong, and I eventually learned how wings actually generate lift. This experience taught me to trust my thinking when I could back it up with logical, airtight reasoning – even if the whole world says otherwise.

Incidentally, a pair of molecules that part from each other at the leading edge do NOT meet at the trailing edge. The one on top gets there far earlier. To help other students in the same quandary, I published articles explaining how wings really work in a number of places, including Quantum magazine and Model Airplane News. Many years later, my son and I made a short and funny instructional videotape on the subject that has proved useful in stimulating class discussions.

Flying High Through College

In high school and college, many young men discover young women are more interesting than airplanes and give up the latter. I made the usual discovery, but did not give up flying models when I went to college, eventually earning degrees in math and physics from the State University of New York at Stony Brook and in computer science at Penn State – where I regularly lost Free Flight rubber and towline models in thermals over the cornfields. Man cannot live by science alone, so I changed gears and studied music at the University of California at San Diego. Since then, I have performed in numerous concerts, once as a soloist with the San Diego Symphony. I became the conductor of the San Francisco Chamber Opera Company. Being a soloist with an orchestra and conducting fulfilled two childhood dreams, I'm a great believer in doing what you dream. I can't say that music has a lot to do with models, but the polished top of a grand piano makes a great place to photograph a handsome model!

The University of California is a few miles from the Torrey Pines cliffs, and in 1968, I started building RC slope soaring models. At that time, only full-size sailplanes, pelicans, and seagulls used the cliffs. I learned how to fly slope by watching the birds. I was not the first to fly slope with RC, but there were so few doing it then that I usually flew alone – now you need a traffic cop. I became a professor of visual arts (don't even ask how this happened) and a computer center director at UCSD and taught flying RC informally. I also moved into glow engines and could finally afford Radio Control, beginning with a single channel escapement system. On a great soaring day, flying east of San Diego, I lost an Ace Nomad RC glider to a thermal; the thermal was going up faster than the Nomad could spin down!

For a few years, I went through a phase where I built and flew only flying wings. They were very varied, made of conventional materials or cardboard, powered and unpowered, aerobats, and thermallers. When I felt that I really understood how they worked, and when I realized that there were aerobatic maneuvers that you just can't do cleanly, or at all, with a flying wing, I went back to designing conventional configurations.

It was about then, too, that I designed and built a full-size hang-glider. I made it from bamboo that grew in my back yard and hardware-store plastic ground-cover material. I flew it a handful of times from sand dunes until I felt confident in turning and landing and one day I launched from a 70-foot cliff and really flew. A friend tried it and crashed, destroying the glider. Fortunately, he wasn't hurt beyond a sprained ankle, and I went back to models.

I violated the stereotype of a 1960s college student in that I never tried drugs, not even so much as a puff of pot – when invited to, I would say that my drug of preference was model airplanes. Flying them is the best way I know to get high.

The Western Wind

Upset by the many beginners who tossed their airplanes over the cliffs, only to have the planes crash on the first flight, I decided to design an unbreakable sloper. By 1974, I had moved to the San Francisco area where my friends and I perfected the all-cardboard Western Wind slope soarer. I soon formed a company, Jef's Friends, LP and had the planes die-cut and printed on custom-made water-resistant cardboard. By coincidence, I had had a summer job doing cardboard display box design and steel-rule die layout, and so I was able to design the die

myself, which reduced the expenses considerably. In the next few years, we sold 2,500 Western Winds at $12.95 each. The Western Wind was nearly indestructible, and our club enjoyed contact combat, often flying seven or eight at a time. Being cardboard, they provided excellent protection for the radio gear (why do you think things are shipped in cardboard boxes?). The company was almost scuttled when Radio Control Modeler magazine wrote a “review” where the writer opened the kit, decided that it was no good and the magazine condemned the model without ever building or flying one! When that review came out, the distributors who had just begun handling the Western Wind dropped it. At first, I was pretty upset, but it turned out to be a boon financially, as the plane sold well on its merits. Real reviews, done by other magazines, were very positive, and we made a lot more profit on each one selling via mail order than through stores. To this day, I still meet people at the cliffs and get e-mails from fliers who tell me that they learned to fly with a Western Wind.

When starting on the Western Wind concept, I was a visiting scholar at the Stanford University Artificial Intelligence Laboratory and I used their PDP-10 computers in designing the Western Wind. It may be the first model kit ever to use computer-aided design, if so, it was a historic first to what has become a common practice. I also became addicted to e-mail and the Internet (then the ArpaNet).

In the late 1960s, I had started writing articles and columns for Model Builder, Model Airplane News, Slope Soaring Digest, SoarTech and, of course, AMA's magazine. I currently write at least one modeling article a month, sometimes more. I also write for non-modeling magazines and journals.

In the early 1970s I competed in Free Flight, outdoor rubber in various classes, HLG and catapult glider. One HLG contest I'll never forget. It was scheduled to end at 1 p.m., and there had been no thermal activity. I had used all but one of my official flights and was losing badly to taller, stronger club members who could launch higher. As I watched one of the gliders circling, I noticed a tiny blip in its flight path. With only a minute or two left to launch, I called for a timer and ran down field to where I thought the thermal might have drifted. I made a clean launch, and the plane rolled out into a smooth, slow glide. We last saw that plane heading over San Bruno Mountain...and I won the contest. I still enjoy watching even the simplest glider; nothing in model plane flying is quite as beautiful.

Indoor RC is not new to me. At an indoor Free Flight contest at the Cow Palace in San Francisco in the 1970s, I flew a small, Brown Jr. CO2-powered, semi-scale Piper Cub made of Styrofoam, controlled by a single-channel system with an Ace transmitter, an Albin super-regenerative receiver, and a Bentert magnetic actuator. This would be considered an up-to-date model even as I write this 30 years later. I also put a single-channel system into a Gollywock, an early example of rubber-powered RC.

Apple Computer and Kraft

In 1975, I started another company, Bannister & Crun. We wrote software and manuals for the nascent microcomputer industry, and in 1976 – working on the side as a free-lance reporter for Dr. Dobbs' Journal – I met two guys in a garage. They were Steve Jobs and Steve Wozniak. I

kept in touch and in 1978 became Apple's 31st employee. My company became Apple's publications department. It was about then that I started flying electric power. Kraft sold a foam Chipmunk that had marginal performance, I built a solar-powered model that just barely maintained its altitude, but it did stay aloft on bright, unsmoggy day. It took a few years, but we certainly have learned how to get great performance with electrics. To get back and forth to work at Apple, I drove a homemade electric car, converted from a Fiat 600. I have been driving electric cars and flying electric models ever since.

By 1979, I had conceived and named the Macintosh computer, and formed a group in Apple to build and program it. The Mac is not a model airplane story, though you might be pleased to know that every time you use click-and-drag with a mouse, or a number of other interface innovations, you are using something invented by a fellow modeler. During those years, I sometimes worked with Kraft Systems on the joysticks for the Apple II; I also designed a transmitter user interface for them. I loved Kraft's KPS-18 servos, they looked tiny back then, and were small enough for full-house 1/2A models, but our present small servos are smaller, lighter, and faster.

If it weren't for model planes, there probably would have been no Macintosh computer – the project was canceled repeatedly by Apple's management who did not understand the importance of having a good human-computer interface. But I kept the project going secretly because I knew that graphics and graphic user interfaces in a popular-price product represented the future. My experience with figuring out how wings worked gave me the confidence to disagree with management and survive.

One thing that had always seemed beyond me was metalworking. At the instigation of a friend and my brother, I got a small lathe and a tiny mill cheaply at an auction, and learned to use them, mostly from books. My brother challenged me to build a 5-cylinder scale radial engine for a tiny Monocoupe I was building. I designed and built the motor, which was all of two inches in diameter, and, to my delight (and surprise), it ran.

Information Appliance, Computer Transmitter and Hiller

After leaving Apple, I started my third company, Information Appliance, Inc. Many of the employees were modelers. There was a field across the street of our headquarters in Menlo Park, so we often flew at lunch break. Some were 1/2A cardboard designs, but most were of conventional construction. Once, when retrieving an airplane from the field I wandered into an old grove of ironwood trees. In the weeds, I noticed a gleam, cleared some dead plants, branches, and leaves away, and found what seemed, from its construction, to be the remains of an aircraft. After a lot of head scratching and searching around, I figured it to be the wreck of an experimental hovercraft; one part had a plate that identified it as having been built by Hiller. Being an airplane buff, I knew that they had had a facility in that area years earlier. The Hiller aircraft museum was just getting organized in nearby San Carlos, so I called them about my find. A few weeks later, they sent out a truck and reclaimed what they informed me was the long-lost Hiller HX-60, which they plan to restore.

Information Appliance Inc. made many interesting products that are not relevant to this story. But one of my employees, Ralph Voorhees, was (and continues to be) an inspiration with his magnificent craftsmanship and inventive airplane designs. My flying interests moved into aerobatics, and I learned how to make Cox Medallion .049s idle slowly and respond to exhaust restriction throttles reliably. A scale model of a Fournier powered glider, with one central wheel, turned out to be a great teaching machine: Doing touch and goes on one central wheel on a tiny piece of pavement that was in the middle of an otherwise overgrown and rough field taught me the virtues of a good, stabilized, approach and keeping your wings level. With a .049 engine and an 8-oz. fuel tank, I could practice for over a half-hour on a single filling. That's a lot of touch-and-goes. Ever since, I've been known as a guy who can land almost anything smoothly. Well, usually.

With a staff of fliers as well as computer software and hardware engineers at Information Appliance, it seemed to me that we could improve RC transmitter design by using a computer. We soon had built (in 1985) one of the earliest (I don't know if it was the earliest) computer-based RC transmitters. Minoru Taoyama designed the hardware and I designed the interface. It had all the usual: servo reversing and servo throw, exponential (actually, any curve was possible), any mix of any number of channels to any channel and it had a very neat auto trim (that Brian Howard suggested). You could trim aileron, elevator, and rudder simultaneously. Here's how it worked, using the stick, you held the plane straight and level, and as soon as that was achieved, you pressed the trim button and the positions of the controls when you hit trim were stored and used as the no trim condition. There were no trim levers, and it was a delight to fly. Retrimming for various flight conditions was nearly instantaneous. One advantage this transmitter had over present designs was a 16-key pad, so that you could just enter channel numbers and settings without having to scroll through tedious menus as with present transmitters. I tried to interest Kraft and Airtronics in the design at the time, but did not pursue it as we had other business interests that seemed more important at the time.

The Anabats

When my son was six, in 1990, he started flying RC. I again saw the need for an unbreakable plane, but he progressed rapidly beyond the Western Wind I put together for him: he was ready for ailerons. There were (and still are) few kits for expert aerobatic slope soaring, ones with symmetrical airfoils and therefore able to do outside maneuvers as easily as inside, ones designed to do clean snap and axial rolls, designs more like pattern ships than long-winged sailplanes. I had built a few with conventional construction, but they were fragile.

I wanted to design a plane that would bounce, that would be very easy to build, not requiring painting or iron-on covering. After a lot of experimentation, I developed a method of building with foam, a few pieces of strapping tape or spruce to take the tension and a covering of packing tape to make a monocoque construction where the skin handled much of the mechanical loads. I called this series of models Anabats from the adjective “anabatic” meaning “upward moving.” The airflow up a slope is anabatic.

Nearly everybody in my club wanted one, so I made a short run of 25, and they all flew as well as the first. The plane's reputation moved up and down the coast, and soon I was in production.

When demand got out of hand, I partnered with a friend, we built production jigs, ordered material in quantity, and my fourth company, Anabatic Aircraft, was born. Eventually, it moved into industrial space, I sold my interest in it, and it carried on for a few years. One of the secrets that made the Anabats so sturdy was a careful placement and order of putting on the tape, carefully explained in our manual. However many people just put on the tape any old way, so long as the model was covered. They flew just as well, but were not nearly as sturdy.

After I left the business, many other companies started making “foamies.” I had felt good about the Western Wind design, but it had not led to a proliferation of cardboard models. The Anabat was even better, not only did it introduce thousands of fliers to ailerons, but also my idea spawned a whole new breed of model planes. From other companies came the brilliant innovation of using EPP foam. They didn't require careful taping patterns and were inherently stronger, though heavier. The Anabats can do aerobatics in light lift that could not support the EPP models in level flight, but EPP is great for combat, which is more fun than aerobatics for most people.

For a number of years I ran slope aerobatic competitions, which Anabatic Aircraft and some other companies sponsored.

Research into Symmetrical Airfoils for Models

In designing the Anabats, I had to choose an airfoil. I knew that I wanted a symmetrical airfoil, so I went to the books to look at the data on symmetrical airfoils. To my surprise, nobody ever seems to have designed symmetrical airfoils for model sailplane aerobatics (flying at a Reynolds number of about 100,000). The NACA symmetrical airfoils had very poor performance at this range, so I studied the technical literature (this is where those years of math and physics help). Wortmann had designed symmetrical airfoils for full-size sailplanes and Selig had designed a symmetrical airfoil for model tail surfaces, but otherwise there was nothing. I created a class of airfoils (the WE series) that I thought might work better than what was available. I used it on a prototype Anabat, and the performance was improved. Other pilots were also impressed at the surprisingly good penetration of such a light model and the model's solid low-speed characteristics. However, I was not satisfied with subjective impressions and I did not know if I had chosen the best member of the family of airfoils that I had designed.

At that time my son Aza was looking for a sixth grade science fair project. Not intimidated by having to learn about coefficients of lift and drag, L/D ratios and Reynolds number effects, he took on the task of finding the optimum combination of parameters. I wrote a program that generated my airfoils in the form the NASA computers required and Aza chose which to run, ran them (via email and FTP) on the supercomputers and analyzed the results, plotting them on a spreadsheet graphics program. Based on the results, he chose the next set for testing, and so forth until he felt he had optimized the foils; he wrote a 46-page report. Never underestimate what a kid can do when motivated!

To find out if the results were realistic, some of the airfoils were run on a different program, and two airfoil wind tunnel models were built and run at the Princeton low-speed wind tunnel and the University of Illinois low-speed wind tunnel. The alternate program and the wind tunnel results

confirmed our computer analysis. Building a wind-tunnel model is very exacting work for an 11-year-old, and he recruited another sixth grader who helped. As it was not part of his science fair project, I did some of the precision work, such as making the metal templates for cutting the foam core.

The results were far better than expected. In terms of efficiency and maximum amount of lift, the best of the WE series were between 10 and 20 percent better than anything previously known and we expect them to be widely used.

For the past 14 years, I've been running an annual model plane contest at a local school in conjunction with their science fair. It's a very hectic day, and it's become an institution there. As I have noted, I love working with kids. There is something special about flying machines that catch their imagination.

A Plane for the Government – And What's Next

In 2001, I submitted a bid on a U.S. Forest Service RFQ (request for quote) for an aerial surveillance vehicle to study the unique ecosystems in the tops of 250-foot tall trees in the Pacific Northwest, riparian habitats and to study the aftereffects of forest fires. The aircraft had to be silent, carry no dangerous chemicals, have a real time visible light and infrared video downlink and a high-resolution digital camera that could be operated in the air, and be able to stay aloft for 20 minutes and fly at least 20 mph. To my surprise, I won the bid. I was worried that my cost or time estimates might be off, as I had never done this before, but managed to build, demonstrate and deliver the electric-powered unmanned craft before the deadline and on budget. Fortunately, I am a licensed amateur radio operator (KE6IGI), so that I could legally assemble, adjust, and use the equipment I needed. That project was reported on in a number of newspapers and magazines.

Future Flights

At present my models are either scratch-built or ARFs (but not standard kits), either sailplanes or electric powered, and all are as small as I can make them and still have them fly at scale or at least reasonably realistic-looking speeds by building very light. I am learning to fly helicopters. I have two inexpensive numerically-controlled machines in my shop for making parts, and it's great fun to be able to draw a complex part on the computer and have it in your hands a few minutes later, accurate to a few thousandths of an inch.

I plan to keep on working with indoor and backyard RC models. I dream of making a fleet of scale models all to1/12 scale and to fly them from a 1/12-scale airport, in the tradition of model train layouts. There are some novel and very light aircraft structures that I hope to build, structures that would be impossible – or at least extremely difficult – to design and make without computer-driven tools. And I intend to increase my repertory of aerobatic skills, now that some electrics can do knife-edge flight.

I know that I've left out a lot of model airplane events I've participated in and have only mentioned a few of the models I've built or flown, (and I forgot the Free Flight kits I designed). Worse, I've mentioned only a few of the many wonderful people I've enjoyed working with. They are not famous, and you'd probably not recognize their names, so I will not list them. But they know who they are, and I thank them all.

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