In Memoriam Ulrich Grigull

Professor Dr.-Ing., Dr.-Ing.c.h. (1912 - 2003)

In the morning of October 28, 2003 a long line of mourners walked to the final resting place of Ulrich Grigull at the Waldfriedhof in Solln, Muenchen. The funeral procession was headed by his family, followed by representatives of Government, University, and Bavarian Academy of Science, by friends and university colleagues, and by his second great family the former students of the chair of Thermodynamics of the Technical University of Muenchen. The passing of Prof. Grigull was unexpected to all of us. Because, only one and a half year ago at his 90 birthday, we met him in best physical condition. We all remember his words, after he finished the words of gratitude to all speakers and the audience: "I would like to tell you an additional story, but it's late now, I tell you this story next time." This story he took along with him. All of us console ourselves to hear that after only a short painless period of illness, he passed peacefully away in the early morning of October 20 in his home, surrounded by his family circle.

Prof. Grigull was born on March 12, 1912 in Gallingen in East Prussia. After he received the maturity certificate of the Gymnasium in Koenigsberg, he studied Mechanical Engineering at the Technical University in Danzig (1930-1935). At that time Danzig was famous in the Engineering sciences. Grigull enjoyed especially the lectures of Professor Ernst Schmidt in Thermodynamics, Heat Transfer, and Fluid Mechanics. These fields have determined his further development and finally his life. After his Diploma he became Assistant to Professor Ernst Schmidt who was the director of the Thermal-Engine Laboratory at the Danzig University. At that time Heat Transfer was a relatively new academic discipline, which was well practised in the laboratory of E. Schmidt, from which about many pioneering work give evidence. By

that Ulrich Grigull was inspired, there he received his scientific background which became his guiding principle for his further life.

In 1937 E. Schmidt went to Braunschweig to establish and head the Institute of Aircraft Engines of the German Aeronautical Research Establishment. Grigull followed him to this new institute. His first task was to investigate the heat transfer at natural convection near the thermodynamic critical state. This work showed - for the first time - the large increase of the heat transfer coefficient in a near critical fluid. It resulted in the development of a new cooling method of the blades for high-temperature gas-turbines. A report with the co-authors E. Schmidt and E. Eckert to the German Academy of Aeronautics was Grigull's first scientific publication. At that time the report was classified as top secret, and after World War II it was considered so important to be translated into English.

Among this experimental work he performed a theoretical study on turbulent film condensation, it was accepted as Doctoral-Theses by the Technical University Braunschweig. Shortly afterwards he volunteered to join the Navy as chief engineer on submarines and destroyers. After the war, at a very difficult period in Germany, he had to take care for the living of his family: his wife Lydia and his daughter Barbara, born in 1942, his second daughter Andrea was born in 1953. Grigull worked as a consultant to various chemical and textile industries and became director of a renowned firm which produced insulating materials and manufactured insulation.

In 1953 he changed to Farbenfabriken Bayer AG, in Leverkusen. During the years there, he was able to revise completely the book by Groeber/Erk from 1933 with title "Grundgesetze der Waermeuebertragung" (Fundamentals of Heat Transfer). He collected the literature appearing during Word War II and rewrote the book after a careful literature selection in many night hours. It became a standard in German literature for thermal engineering, it was in those days the only book in Heat Transfer written

in German language. Students called the book simple "The Groeber/Erk/Grigull". It also received high international appreciation by being translated into six foreign languages - English, Japanese, Russian, Spanish, Turkish and Chinese.

In his various occupations in the post war time Grigull became familiar with a variety of technical heat transfer problems and made his contributions to their solutions. Seventeen papers which he published in the years 1950 to 1959 give evidence. Further, besides his job at Bayer company, he gave lectures at the Technical University Braunschweig on "Heat Transfer" filling a gap since E. Schmidt had left Braunschweig for Muenchen in 1953. By his book and his correspondence in his literature search he became internationally recognized. Therefore, in 1960 he was invited to found together with A.J. Ede, C. Gazley, J.P. Hartnett, A.V. Luikov and D.B. Spalding the "International Journal of Heat and Mass Transfer" with Robert Maxwell being the Publisher with his Pergamon Press. This Journal made apparent the world wide interest in science and application of heat transfer.

In 1961 Ulrich Grigull became the successor of Ernst Schmidt as Professor and Director of the Institute for Thermodynamics at the Technical University Muenchen. With his wide-spanned ideas which he now activated in numerous research projects, he was a worthy successor to this chair which had been held before by Wilhelm Nusselt, Moritz Schröter, and Carl von Linde, the founder of the chair.

Professor Grigull continued in the tradition of the chair and added further to its high scientific standing. In the field of heat and mass transfer optical methods using shadow-graph and Schlieren-methods as well as interferometry with a Mach-Zehnder interferometer were further successfully developed. Also the Holographic interferometry was adopted and used to study thermal conductivity in a near critical fluid. From Ernst Schmidt he inherited the thermodynamic research projects on the properties of water and steam, and continued with measurements of thermophysical proper-

ties as: viscosity of water and steam at high pressures and temperatures, Joule-Thomsen coefficient at high pressures and temperatures, and new determination of the critical parameters of water with an optical method. He was many years the head of the German delegation in the meetings of the International Association on the Properties of Water and Steam. To these annual Working Group meetings the chair contributed with many activities as: data collection and evaluation, comparison of equations, developing of skeleton tables for equilibrium and transport properties, developing of equations for surface tension, refractive index, forming of a fundamental equation of state, development of a fast method to determine the thermophysical properties for power plant optimization etc. Grigull was editor of German and international editions of the Steam Tables.

Grigull's scientific accomplishments are documented in more than 120 papers and 40 books and book contributions. He supervised more than 40 scientists with their doctoral theses from many aspects of heat transfer and thermodynamics. As a teacher he led generations of students to an understanding of Thermodynamics and Heat Transfer. With his profound experience in these fields, he was convinced that for modern techniques these disciplines are of fundamental importance and should take up a high position in education and research. To force this opinion in German public he founded in 1968 together with E. Eckert and P. Grassmann the German Journal "Wärme- und Stoffübertragung". Further, his personal engagement is expressed by the fact that he was many years engaged as head of the VDI/GVC group (Verein Deutscher Ingenieure / Gesellschaft fuer Verfahrenstechnik und Chemieingenieurwesen) for Thermodynamics and Heat Transfer. In these annual meetings mostly new research results have been presented by young scientists of German universities and industries. Grigull, as chairman, was always very fair to all of them, even when the presentation was not to the satisfaction of the audience. For this noble feature he obtained deep respect from his colleagues and the audience.

Nevertheless, Grigull strongly advocated for the international exchange in science and of research results. This became manifested in great international conferences for instance: "The International Heat Transfer Conference" and "The International Conference on the Properties of Water and Steam". The first one was organized by an "International Assembly", the second by local and national committees supported by the "International Association for the Properties of Water and Steam". For many years Grigull served as chairman for the German committees, and was selected as president of the international organizations. In 1979 the Technical University Muenchen hosted the "International Conference on the Properties of Steam" and in 1982 the "International Heat Transfer Conference". The first one was attended by about 200, the second by about 900 scientists from all over the world. In both cases Grigull headed the local and the scientific organization, and was president in office of the respective international organization.

Grigull was not only an outstanding researcher and highly recognized academic teacher he enjoyed also high reputation among his colleagues of the university, by them he was elected as Rector in 1972, two times re-elected, and after a change of the University constitution he was elected as President of the Technical University in 1976. In that time he set decisive rules for the successful development of his university. He held this office for eight years until his retirement in 1981.

He retired from office but never from activities. Now he was able to devote his time to subjects which he always was inclined to: history and especially that of technical accomplishments. His studies take us back into the world of the early 18^{th} century when heat, enthalpy and temperature were all about the same which Isaac Newton called "Calor". Ulrich Grigull visited for his studies libraries in Amsterdam, Florence and London in order to go back to the roots. One of those roots was Isaac Newton. He had suggested a temperature scale already in 1692. Grigull found out that his measurements of the solidification temperature of various substances agree relatively well

with nowadays results, considering the facts that could not be known to Newton 300 years ago. Or that Newton's enthalpy balance could well be written as convective heat-transfer law in nowadays sense. Thus this balance is the oldest quantitative evidence of a heat-transfer problem. It might be interesting to know that Grigull used the original writings of Newton which were written in Latin. Another early pioneer of temperatures and its measurements caught Grigull's interest: Daniel Gabriel Fahrenheit. Grigull studied his works and published a paper to Fahrenheit's 300. birthday: "Fahrenheit, a Pioneer of exact thermometry".

In 1975 Grigull was nominated to be a member of the Bavarian Academy of Science. After his retirement he spent much time for the Academy work. He headed the Kepler-Commission of the Academy which is appointed to gather all publications and papers of Johannes Kepler (1571 - 1630), up to this days Kepler is an international recognized mathematician and astronomer.

Many honors and awards have been bestowed on Ulrich Grigull. To name just a few: he was Honorary Doctor of the University Stuttgart; by the American Society for Mechanical Engineers and the American Institute for Chemical Engineers he was distinguished with the Max-Jakob-Memorial Award for "his excellence in research engineering practice, teaching, journal-ship and international service in heat and mass transfer"; he has been elected an "Honorary Fellow" by The International Association for the Properties of Water and Steam; he was honored with the "Gauss-Medal" of the Braunschweig Scientific Society, and with the "Luikov-Medal" of the International Center for Heat and Mass Transfer. The state of Bavaria honored him with the "Order of Maximilian", the highest award for merits in sciences and arts.

Many warm words of appreciation we received as a first response to the sad news of the passing of Prof. Grigull, here we will cite only one: the condolence letter from Professor Akira Nagashima from Keio University, Tokyo, he wrote:

"It was a very sad news. Since the very first time, for 40 years, I have been one of the admirers of Professor Grigull. He was not only a really great professor in science and engineering but also a man of real intellectual and a man of warm humanity. He has done so many contributions to the world. We lost the great member of our society. Please convey my sincere condolence to Mrs. Grigull".
We agree fully with this letter.

Professor Grigull will be remembered to his students, his national and international colleagues and friends as a honorable gentleman, as a great man in fundamental and applied engineering sciences. We all miss him, and will never forget him.

November 2003

Johannes Straub
Franz Mayinger
Erich Hahne