



vertiflite Book Review

Göttinger Monograph N: German Research and Development on Rotary-Wing Aircraft (1939-1945)

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After the end of World War II, the British Ministry of Supply — interested in German aeronautical technology developed during war — ordered the German aeronautical research establishments in Göttingen and Braunschweig to summarize their research. The *Göttingen Monographs About Advancements of the German Aeronautical Research Since 1939* comprised several volumes. *Volume N, German Research and Development on Rotary-Wing Aircraft* — written by Gerhard Sissingh and O.H. Nagel and edited by Albert Betz (as in the Betz Limit for wind turbines) — was the only volume not translated in its entirety from German into English. This volume N was rediscovered some five years ago by Prof. Berend G. van der Wall at the German Aerospace Center (DLR) in Braunschweig. Prof. van der Wall translated and edited the material, which has now been published in the English language by the American Institute of Aeronautics and Astronautics (AIAA).

CONTENTS: Introduction; Design of the Rotors; Description of Developed and Planned Vehicles; Testing and Accidents; Extension of Glauert-Lock-Wheatley's Rotary-Wing Theory; Dynamic Rotor Problems; Performance Investigations; Flying Qualities; Various Other Topics; Prospects; Bibliography; Modifications to the Original Text;

Origin of the AVA Monograph N; Short Biographies; Index; Supporting Materials

This 245 page book is a must for rotorcraft history buffs as it gives a comprehensive view of the efforts of the German rotorcraft pioneers during the years from 1939 through 1945. Their work was contemporaneous with that of Ludwig Prandtl (1875-1953), the founder of modern aerodynamics, working at the University of Göttingen and founder of the famous AVA (Aerodynamic Research Establishment).

However, this book should also be of great interest to any student or practitioner of the rotary-wing sciences, as a reminder of how much can be accomplished within a short time and without computers, using slide rules and mechanical calculators. In fact, the reviewer believes that this "lack" of computers resulted in a deep understanding and clear presentation of the physics and other issues involved.

Readers interested mostly in hardware and testing will enjoy the initial two sections written by O.H. Nagel, which describe all important rotorcraft developed during the period, to include the Fw-61, often considered the first practical, functional helicopter, first flown in 1936; the Fa-223, Fa-230, Fa-330, Fa-284 (not flown), Fl-184, Fl-185, Fl-265, Fl-282, Fl-282B, Fl-339 (not flown), and others. The Fa-223, Germany's largest helicopter flown during the War, had a

maximum takeoff weight of 4,300 kg (9,480 lb) and a Vh of 210 km/hr (113 kt), and achieved a ceiling height of 7,100 m (23,000+ ft).

Configurations from pure autogyros, single rotor helicopters (some with transition to autogyro flight for high speed), intermeshing rotors, and side-by-side configurations were developed. With today's renewed interest in compound helicopters, the Flettner Fl-185 helicopter deserves special mentioning, as it used two propellers for both automatically adjusted torque reaction as well as auxiliary thrust. This arrangement is very similar to today's experimental Airbus Helicopters X³. However, the Fl-185 did not yet feature wings. Other innovations of the industry included automatic switching between helicopter and autogyro mode, or to complete autorotation mode, as well as landing on a flexible ship-mounted platform with a rigid landing gear to save the weight of oleos. The configurations, test developments and practical operational achievements, as well as accidents of the above mentioned rotorcraft are described in Nagel's sections.

Regarding development risk, Nagel remarks: "Because the development initially had to proceed on an empirical basis without noteworthy support of theory and without larger scientific research, every first takeoff of a new

or modified model had the possibility of a surprise.... This improved only after the creation of a central helicopter research establishment in the Aerodynamic Research Establishment (AVA) Göttingen in 1943."

Sissingh's chapters, comprising the main body of the Monograph, deal with all areas of rotary-wing theory under development at the time. The comprehensive nomenclature section is most helpful in reading these analytical sections of the book; notations will generally be familiar to a reader living in the US environment, while the use of the metric system may require some mental adjustment. (While this reviewer contributed to some translational and technical aspects, it should be mentioned that some Germanic expressions were deliberately retained to preserve the flavor of the time. For example, rotor blades are frequently referred to as "wings.")

The Germans started with Glauert-Lock-Wheatley (NACA) developed theories and extended them. NACA on the other hand immediately published some of Sissingh's early work — as long as it was available — in 1939 as NACA TM 921. The chapters on aeromechanics, performance, flying qualities and special topics comprise 237 formulas and 62 illustrations, filling 90 fascinating pages.

The accomplishments of mainly the companies Focke-Achgelis in Bremen and Anton Flettner in Berlin led to practical rotary-wing aircraft, based on a practical understanding of the aeromechanical theories, coupled with mastering materials and manufacturing technology suitable for serial production.

A most valuable addition to the mostly technically-oriented original monograph is the appendix containing short biographies — collected by Prof. van der Wall — of the key players involved, namely Albert Betz, Friedrich L. von Doblhoff, Anton Flettner, Henrich C.J. Focke, Kurt H. Hohenemser, Walter Just and Gerhard J. Sissingh.

Flettner, Sissingh, Hohenemser and Doblhoff all continued working after WWII in the rotary-wing aircraft field in the United States of America in various capacities at Lockheed, McDonnell, Kellett, Vertol and Hiller, with decided influence on the products under development at the time, particularly advanced configurations, such as the Lockheed Cheyenne and the McDonnell XV-1 compound helicopters. Betz,

Just and Focke remained in Europe contributing significantly to the emerging European rotorcraft industry, including the education of the next generation of

rotary-wing engineers.

The reviewer also wants to take this occasion to extend his gratitude posthumously to his first mentor, Prof. Walter Just.

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About the Reviewer

Walter Sonneborn began his career in 1962 in Germany under Prof. Walter Just. He worked at Bell Helicopter from 1965 until his retirement as a Vice President in 2002. Since then he has been consulting for several aerospace companies and government agencies. He is a recipient of the AHS Klemin Award, the Nikolsky Lectureship and an Honorary Fellowship.

