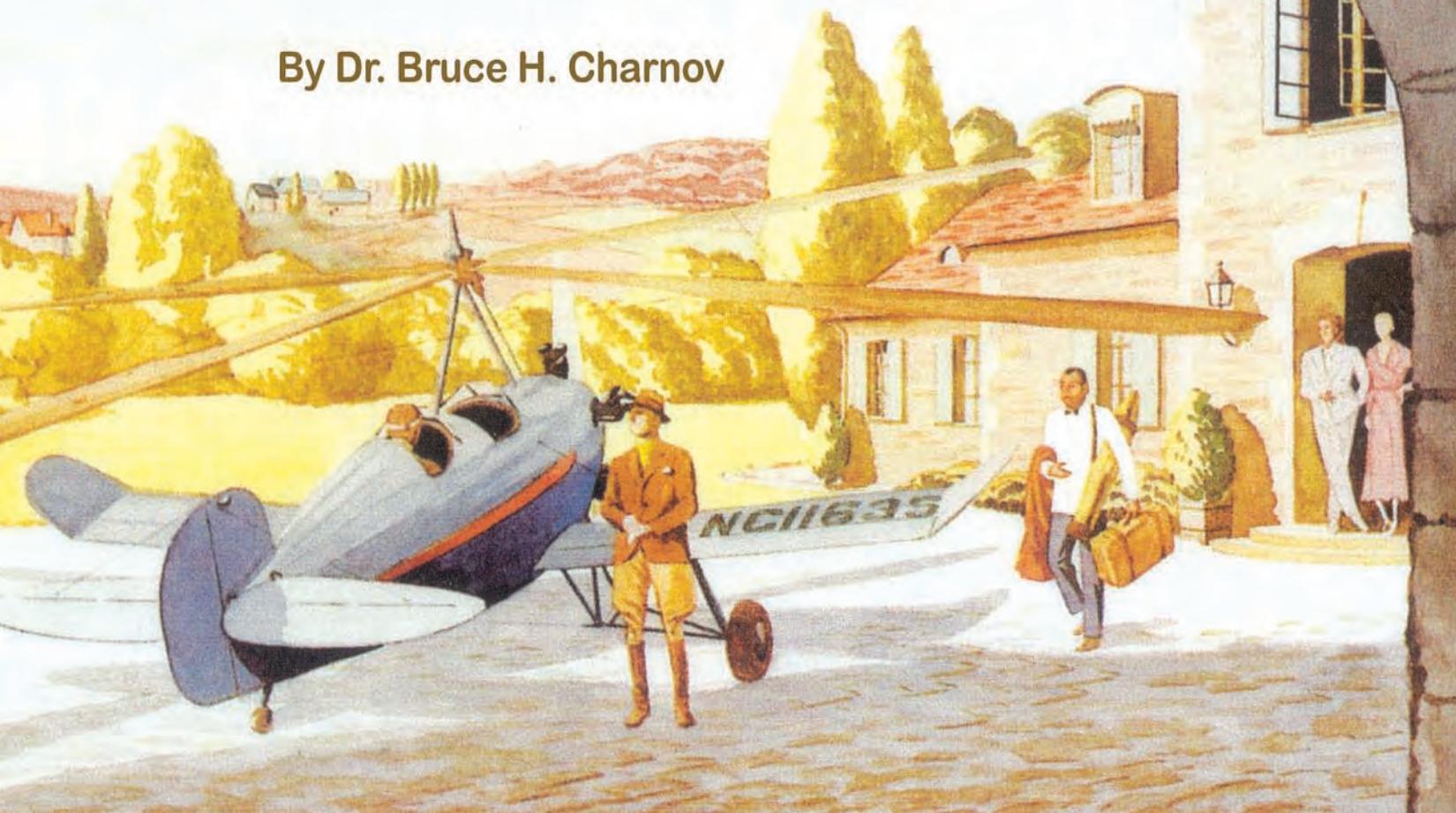


The 1938 Franklin Institute Meeting

Evolution and Revolution in Rotary Wing Aircraft

By Dr. Bruce H. Charnov



The Rotating Wing Aircraft Meetings of 1938 and 1939 were the first national conferences on rotorcraft. They marked a transition from a technological focus on the Autogiro to the helicopter. In addition, these important meetings helped to lay the groundwork for the founding of the American Helicopter Society. – Ed.

The Rotating Wing Aircraft Meeting of October 28 – 29, 1938 at the Franklin Institute in Philadelphia, PA, sponsored by the Philadelphia Chapter of the Institute of the Aeronautical Sciences (IAS, the forerunner of the American Institute of Aeronautics and Astronautics, or AIAA), was an historic gathering of those involved, committed to and researching Autogiro, convertiplane and helicopter flight. It was, as described in the preface to the conference proceedings, “the first free discussion in this field of science open to all engineers in the aircraft industry.”

This advertisement showing Pitcairn’s 1932 Tandem landing at an estate was typical of their strategy to market to the wealthy. “If yours is such an estate or if you will select a neighboring field, a Pitcairn representative will gladly demonstrate the complete practicality of this modern American scene.” With the Great Depression wearing on, however, the Autogiro business was moribund by the late 1930s.

This was a significant gathering for the future of rotary wing flight in America, coming at a time when the Autogiro movement was moribund and helicopter development was just about to receive a boost with commencement of the just-passed Dorsey-Logan Bill. And, perhaps of greater importance, those attending – including many of the leading developers of rotary wing flight – were actively speculating as to the future that rotary wing flight might take. Their speculations, now generally forgotten, would be vindicated within the decade to come, and their efforts subsequent to that ini-

tial rotary wing meeting shaped the course of rotorcraft history. This historic meeting dealing with rotary wing flight has been either unjustly forgotten or inaccurately mythologized, and only when examined, does it reclaim its historical importance and place in vertical flight history.

The meeting consisted of invited papers based on topics assigned by Chairman E. Burke Wilford, President of the IAS Philadelphia Chapter, in consultation with the organizing committee, which included Dr. Ralph McClarren (IAS Secretary, member of the Franklin Institute and active in the development of the Wilford Gyroplane), W. Laurence LePage (who would officially form the Platt-LePage Aircraft Company a few days after the conference to build the XR-1), Richard H. Prewitt (Kellett Autogiro Company), Agnew E. Larsen and James G. Ray (both of the Autogiro Company of America). This article summarizes this historic meeting and some of the critical discussions.



With Klemin and McClarren's help, Herrick built his HV-1 in 1931. Herrick is shown here with the HV-2 in 1937. Test pilot George Townson had made more than 100 conversions from fixed-wing to gyroplane mode by the end of 1937.

The First Session Friday Morning, October 28, 1938

The introduction was given by E. Burke Wilford in his role as President of the Philadelphia Chapter of IAS. He began optimistically:

“As this is probably the first rotary wing aircraft conference occurring in the world, we hope to make a little history here, and the only way that we can do that is for everyone to say what he thinks. Don't be afraid of hurting anybody's feelings, or departing from conventional procedure. That is what this meeting is for, and we hope that it will be the start of a real boom in the rotary wing aircraft industry.”

Ralph H. McClarren's "Review of Rotating Wing Aircraft" commenced with historical antecedents: the maple seed, the boomerang, the toy "Chinese top," and a working Pitcairn Autogiro model. He showed slow-motion movies of a hummingbird hovering in flight and other demonstrations from what was known as the "Franklin Institute traveling air show."

Kellett chief engineer Richard H. Prewitt's presentation, "The Autogiro," then summarized American and British Autogiro organizations and achievements, concluding with a description and film of the civilian and military versions of the Kellett direct-control Autogiros.

The second presentation, Gerard P. Herrick's "The Convertaplane," detailed the history of the HV-2A Convertaplane, an initial attempt to combine fixed and rotary wing flight using a biplane whose upper wing rotated, using a symmetrical airfoil mounted on a central rotor pylon that allowed aerodynamic adjustment for control. It sat on a hinged mount, using standard ball bearings that teetered to compensate for the lift dif-

ferential between the advancing and retreating sides. The biplane took off conventionally (with the upper wing fixed), then converted into a gyroplane with the upper wing rotating to provide lift on the central pylon.

Herrick concluded: "The Three Musketeers of the Convertaplane are present. As every engine needs an eccentric to bob up on special occasions for special purposes, we have an eccentric in the inventor [that being Herrick]; also the expert aeronautical engineer, Ralph McClarren, to keep the inventor within bounds and incorporate his ideas in the best practice, and the pilot, George Townson, who was courageous enough to prove the safety and simplicity of this new converting form of flight."

Session Chairman Dr. Alexander Klemin continued: "I am sure, gentlemen, we all enjoyed Mr. Herrick's paper immensely, and never have I seen anyone so sincere, modest and what should we say, gentlemanly, in the presentation of his own ideas. I think it is quite refreshing, and you will notice that Mr. Herrick's humor is particularly subtle, though very mild. The only thing I don't approve of are his mathematics. [Laughter] I think his mathematics are of the type of which the college professor, in marking down a paper say[s], 'I think I shall give him a C, minus.'"

Klemin then introduced "The Development of the Helicopter – Past, Present and Future," by Haviland H. Platt. This included the Past – attainment of sustained free flight without regard to utility or safety; Present – provision of adequate flight control and safety; and Future – attainment of useful performance. The present centered on the Focke helicopter, asserting that "the Focke helicopter is open to great improvement in three



Dr. Alexander Klemin was a founding member of AHS and heavily involved in IAS. He headed the Research Department of the Army Air Service during World War I, and was in charge of the Guggenheim School of Aeronautics at New York University from 1924 to 1941. In 1952, AHS initiated the Alexander Klemin Award, honoring "the memory of an eminent aeronautical engineer, educator, author, and outstanding pioneer in rotary-wing aeronautics." He was named an Honorary Fellow by the Society in 1946.

ways: 1. Increase in aerodynamic lift efficiency, 2. Reduction of structure weight, and 3. Reduction of parasite drag" and that "in the case of the helicopter . . . the theoretical gain of the single over the double rotor appears to be much more pronounced than is that of the monoplane over the biplane. . . . Concerning structure weight, the advantage is again clearly on the side of the single rotor which does not require outriggers and long drive shafts."

Klemin then continued: "Everybody knows Burke Wilford, knows him as a swell engineer and a good fellow, and loves him, and that is the best introduction I can give to our Chairman." Wilford's presentation, "The Gyroplane" described the development and flight trials of the Wilford Gyroplane, and the speaker shared two visions for the future: a streamlined version of the Focke Helicopter, which he called the Heli-Gyro, and a 1950 concept that would foreshadow the Fairey Rotodyne:



In 1931, E. Burke Wilford built the first successful autogyro to fly with a rigid rotor. It replaced the Cierva-type hinged rotors with a rigid rotor with cyclic pitch variation, based on the patents of Germans Walter Reiseler and Walter Kreiser – hence the designation, "W.R.K. Gyro." (Courtesy of the Smithsonian Institution National Air and Space Museum. Negative number 9A01102.)

"I am a great believer in Mr. Herrick's principle of the Convertiplane . . . Here is something, say in 1950 we

will be going to Europe in. It is a clipped wing aeroplane, with 10,000 horsepower . . . It has just enough wing area to support it at 250 miles cruising speed, so that you design the most efficient ship just to fly. You don't worry about landing. Then, we put Ralph McClarren's maple seed on top, and we have take-off and landing."

The Second Session Friday Afternoon, October 28, 1938

Wallace Kellett introduced "Lieutenant Gregory . . . [who] represents the United States Army and the War Department . . ." Gregory began "Army Experiences With Rotating Wing Aircraft" with a curious comment:

"I am reminded of a story that Major Carl Green told me last night. He said that one man walked up to another and said, "Brother can you give me a quarter to buy a cup of coffee?" The man looked at him and said, "A quarter! My gracious, I could buy five cups of coffee for a quarter. If you would ask for a dime, I might give it to you." He said, "Now listen. I asked you for a quarter. If you want to give it to me, O.K. If you don't want to give it to me, O.K. But don't try to tell me how to run my own business."

H. Franklin Gregory was stating that he wouldn't tell them how to do their business; but at the same time he was also telling them not to tell him how to do *his*, in this case, *his country's business* – and that business was, in his own later words, "to look for a successful helicopter."



Frank Gregory would soon head the Army Air Corps' rotary wing aircraft development section at Wright Field. His first involvement with rotorcraft was in early 1936, when the National Advisory Committee for Aeronautics (NACA) requested Army pilots to fly two research Autogiros. In 1944, Gregory (right) and Igor Sikorsky (left) became the first two AHS Honorary Fellows.

Gregory summarized the Army's involvement with the Autogiro concluding: "Well trained pilots are necessary for the operation of the present autogiro. . . [which] in the hands of an expert is probably as safe as the conventional airplane. I didn't see any tomatoes come this way. [Laughter] . . . the autogiro may develop into an extremely useful military instrument, particularly adapted to certain observation and other needs in Army cooperation." Gregory knew, in asserting that the Autogiro required expert pilots, he was challenging the industry's assertions that the Autogiro was the "safe aircraft for the masses."

Kellett then introduced Congressman Frank Dorsey, then running [unsuccessfully, it would turn out] for reelection.

"Our next speaker is Mr. Dorsey. I think that name ought to mean a great deal to everyone here today, because Mr. Dorsey who had the foresight to see that the development of rotary wind [sic] aircraft should be carried on as part of our national resources . . . which resulted in the enactment by Congress in the last session of the Dorsey Bill, authorizing \$2,000,000 for autogiro – excuse me, rotary wing aircraft – development."

Dorsey quickly let Autogiro constituents know that he noted Gregory's challenge, stating: "I was quite interested in the remark, and *I didn't have any tomato to throw at the time* [emphasis added]." Dorsey, in his "verbal tomato," recounting at some length his near disastrous experience in a fixed wing aircraft, segued to his prepared speech with the declaration that "I thought there surely must be some kind of an aircraft can keep you in the air, or let you down on the top of a tree somewhere without cracking everybody up. So I became interested in the subject, and I just want to express a few thoughts to you this afternoon concerning what part the government should play in the development of rotating wing type aircraft, and what you can do to assist such a program."

Dorsey, describing the government's stake in supporting rotary wing development, advised the manufacturers to pursue "military and civilian procurement programs of the government, the airmail service, and the restricted but growing private market." He then asserted: "The federal government cannot be a profligate sugar daddy, a careless angel backing uncertain, untried proposals. As American citizens, we should be proud this is so. As a member of Congress, I shall always insist that it be so." He added: "For these very reasons, I am proud of the part I played in obtaining federal assistance for the rotating wing aircraft industry."

Dorsey's presentation came to an end – as soon would his Congressional career. The Dorsey-Logan funds, greatly reduced, would spur the growth of the rotary wing aircraft industry – the helicopter, as Gregory would work to effectively see that no significant

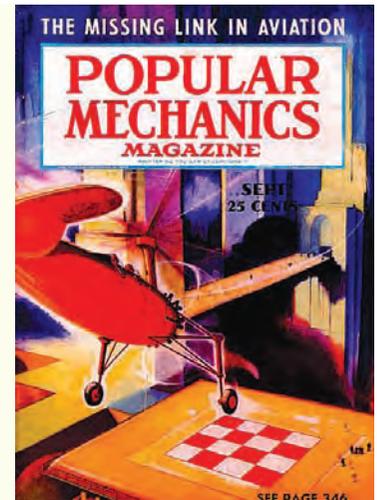
funds would go to the Autogiro.

Kellett then introduced A. G. Galloway of the U. S. Department of Agriculture who spoke optimistically about rotary wing aircraft for agricultural uses. The session moved quickly to John M. "Johnny" Miller, who had just published an Autogiro cover story in that September's issue of *Popular Mechanics Magazine* entitled "The Missing Link in Aviation." Miller was a well known Autogiro pilot, having flown the first transcontinental flight. At the time, he was lobbying Congress to provide funding for an experimental rooftop operation for expedited mail delivery.

Miller gave a highly generalized presentation on "Autogiro Piloting Technique" but then ventured into uncharted territory, landing an Autogiro "blind." This occasioned a spirited exchange with Gregory, but Kellett was anxious to get to Pitcairn pilot James G. "Jim" Ray's presentation on "Commercial Uses of Rotary Wing Aircraft." Ray cited past Autogiro commercial uses and concluded that "the Autogiro with jump take-off or the true helicopter will permit him to land and take off most anywhere. The addition of roadability . . . will make it possible for the one vehicle to take you from where you are to where you want to go. This complete fulfillment of one's personal transportation requirements can only be attained with rotative wings." Ray emphasized the ability of rotating-wing aircraft to shorten travel time, and increase utility and convenience in "large metropolitan or built-up areas [as a] practical shuttle service with both passengers and mail from city center to the airport."

With regard to maritime rescue work, he stated: "straight helicopters, of course, will be the most suitable because they will not require a wind to hang motionless and remain airborne while someone or something is taken aboard." Ray's focus on rotary wing aircraft was completely in keeping with the meeting's theme, but must have proven disconcerting to those who saw him as a champion of the Autogiro. Kellett, reassuming the podium, commented only that Ray's presentation "ought to intrigue our imagination" as the helicopter had been placed front-and-center, with more to come.

Raoul Hafner claimed "The Hafner Gyroplane" was "substantially identical with what I said a year ago



Johnny Miller was a major proponent of rooftop mail service, shown here in the 1938 Popular Mechanics Magazine, and in July 1939 would help initiate an experimental mail route from the roof of the 30th Street Post Office in Philadelphia to nearby Grand Central Airport in Camden, NJ.

before the Royal Aeronautical Society and later at Cambridge University”, including the revolutionary “spider rotor hub design.” Hafner passed quickly over his innovations into a discussion of aerofoil section selection and joystick arrangement – showing images of his A.R.III and contrasting the standard Autogiro “jump take-off” with the A.R.III’s “towering take-off”:

“The jump type of start involves an inefficient conversion of energy due to high induced air-flow velocities, and is generally, particularly if there is no wind, followed by a substantial loss of height to regain speed after reaching the top of the leap. The purpose of the towering take-off is primarily to hold the machine after the start in the proximity of the ground, thereby keeping the induced drag down, while the air-screw accelerates it to climbing speed, and to regulate the rate of conversion of energy in the rotor through the sensitive feel of this control, in order to suit varying wind conditions.”

Hafner concluded: “The gyroplane of today can perform . . . satisfactorily, and the helicopter, the logical development from it, will not only improve on it, but will be able to challenge the fixed wing plane in almost any department of flight. In its new form, as I visualize it, and which may well appear in the near future, it will be a craft of mechanical simplicity and aerodynamic beauty and performance calculations give indeed justification for great expectations. I will speak of this tomorrow.” Thus the presentation ended – it had quietly and eloquently transitioned from the Autogiro past to the helicopter future and towards the future helicopter.

And with that the meeting adjourned to a banquet at the Penn Athletic Club, and a presentation by Edward J. Nobe, then Chairman of the Civil Aeronautics Authority, an after-dinner speech of the kind afforded attending dignitaries who have little to contribute.

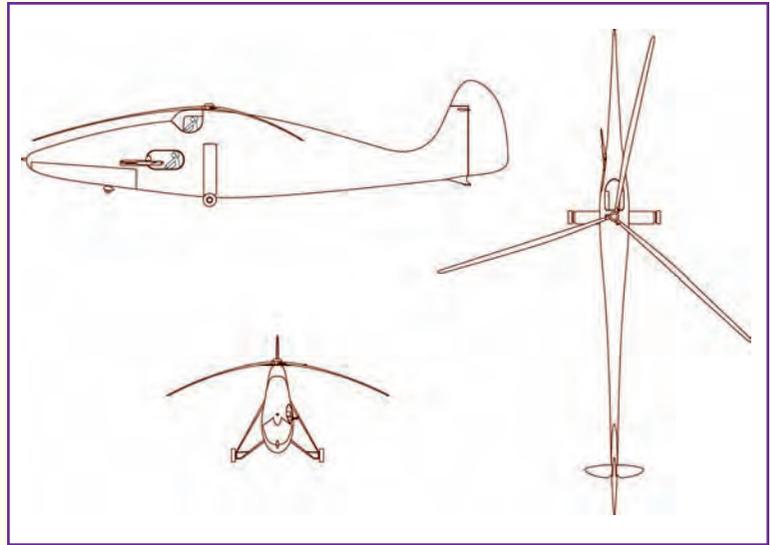
The Third Session Saturday Morning, October 29, 1938

“Research Programs” began with N.A.C.A.’s Dr. George W. Lewis’ introductory remarks asserting the value and priority of rotary wing research programs, making an appeal for Dorsey-Logan funds in self-serving arguments directly or indirectly also advanced by the other advocates of rotary wing aircraft research: Everett B. Schaefer on behalf of New York University’s Daniel Guggenheim School of Aeronautics, Montgomery Knight on behalf of the Georgia School of Technology, and the N.A.C.A.’s F. W. Bailey, Jr.

Knight described work on using a subscale “jet drive system” for a powered rotor (obviating the need for counter-torque) using an axial blower to eject air from the tips of the rotor blades. He announced that the

“work of designing another and very important piece of equipment had been started . . . a full scale single-seater helicopter which will be used not only to determine the feasibility of the jet drive but also to check the scale effect corrections.” This helicopter project was unique, staking a claim on the rotary-wing future. In Vienna, jet rotor research begun in 1942 by Friedrich von Doblhoff would result in the WNF Wn 342, followed by a plethora of designs after World War II.

The Fourth Session Saturday Afternoon, October 29, 1938



In 1938, Raoul Hafner was studying the idea of balancing main rotor torque reaction via aerodynamic side force on the fuselage, which nearly had an airfoil shape. Adjustable control surfaces allowed for fine adjustments of the torque balance. Hafner’s P.D.7 schematic is shown here, redrawn for clarity. (Courtesy of Jens Baganz.)

The final session was entitled “Future Types and Development” and began with Hafner’s presentation, “The Hafner Gyroplane and Helicopter” in which he stated:

“In spite of the fact that the success I have so far achieved is connected in popular report with a gyroplane which embodies my principles of rotor construction and control, the investigations and experiments in respect of rotative wing aircraft, which I have carried out almost single handed over a period of nearly ten years, have always had as a one of their ultimate aims the practical helicopter, which, I believe, I can now claim to have achieved with a single rotor design. The single rotor helicopter represents an aerodynamic ideal, which has its analogous counterpart only in the sailplane, and the degree of its mechanical simplicity and consequent reliability closely approaches an extreme. At this date very little remains to be done before

an experimental construction might be hopefully undertaken.”

After an insightful critique of the Focke twin-rotor configuration, Hafner concluded:

“I consider that the value and importance of the helicopter lies in its inherent potential simplicity as it offers an aerodynamic ideal. It has the qualities to challenge the fixed wing aircraft of medium size, in almost any department of flight, except perhaps, maximum speed.

With this in mind I developed my project of single rotor helicopter, which is covered in various patent applications. It may seem somewhat daring at first inspection, but closer study reveals its sound technical basis. It consists essentially of a single low-torque high-speed rotor controlled similarly to that of the A.R.3 Gyroplane, and a suspended fuselage adapted to receive aerodynamically the requisite balancing torque from the rotor downwash. Its appearance may be strange to eyes used to aeroplane lines, but the fact remains that it represents structurally and mechanically a logical combination of practical features, and my confidence in its aeronautical authorities

I have two helicopter designs in preparation, the P.D.7 is an advanced one, and the smaller one, the P.D. 6, is only an experimental machine. The experimental machine is powered with a Propcher engine, and is a single-seater about the same size as the existing A.R. 3 Gyroplane, and I expect to get 150 miles an hour top speed with it, and about 1500 feet rate of climb, whereas the P.S. 7 machine will be a development from it, and we calculate the maximum speed at 210 miles per hour. . . . The maximum rate of climb of this machine, near the ground, will be 3800 feet per minute.”

And with this projected rotary wing developments that bordered on the fantastic in 1938, Hafner ended his talk. His technology and designs evoke admiration even today.

Session Chair Wilford proclaimed, with understatement: “We will be talking all afternoon about the surprise Mr. Hafner has given us,” and then turned to Paul Hovgard’s “Future Types of Gyroplane.” Hovgard, positing a continuum from Cierva to Hafner, went on to discuss the advantages of rigid rotors, stating:

“[I]t does not naturally follow that, as soon as the Helicopter is perfected, the Autogiro will become extinct. In fact, you could contend that the advent of the helicopter would first affect the field by increasing the popularity of the

autogiro. . . . So anyone who contends that the helicopter is going to make the autogiro obsolete has no basis for such contention.”

But it did not work out as Hovgard envisioned. As the February 1944 issue of *Flying Cadet* magazine stated: “Yes, the helicopter is reliable, adaptable, and equal to almost every situation. She seems to have her rival, the autogiro, quite outclassed.”

Wilford then introduced W. Laurence LePage’s “The Helicopter in Europe.” LePage presented a brief communication from Louis Bréguet asserting that “that the helicopter will have a flexibility of use which will be superior to that of any other flying machine, permitting on one hand, hovering and vertical flight, and on the other hand, propulsion at a very high speed under particularly economical conditions [T]he helicopter is at all times superior to the autogiro, no matter what phase of flight is being considered.” LePage then turned to Professor Henrich K. J. Focke’s work and showed a film of the Fw 61 in flight.

The final speaker was Dr. Max M. Munk. Munk had left Germany after World War I, and, after several years at N.A.C.A., was then at Catholic University in Washington, D.C. Munk declared, “I made the whole paper, but I had nothing whatsoever to do with the title. This title was very ably prepared by our Chairman, Mr. Wilford.” Munk, searching for a way to make “High Speed With Safety” relevant to the meetings, proceeded with humor:

“... I have talked with several pilots and designers during the last day, and they all confirm to me that actually a rotary aircraft is much safer near the ground at low speed, and it is the only means from that standpoint to do it at all. The [light aircraft] is not safe enough. Of course, this German plane [the Focke Helicopter], they flew it in a hangar, inside. In America, we use escala-



Haviland H. Platt (left) and W. Laurence LePage (right) were both vertical flight enthusiasts, and formed their company shortly after the conference. In 1941, they would test fly their XR-1, the first American military helicopter to takeoff and hover with good control. (Courtesy of the Platt-LePage Aircraft Archives.)

tors for that, and there are no gusts; then you can do it. That is not the problem. The problem is not to fly inside of a building, but outside of a building. So you see that in an indirect way, the great essential advantage of rotary aircraft is that it combines high speed of the lifting element with slow speed of translation, and in that way, brings out and reserves in a safe slow motion without ground – of course not for landing and take-off as some of the speakers suggested, for only for flying without ground. I think, therefore, that the slogan of rotary aircraft is very properly ‘high speed with safety.’ ”

And with that, the meeting was adjourned.

Conclusion

There is little doubt that Raoul Hafner placed an indelible stamp on the proceedings, reinforced by Europeans, Bréguet and Focke, and Americans, Hovgard, Ray and Gregory. The combined impact of their presentations pointed undeniably towards the hel-

icopter. Those in the audience advocating the Autogiro could justly have left the meetings with the suspicion that their cause was already lost.

About the Author

Dr. Bruce H. Charnov is an Associate Professor and the Former Chair of the Department of Management, Entrepreneurship and General Business, at the Frank G. Zarb School of Business, Hofstra University, New York. He is the author *From Autogiro to Gyroplane: The Amazing Survival of an Aviation Technology* (Praeger Publishers, 2003).

This article is a much abbreviated version of the paper, presented at Forum 62, entitled, “A Critical Re-Examination of the Franklin Institute Rotating Wing Aircraft Meeting of October 28 – 29, 1938: Facts and Myths Surrounding the Foundations of Autogiro/Convertiplane/Helicopter Development in America and Europe.”



The Society salutes its AHS Presidents and their outstanding contributions to the international vertical flight community.

1944 -- 1945	Ralph Alex	1976 -- 1977	Charles W. Ellis
1945 -- 1946	C. L. Morris	1977 -- 1978	Charles C. Crawford
1946 -- 1947	R. G. Anderson	1978 -- 1979	Robert Lynn
1947 -- 1948	R. H. Prewitt	1979 -- 1980	William F. Paul
1948 -- 1949	Ralph Lightfoot	1980 -- 1981	J. N. Kerr
1949 -- 1950	Alexander Klemin	1981 -- 1982	Fred L. Smith
1950 -- 1951	Frank N. Piasecki	1982 -- 1983	Joseph Mallen
1951 -- 1952	Bartram Kelley	1983 -- 1984	Richard B. Lewis
1952 -- 1953	T. R. Pierpoint	1984 -- 1985	L. M. (Jack) Horner
1953 -- 1954	C. W. Lefever	1985 -- 1986	Robert Zincone
1954 -- 1955	J. P. W. Best	1986 -- 1987	Norman B. Hirsch
1955 -- 1956	William B. Bunker	1987 -- 1988	William J. Crawford
1956 -- 1957	C. M. Seibel	1988 -- 1989	William W. Walls
1957 -- 1958	Don R. Berlin	1989 -- 1990	Stanley Martin
1958 -- 1959	Charles H. Kaman	1990 -- 1991	Eugene Buckley
1959 -- 1960	Ralph P. Alex	1991 -- 1992	Thomas Gunn
1960 -- 1961	L. S. Johnson	1992 -- 1993	Edward J. Renouard
1961 -- 1962	C. F. Von Kann	1993 -- 1994	C. Thomas Snyder
1962 -- 1963	E. J. Ducayet	1994 -- 1995	Webb F. Joiner
1963 -- 1964	Stanley Hiller, Jr.	1995 -- 1996	Gary F. Rast
1964 -- 1965	John L. Buehler	1996 -- 1997	George T. Singley, III
1965 -- 1966	Robert L. Lichten	1997 -- 1998	S. Michael Hudson
1966 -- 1967	Leon L. Douglas	1998 -- 1999	Dean Borgman
1967 -- 1968	Robert A. Wagner	1999 -- 2000	Chuck Vehlow
1968 -- 1969	Paul W. Holt	2000 -- 2001	John Murphey
1969 -- 1970	K. B.. McCutcheon	2001 -- 2002	Gilles P. Ouimet
1970 -- 1971	Joseph Mashman	2002 -- 2003	Robert G. Loewy
1971 -- 1972	H. N. Stuverude	2003 -- 2004	Paul W. Martin
1972 -- 1973	Frederick W. Garry	2004 -- 2005	William H. Forster
1973 -- 1974	James F. Atkins	2005 -- 2006	Philip J. Dunford
1974 -- 1975	Thomas R. Stuelpnagel	2006 -- 2007	Richard J. Millman
1975 -- 1976	Gerald J. Tobias		

