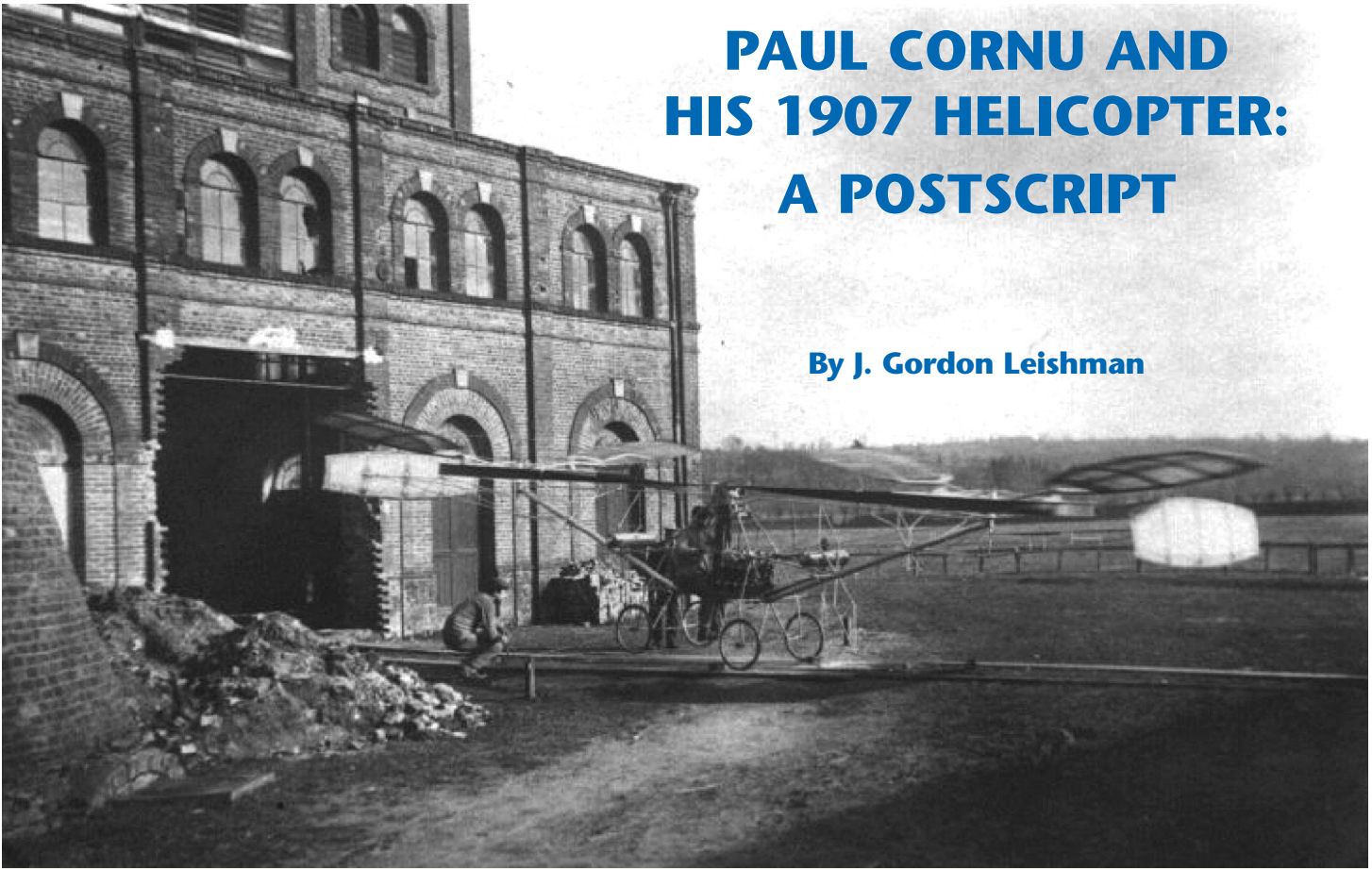


PAUL CORNU AND HIS 1907 HELICOPTER: A POSTSCRIPT

By J. Gordon Leishman



As 2007 comes to an end, and the various activities related to the European-proclaimed “Centennial of Helicopter Flight” finally subside, the AHS’s History Committee has been diligently completing its detailed research into the work of Frenchman Paul Cornu, and uncovering a better scientific and engineering understanding of what Cornu accomplished with his 1907 helicopter, shown in Figure 1. Research materials have included: Paul Cornu’s journal articles in *L’Aerophile* (some of which are in the Smithsonian Institution’s rare book collection), Cornu’s patents (for which several relate specifically to rotating-wing concepts), and a detailed transcript of his journal (logbook) from 1905 to 1908, the latter being provided by a member of the Cornu family. The effort has been compounded by the need to carefully translate all of the materials from French, but this has all culminated in a much clearer understanding of Paul Cornu’s actual accomplishments over what has been previously reported.

What is evident is that in 1906, Paul Cornu was well ahead of others who were attempting to build piloted helicopter concepts about that time, including Louis Breguet (France) and R.E. Mumford (Britain). Cornu built a force balance for his rotor tests, and was one of the first to conduct systematic experiments to study the thrust and power requirements for vertical flight. Cornu’s free-flying test rig – a model weighing up to 18 kg (40 lb) lifted by a 2 hp engine driving two contra-rotating rotors – was to make several sustained flights, in both hover and forward flight, and with many witnesses to the event. The flight-worthiness of his test rig can also be verified through engineering calculations. Of

Figure 1. Perhaps the only photo of the Cornu helicopter that exists, suggesting a hop into the air, here with at least the two rear wheels free of the ground. (Photograph courtesy of Francois Cornu)

some further significance, is that Paul Cornu was also looking at methods of achieving flight control and forward propulsion at a time (1906) when others were thinking only of ways to get vertically off the ground.

The construction of Cornu’s piloted helicopter concept took almost a year, but it followed closely the design described in US Patent 902,859, filed on September 11, 1906 – see Figure 2. At least one point of previous contention has been finally resolved. On 13 November 1907, a date that has been unremittably cited as the date that Paul Cornu first “successfully” flew his helicopter, a stripped-down version of his machine lifted a sandbag that was strapped to the pilot’s seat. Cornu was to record the details in his logbook: “13 November 1907: In the afternoon, the second attempts. The machine rises with a 55 kg [121 lb] sandbag. We try to hold it down, but I find myself lifted up and carried away, Jacques [his brother] is almost too. It takes little to escape us. Finally I jumped on one of the handles, and with one hand clinging to the undercarriage, I manage with the other to reduce the spark advance and the aircraft finishes on the ground without any damage.”

Until this point, Cornu’s machine consisted only of the airframe, engine and rotors. The control surfaces, which were two “wings” with adjustable pitch that were placed in the slipstream flow below the rotors, were then added and the machine configured for its first piloted flight; but it did not take off because of drive belt

slippage, a problem that was to plague Cornu throughout all of his attempts at flight. Replacing the rubber surfaces on the drive wheels and molding the shape of the drive belt to the flywheel with a hot iron helped reduce – but not eliminate – the belt slippage problem. On 6 December 1907, Paul Cornu was to report: “I climbed for the first time in the aircraft and on the second attempt, with very little [spark] advance, all off, but there is still slipping on the big pulleys.” This entry in his logbook, and the specific words “all [wheels] off” suggests that Cornu’s machine made a brief piloted hop on that day.

But it seems that Paul Cornu did not view this modest accomplishment with the same level of success that has been credited to him by so many others over the last century. This has included claims of free flight of up to 2 meters in altitude and for up 20 minutes, all of which are unsupported by any form of hard evidence, such as photos, eyewitnesses or any entries in Cornu’s own logbooks. Cornu made several more attempts at flight during the following weeks, and he goes on to say: “From December 7 to 27, I tried different ways to get a better grip on the pulleys.” He continues with some comments about the adjustments needed to the rotors to get sufficient lift: “During these experiments, we have tried every possible change to the propellers [rotors].” His logbooks suggest much frustration and disappointment over the lack of real progress. At best, his attempts at flight resulted only in the rear wheels of his machine coming off the ground, and perhaps getting lighter on the front wheels and moving slowly forward – as shown in Figure 1. Engineering calculations, as was done for Cornu’s test rig, confirm that free flight, clear of ground effect, would have been impossible using an engine that produced, at most, 24 hp. In fact, an engine closer to 40 hp would have been necessary to lift his machine, even under the best of circumstances.

By December 29, 1907 Paul Cornu was to summarize the outcome of his prior work, and came to a profound conclusion that the future helicopter will not resemble the one he had developed: “Based on the tests that I have done so far, here are the main provisions and dimensions that a helicopter should have to be able to lift one man, and whose weights with the aviator would be about 300 kg [661 lb]: engine 30 hp operating with a transmission gear and two propellers made of metal superimposed on the same axis and rotating in opposite directions, with a diameter of 3 meters [9.8 ft], turning at 1,000 revolutions per minute.” But he went on: “The crucial point is to use rotors of small diameter rotating at a very high speed.” Of course, Cornu’s conclusion here is contrary to a modern understanding of helicopter performance, where best hovering efficiency is, in fact, achieved using a large diameter rotor rotating at low speeds.

While Cornu’s attempts at piloted helicopter flight during 1906–08 weave an interesting story, at best, like other vertical flight machines of the era, his full-scale machine most likely made very brief, uncontrolled bouncing hops into the air.

Paul Cornu clearly did not fully appreciate the engineering needed to achieve helicopter flight, or how to scale up his successful test rig with an engine of sufficient power. But the significance of Cornu’s work lies more in his systematic and relatively scientific attempts to understand the relationship between rotor thrust and power requirements, and in exploring methods of controlling a helicopter in flight and propelling it forward. But after his last unsuccessful attempts at flight with his helicopter in the spring of 1908, Cornu was not to build any other flying concepts; although in 1908, he did construct a non-flying test rig using coaxial rotors, and also pursued the design of a hybrid aircraft concept he called a “helicoptane.”

Of course, one major issue at the time was the general unavailability and relatively low power of internal combustion engines, something that Paul Cornu was intimately aware of. He was to write: “October 20th 1908: Travel to Paris to study engines. I only see two models: the very light ones that do not work and those that weigh at least 3 kilograms per hp, which is too heavy for the helicoptane.”

Better success with the helicopter was to take at least another decade, with Jacob Ellehammer, Etienne Oehmichen and Coradino d’Ascanio making further progress as technology slowly matured, and with Cierva pioneering the development of the articulated rotor in 1923, which was to prove key to the ultimate realization of a practical helicopter. The first real successes with the helicopter were not to occur for nearly three decades after the attempts at flight by Paul Cornu. In this respect, the year 1907 has limited significance in the overall development of the helicopter as a practical and useful aircraft, and there will be more appropriate opportunities in the future to celebrate an entire century of successful helicopter flight.

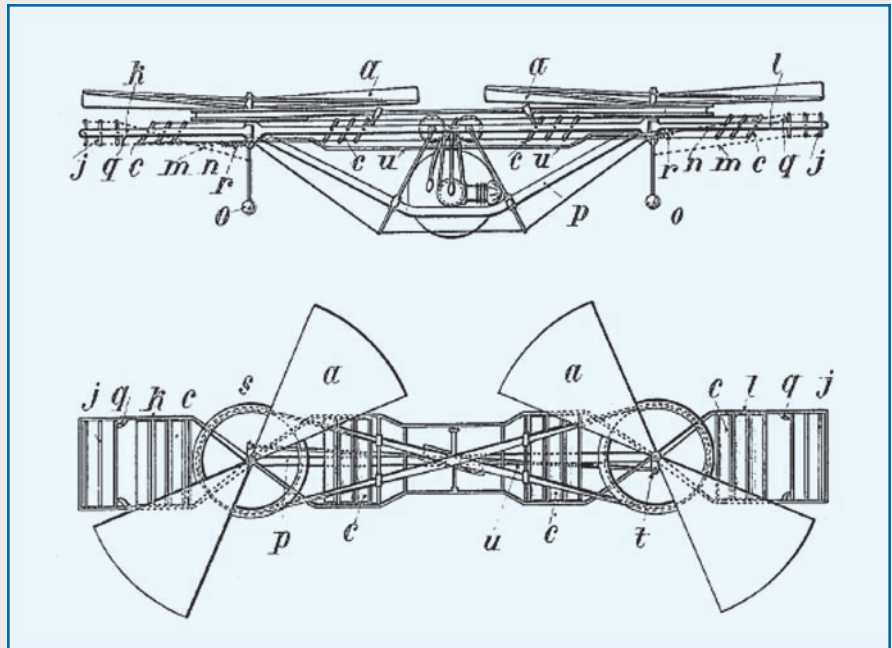


Figure 2. An image from Cornu’s helicopter patent as published in U.S. Patent 902,859, filed on September 11, 1906 and issued on November 3, 1908.