

# In search of a challenge

***(On March 8, 1946, the Bell Model 47 was awarded the first commercial helicopter license. What were the events that led to this monumental achievement in aviation history? Arthur Young, the inventor, recently reminisced about these early days. He was interviewed at his Institute for the Study of Consciousness in Berkeley, Ca. Also in attendance was Bartram Kelley who retired as senior vice president-Engineering in 1974. Kelley, now a Bell consultant, began his distinguished career as an apprentice to Young and worked with him on the Model 30 program).***

In 1928, a brilliant 23-year-old inventor named Arthur M. Young was seeking a challenge — some project that appealed to his competitive nature and would take time to develop.

To evaluate ideas he had for inventions, Young made periodic visits to the Patent Office in Washington. It was a book by Anton Flettner, however, that stimulated his interest in the helicopter.

“Flettner had invented a ship that had crossed the Atlantic in 1927 by means of rotary drums,” Young explained. “This was about the time of Lindbergh and I was very impressed. What caught my attention was a large rendering of a windmill with propellers on the tips which was displayed in the book. When the wind turned the big windmill, the small propellers rotated at high speed with smaller gears picking up the power. I felt that Flettner’s idea could be applied to aircraft.”

Having no knowledge of helicopters, Young’s initial method was to visit public libraries in larger cities and read everything he could find on the subject.

“There wasn’t much information on helicopters before 1900,” Young pointed out, “because until the arrival of the automobile, engines hadn’t been built that were powerful enough to meet the requirements of vertical flight. I also discovered that there were more attempts to make helicopters than airplanes. But in 1928 there were still no successful rotary wing machines.”

Young, however, finally ran across a book about helicopters — “*Le Vol Vertical*” — which he described as a “pretty good covering text.”

“In these early days when you announced you were working on a helicopter,” said Bart Kelley, “you were considered eccentric. Arthur was not only a young man with independent means, but he had the courage and persistence to devote his energies to what was thought of as a crazy invention.”

The inventor’s next step was to set up a small aeronautical laboratory in a barn on the family estate in Radnor, Pa. where he began experimenting with small models.

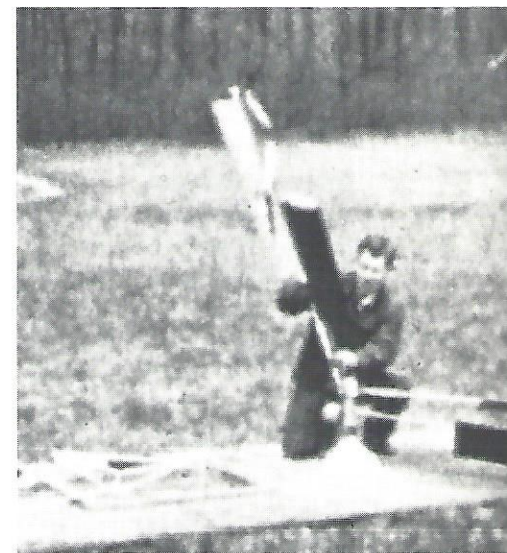
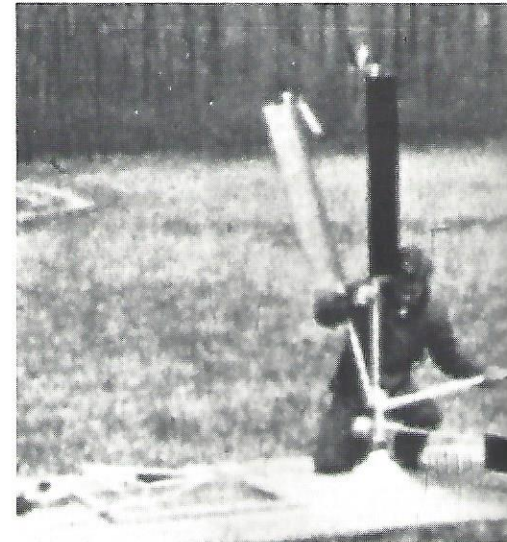
Parts for his first helicopter model came from a toy store and consisted of rubber bands, carved wooden propellers and balsa wood strips. The first flight of the copter, which was six feet in diameter, lasted some 10 seconds. It was a beginning.

For the next several years, Young experimented on a variety of models, powered by everything from rubber bands to electric motors.

“There were so many crashes that Arthur had to learn mass production of rotor blades,” recalled Kelley, “so he taught a neighboring farm boy how to make them.”

In 1937, Young developed a larger model, powered by a 20-horsepower outboard motor. It involved complicated gearing which went up through the hub, out through the blades — turned a corner and spun the little propellers on each blade.

“I used this model to explore stress problems and it blew up on me three times before I got it to hold together,” Young said. “This model was the wrong type and I had to throw the whole thing out, but the experience gained in calculating stress and building parts proved invaluable.”



He drew closer to an answer to the question of flight in 1938. This was also the year that Young converted a barn into a shop and test area on an old farm he had purchased in Paoli, Pa.

“I had considered working on a simpler configuration when I had the opportunity to attend the first Rotary Wing Aircraft meeting. Sikorsky presented a paper there and showed a film that greatly impressed me. It gave a good account of incorporating a tail rotor to correct the torque. From then on I was stuck on the tail rotor principle.”

During this stage, Young also began to experiment on hinged rotors. He had now learned how to simplify through his long apprenticeship and was ready to put his mechanical skills to work.

## Growing helicopters at Gardenville

After a decade of research, many failures and the big breakthrough with the invention of the stabilizer bar, Young was now ready to perfect a model that would appeal to a manufacturer and result in the production of full scale helicopters.

There was one drawback. Although the stabilizer bar provided smooth model flights, there were no remote controls for demonstration purposes.

“Arthur solved this problem by replacing the bar with a flywheel positioned on top of the mast,” Bart Kelley explained. “The rapidly turning flywheel tilted the rotor as the bar had previously done, and the flywheel could be tilted by the operator on the ground by means of solenoids or electromagnets. This remote control system enabled him to maneuver the model around the old barn’s interior and even fly it out the door and back.”

Young’s first attempts at interesting aircraft companies in his machine met with little enthusiasm until a friend, a Dr. John Sharp, visited Bell’s plant.

“Dr. Sharp’s avocation was making complicated gears,” said Young, “and while he was talking over his project with an engineer he mentioned that there was the character who had a helicopter model that would go out the barn door and return under remote control.”

This chance remark led to an appointment for a demonstration and Young and his flying model arrived at the Bell Aircraft Company in Buffalo, N.Y. on the morning of September 3, 1941.

“The flight was made before a group of engineers in a small area of the factory which was brimming with Airacobra pursuit planes,” Young remarked. “After the demonstration, I showed my film, ‘Principles of Stability’. It traced the various rotors I’d used in my flight tests. The ending concentrated on my present remote control model.

“Then came my introduction to Larry Bell. I took a fancy to him right away. Larry was a marvelous person with a great sense of humor and he always knew what was going on.



**These stills, taken from a 1931 film clip show Arthur Young experimenting with one of his early models. It spun little propellers on each blade, an idea he eventually discarded.**

“I returned to making smaller models and began to concentrate on stability.” Young observed. “This meant I had to have flights and have wrecks.”

“Many earlier helicopters had received backing only to crash on their trial run. The backers then backed out and the project collapsed. I felt you had to have the crackups before the initial flight, because these crackups were teaching you something.”

He began to make progress. If the model had a wreck he could rebuild it in a day and move quickly ahead — experimenting with different rotor configurations.

“My major problem was that when the small helicopter model I was working with took off, it would start to tip a little — dash off to one side and then dash back again. After several swings the model tipped over.

His first thought was to install a pendulum which would sense gravity. But tests showed that the pendulum didn’t know the difference between acceleration and gravity.

“After a series of unsuccessful flights I decided to try a stabilizer bar,” Young said. “The bar was linked directly to the rotor so the rotor plane was controlled independently of the mast.

“With the addition of this device, the model performed remarkably, showing great stability. In a few days I was flying the helicopter in the barn. I could even hover it motionless.”

The problem which had plagued Young had finally been solved.



**In early 1941, Young operates the famous remote control model outside his barn door. Remote capabilities were made possible by replacing the stabilizer bar with a flywheel. When time came to build a full-sized machine, the flywheel proved impractical and cumbersome. Young then reverted to the original stabilizer bar, but added mixing levers to it so that both the bar and pilot could directly control the rotor.**

“One day, I remember, he was walking me through the plant and some Army visitors were coming our way. He took me by the arm and said, Arthur, I want you to meet some members of the opposite sex.”

Larry Bell and the inventor reached an agreement and on November 24, 1941 Young and his assistant, Bart Kelley, arrived at the plant to supervise the initial building of two prototypes that were called for in the terms of the contract.

“I’ve known Arthur since I was seven-years-old,” Kelley said. “When I was serving as his apprentice in 1931, he was measuring the thrust of the propellers he had mounted at the tips of the blades of his helicopter model.”

Prior to his working reunion with Young in 1941, Kelley had picked up a B.A. and M.A. in physics from Harvard and had devoted six years of teaching mathematics in Massachusetts’ preparatory schools.

“When I arrived at Bell,” Young continued, “I thought there would be engineers and experts on many subjects — that we’d immediately start building a full scale helicopter after I told them how big it would be. But nothing happened. They were all too busy with war contracts following December 7.

“I waited. There would be conferences from time to time, but they didn’t amount to anything. Then one day a carpenter came in our office and started sawing the walls down. I asked him, ‘what are you doing?’ In a tone that implied I was a ninny, he said they were going to enlarge the place — put in 24 drafting boards so we could make the helicopter.

“I didn’t want to make drawings. Drawings, which were the normal procedures for airplanes, wouldn’t work for the complex and untried mechanism of the helicopter. Drawings would come later after we built the prototype

“Then I discovered something interesting as I was going over the budget with the engineer who had been assigned to us. It specified that \$250,000 was to make drawings for the helicopters — not to build them as stated in the contract.”

“I must have been divinely inspired, because I went over to the head of manufacturing and explained the predicament. He spoke my language and said o.k., he’d sign a budget to make two helicopters

provided that the engineering drafting department had nothing to do with it.

"Now that I had the budget problem out of the way. I began to think — how do you build a helicopter? It's a horrendous thing — like going to a department store and asking for parts for a space vehicle or something. They may have a lot of items but not the ones we needed.

"I determined that in order to have more room to build and fly the machine, it was essential that we have our own plant. I wrote a memo on the subject and received no response. Subsequently I learned that operating funding was being withheld. This reason, it seems, was that Larry Bell was concerned about how safely a helicopter could land in the event of engine failure.

"My idea for a demonstration of autorotation was to put a raw egg on the model as a passenger. I picked up two eggs at a nearby restaurant — one was for dress rehearsal — and set up a time with Larry to see the performance."

"Back at the shop I rigged the machine to a vertical wire that was attached to the 30-foot ceiling. The model climbed too fast on my first attempt and the egg was tossed out as it hit the ceiling. When Larry saw the test, however, everything went smoothly and the helicopter autorotated to the floor without breaking the egg. He was more than pleased with the demonstration and the funds were released.

"After some searching, we found our location — an old Chrysler agency and garage which was about 10 miles from Bell in Gardenville, a suburb of Buffalo. It had a big yard for preliminary testing and a meadow where we could make short flights. The building was easily converted into a combination machine shop, drafting room, office and workshop for making the blades. The garage served as our manufacturing facility."

Almost immediately, following the Gardenville move on June 23, 1942, a group of maintenance men paid an unforgettable visit to the new helicopter plant.

"They put up a board fence, painted it Navy gray and placed searchlights and armed guards all around," Young said. "I called Bell powers and said listen — this will only attract attention to the place.

Everything was removed and our security measures were reduced to an inconspicuous night watchman."

Young and his small staff were now ready to go to work on constructing the first helicopter, the Model 30.

## Having their ups and downs

When Bell opened its first helicopter plant in Gardenville, there were about 15 people, including engineers, body men, tool and pattern makers, flight mechanics and one welder.

According to Bart Kelley, during the three-year Gardenville project (from June 1942 to June 1945), employees never exceeded 32 in number.

"After our relocation at Gardenville, things really began to hum," Arthur Young recalled. "All the brains were in the small office so we all knew what was going on without having to send memos all over the place. If something went wrong, the machinist would just bring the drawing in and ask a question. It was all very simple."

"It was the tightest organization I've ever seen from the aspect of scheduling," Kelley added. "Every part, for instance, was assigned to an individual so everyone knew who had the responsibility."

Just six months following the group's arrival at Gardenville, the Model 30 was wheeled — or as Bart Kelley described it — "shoved out the garage door."

The ceremony was on a cold winter day in December 1942. A shivering secretary broke a bottle of champagne on the fuselage and aircraft No. 1 was christened Genevieve.

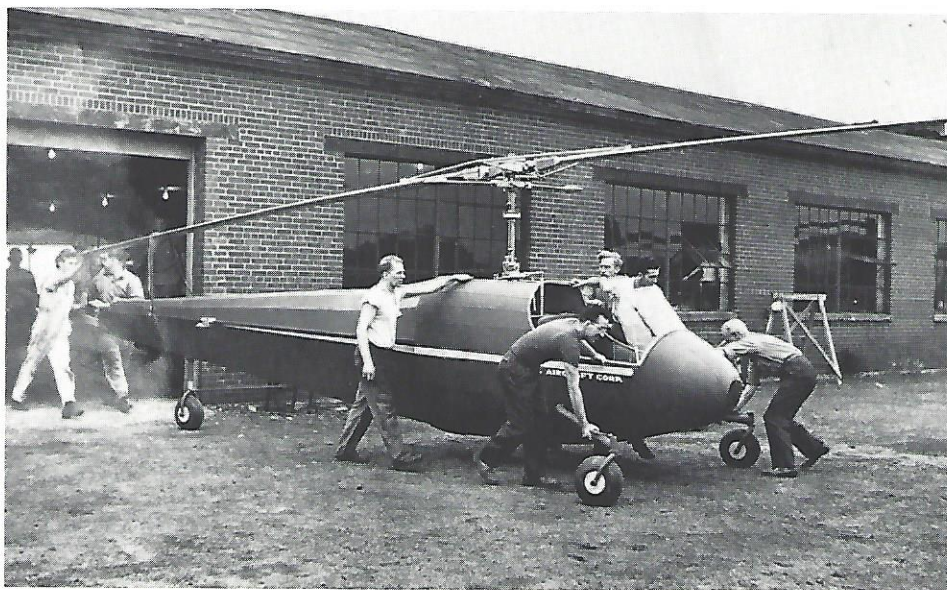
Genevieve's legs were made of 3-inch aluminum tubing; her magnificent rotor measured 32-feet and she was powered by a 160 hp Franklin air-cooled engine.

The rollout ceremony, however, was short lived because the machine wouldn't start. Kelley towed it back inside with his car. Two batteries were added which gave the engine enough spark to kick her off.

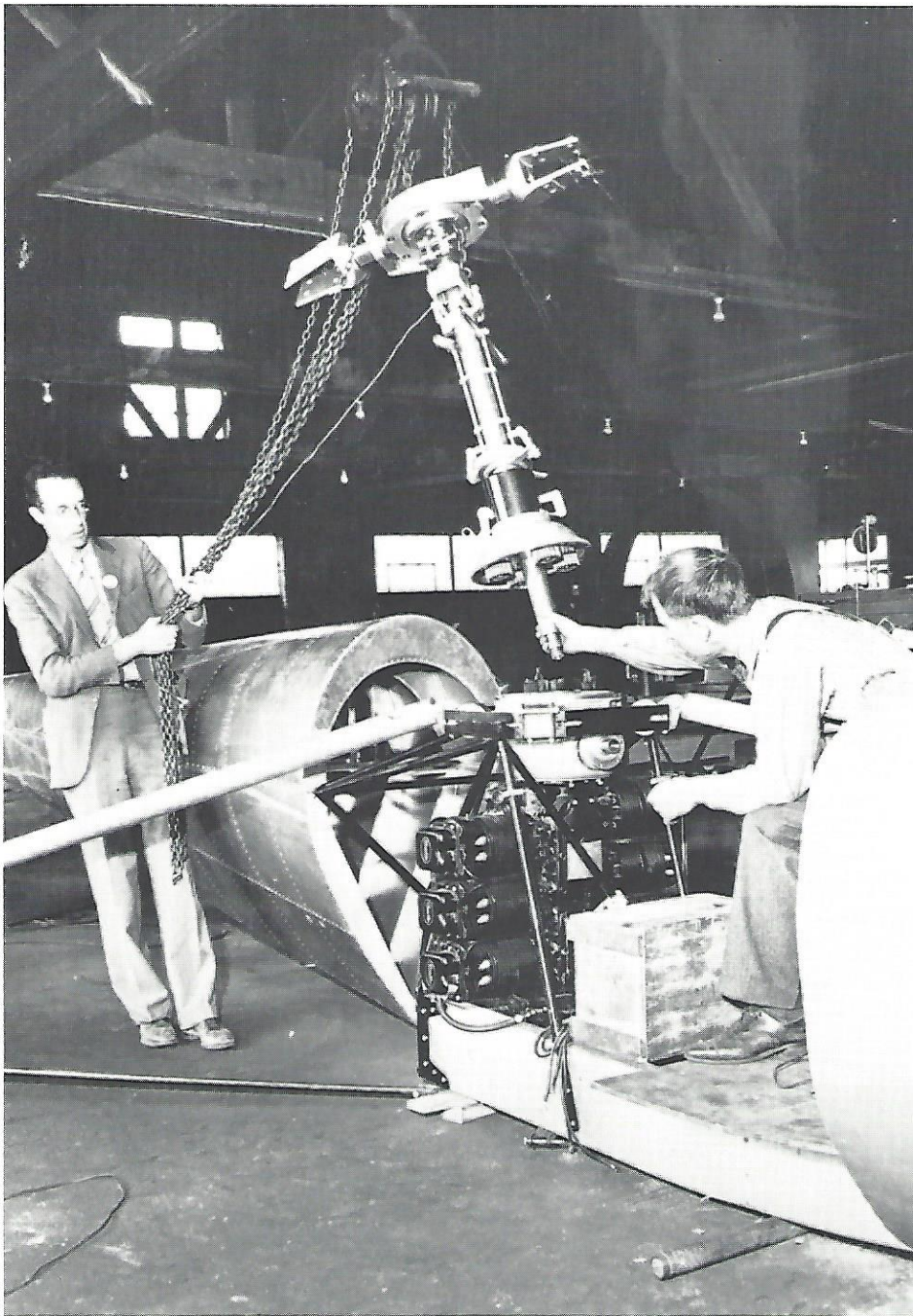
"We made the helicopter so quickly, because we weren't too sure how to make it," Young reflected. "It took longer when you knew all the things that had to be done right."

Although Arthur Young was not a pilot, he was the first to take the control of the Model 30 which was tethered to cables behind the garage. He sat on the helicopter's seat — a wooden bench — and made brief hovers that were not more than a foot off the ground during early testing.

"Our first problem was excess vibration whenever Arthur hovered in a breeze of 20 knots or so," Kelley pointed out. "We later



**Aircraft No. 1, "Genevieve", is rolled out of the manufacturing plant garage after getting a beauty treatment that included wheels and a blue covering for the fuselage and tail boom. Walking by the machine, center, is Arthur Young.**



**Bart Kelley, left, assists Young in putting Ship No. 1's transmission mast assembly together. October 1942.**

solved this problem, but around late December of 1942 we had our first major setback.

"A Bell executive who was also a pilot, felt he should be the first to make the initial flight. While getting the feel of the machine in a tethered hover, he lost control — was tossed into the rotor and slung onto a snow bank. Fortunately, his injuries were limited to a broken arm."

About this time, a pilot was assigned to assist in the helicopter project. His name was Floyd Carlson. Carlson, who had started his flying career at the age of 14, was originally hired by Bell to test fighter planes."

"When the ship was repaired, Floyd learned how to hover it almost immediately," Young said, "and before long he could hold the aircraft motionless at high hovers."

On June 26, 1943 the cable was removed and Carlson took the Model 30 on its maiden run around the meadow behind the garage. Six members of the Gardenville group, incidentally, acquired the ability to fly the helicopter from this tethered technique.

"During our first flights, the aircraft flew very well," Young said, "until it got up to 25 miles per hour. Then, the helicopter experienced severe vibrations. It was actually Floyd who came up with an idea to remedy the situation. He suggested putting a brace on the rotor which we called the Swedish yoke. This yoke stiffened the rotor and we didn't have this problem anymore."

By July 1943, Ship No. 1 was flying at speeds over 70 miles per hour. The aircraft's legs had been removed and replaced with wheels. Genevieve's fuselage and tail-boom were also dressed up and painted blue so she'd look pretty during demonstrations.

When word of the successful helicopter flights got around, Gardenville began getting some important visitors. One was Igor Sikorsky.

"Sikorsky wanted to see the aircraft's vertical engine mount," Young remarked. "His entrance was made in a fleet of Cadillacs driven by vice presidents.



**Floyd Carlson gets acquainted with the first Model 30 during a tethered hover in the yard behind the garage at the Gardenville facility.**

"I remember they all stood around the Model 30 in a circle. Finally, Sikorsky said to me: "I zee you use zee vertical engine. I replied: "Yes, I use the vertical engine." And that was the end of the conversation. They simply got in their Cadillacs and drove away.

"We also had a group of Russian generals pay us a call. Russia had purchased some Airacobras and the generals were at Bell to see how they were built. I'd been flying Ship 1 and when I landed they began swarming all over the aircraft.

"One of the generals kept turning on different switches and I said, 'no,no!' He didn't understand so I slapped him on the wrist and he stopped. I think I'm the first person who ever slapped a Russian general on the wrist."

While flights of the first Model 30 were underway, Ship No. 2 was being manufactured. Its specifications called for an enclosed cabin instead of the open cockpit and room for a passenger as well as the pilot.



**Russian military personnel paid frequent visits to Bell Aircraft during World War II. Young once slapped a Russian general's wrist when he began toying with the helicopter switches. That's Floyd Carlson in the cockpit, right.**

“Under the agreement that Arthur had with Larry Bell,” Bart Kelley injected, “the first helicopter would be made to demonstrate the principles, the second, a two-place machine, was to give Larry a ride.”

As the flight envelope for Ship No. 1 expanded, the field behind the garage wasn't big enough for sufficient maneuvers, so the aircraft was towed by car to a small airport on Buffalo's west side.

Then in September 1943, another setback occurred. While Floyd Carlson was teaching himself to make landings without power in auto rotation, the tail wheel struck the ground with sufficient force to cause a crack-up.

“Floyd said something like ‘oh hell!’ and climbed unhurt out of the wreckage,” Kelley recollected. “Luckily, most of the parts of the ship were salvageable and it was back in action in about six months.

Ship No. 2 replaced the first Model 30 as the test vehicle in late September 1943. It would have made its debut earlier, but suggestions came from Bell Aircraft that the helicopter should look like an Airacobra.

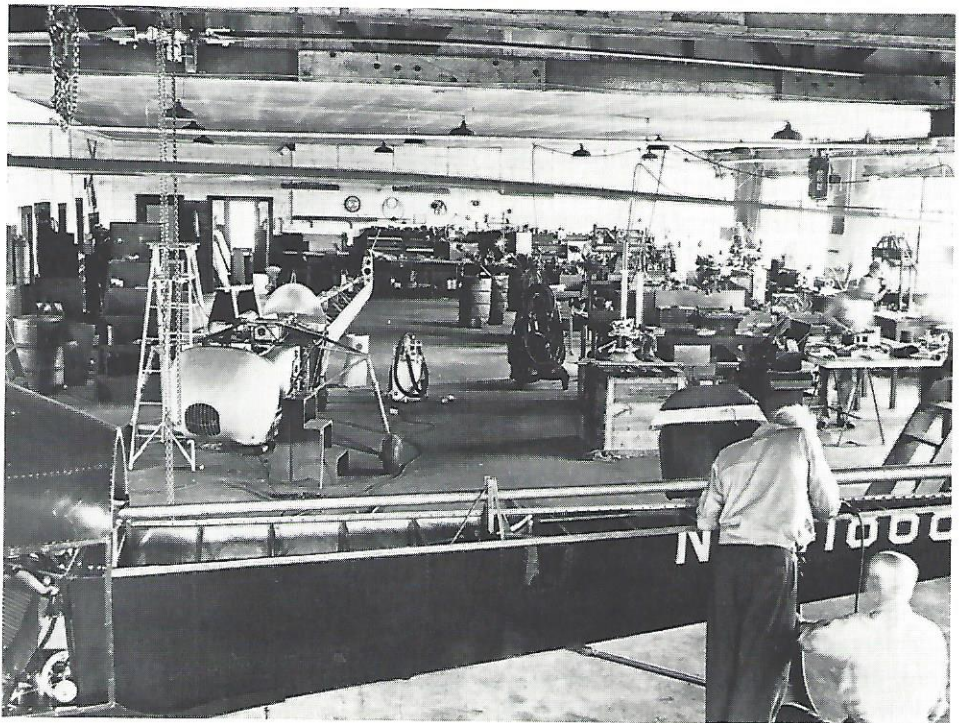
“A designer struggled with this idea for over a year,” Young said, “and when it was finally wheeled out we found that two people couldn't get in, because it was too streamlined. The cockpit, of course had to be widened which took more time.”

One of the first passengers to fly in the second Model 30 was Larry Bell.

Relating Mr. Bell's impression of the flight, Bart Kelley reports: “Larry said that since he was raised on a farm in Indiana, he'd seen a cow from every angle. But he'd never seen a cow from the angle that was provided by the helicopter.”



**Larry Bell made a unique observation about a cow (see text) after taking a ride in the second Model 30. Ship No. 2 was a two-place helicopter with an enclosed cabin.**



**The Model 30s were manufactured in a former Chrysler agency garage in Gardenville, a suburb of Buffalo. Everyone pitched in, including the furnace man (at right, foreground) who is lending a hand on Ship No. 2 assembly. Ship No. 1 is shown in the background.**

## The Model 42 ... beauty & the beast

While Ship 1 was being rebuilt following its crack up, the second Model 30 began making a name for itself by giving rides and participating in a series of demonstrations.

The aircraft's public debut occurred in March 1944. Heralding the event was a two-page spread in the Buffalo Sunday paper. "Long lines of traffic emerged behind the Gardenville shop," Arthur Young recalled. "Nobody paid too much attention to us when we were conducting our test flights. Now spectators were all over the place."

Ship 2 made another big hit May 10, 1944. This time the aircraft went inside the Buffalo Armory to put on a show at the request of the Civil Air Patrol. A crowd of

officers and cadets watched in fascination, as Floyd Carlson put the machine through precision maneuvers.

Not only did the armory demonstration receive rave reviews, but it represented the first indoor flight of a helicopter in the Western Hemisphere.

In the spring of 1944, Ship 1 had been rebuilt and was rechristened 1A. Making a spectacular comeback, the helicopter was the star attraction at a soldier's benefit show, staged at Buffalo's Civil Stadium July 4. A crowd of 42,000 attended.

"The climax of our act was for Floyd to hover the front wheel of the helicopter into my extended hand," Young remarked.

During this period the war clouds were breaking up. With the pursuit plane contracts coming to an end, Larry Bell turned his attention to the helicopter as the answer to the company's future. One day a group of engineers arrived at Gardenville

to get acquainted with rotary-wing flight.

"Larry's idea was for his main engineering department to develop a larger helicopter after they acquired the basics from us," Young said. "Because we were considered a research unit, I believe he thought they could do a better job."

The proposed helicopter, designated Model 42, looked impressive in design specifications and renderings. It was streamlined with plush seats and room for a pilot and four passengers. An introductory brochure showed a high speed of 130 mph and a maximum range of 450 miles.



**Bell Model 30 #2 flying indoors - Buffalo, N.Y. Armory 1944 Civil Air Patrol and guests witnessed flights.**