

In Memoriam Prof. Dr. Eckhart Heidemann

Dr M. Lange

At the 5th of August 1925 Prof. Dr. Eckhart Heidemann was born in Greifenhagen near the river Oder in Pommern. His father and even his grandfather were leather manufacturer. By this heritage it is understandable that his further life was already determined when he was a child.

In Greifenhagen (Oder) he went at school. For four years he joined there the elementary school. For high school he moved in 1936 to the city of Stettin and joined the “Marienstifts-Gymnasium”.

Before finishing the high school in the beginning of the year 1943 he was forced to enter the German army. At the end of war in 1945 he was taken as prisoner of war by the British army in Flensburg. The army released him early in 1946.

To finish the high school Prof. Heidemann went to Hamburg and made a special course to pass the final examination. In October 1946 he got his certificate that allowed him to study.

After war the situation in Germany was very tough. Therefore Prof. Heidemann decided at first to help his father in reconstructing the demolished leather factory in Bergen on the island of Ruegen. Simultaneously he began to learn for two apprenticeships. One was to become a skilled worker for leather-tanning and the other was the education to become an industrial merchant. But this was not sufficient for him. He decided to make a fine tuning of his skills at the “German Tanning School” in Freiberg /Saxony. He stayed here from 1949 until mid 1950 and finished his studies as a certified “Leather Technician”.

In the second half of the year 1950 Prof. Heidemann started to study chemistry at Greifswald-University. In 1952 he got his “Bachelor Degree”.

Due to the political situation in the soviet zone, better known as “GDR” the so called “German Democratic Republic” Prof. Heidemann was forced to leave East Germany. As a son of an entrepreneur it was impossible to finish the studies in the “GDR”. The communistic regime allowed only children of workers or farmers to study. Therefore he left the country and moved to West Germany and joined the “Technical High School” in Darmstadt (Picture). He became a student at the “Institute for Tanning-Chemistry” which was led by Prof. Dr. A.Kuentzel.

In December 1954 he got his “Master Degree” in chemistry.

The year 1955 had a big impact on the life of Prof. Eckhart Heidemann, he married his wife Dorothea at 15th of January in Darmstadt and in the same month he became scientific assistant of Prof. Kuentzel.

1955 Prof. Heidemann worked at his PhD. degree. The title was: “The Behaviour of Collagen in diluted Acid and Caustic” (Picture Front Page).

Conferred was the PhD by Prof. Kuentzel, co-commentator was Prof. U. Hoffmann.

The thesis was completed at 12th October 1957. The colloquium took place at 2nd December 1957. Just in between these dates Prof. Heidemann became father at 11th November. The son Martin was born. His brother Bernd followed at 10th July 1959 and the sister Barbara at 5th January 1962.

At that time in 1957 Prof. Heidemann had to make an important decision. Should he stay at the University or should he change into an industrial employment? He decided to make an academic career. As logical consequence he habilitated in leather chemistry 1963. The title

was “Leather Porosity, Inner Structure and Surface“. The measurements were made with a mercury porosity meter.

1964 he got the “Venia Legendi“, and became “University Lecturer” (Dozent) that means he had the qualification to educate students.

1967 Prof. Heidemann’s tutor and promoter Prof. Kuentzel became emeritus and Prof. Heidemann was commissioned as successor for the academic chair and the institute.

He continued the tradition of Darmstadt’s leather research as scientific son of Prof. A. Kuentzel and as grandchild of Prof. E. Stiasny who was the founder of the first Darmstadt “Leather Chemistry Institute” in 1920.

The name of the institute has changed meanwhile in “Institute for Macromolecular Chemistry” including the department of “Protein and Leather”.

1970 Prof. Heidemann was nominated as Professor. Until the end of his academic career he stayed as chief of this traditional and famous institute in Darmstadt.

The institute and the experimental tanning site are shown in the next pictures. (Pictures). Here he worked on scientific subjects and in the experimental tanning site he tested new recipes and new hardware in a pilot plant scale under economic and practical aspects.

Now I think at this point it is worthwhile to mention that Prof. Heidemann not only passed all academic examinations as a leather chemist but he got the handicraft degree as a master of leather tanning as well. The preparation for the examination and the examination itself he made together with Mister Fleiderer the person who became later the chief of the institute’s experimental tanning site.

We all know “Money rules the World”. Interesting scientific investigations are expensive therefore it is necessary to find sponsors. Prof. Heidemann knew how to play this piano. If he intended to work about synthetic peptides a subject that is not so relevant for a tanner then he tried to get subsidise from the Minister for Research and Technology (BMFT). Was there a more practical background as wastewater reduction in the beamhouse then he asked the “Council of Industrial Research” (AIF). Due to this clever pre selection of motions he was most often very successful in getting financial support.

Prof. Heidemann knew how to attract young students with interesting subjects. So it happened that eighty (80) “Master Degrees” and in total thirty six (36) “PhD’s” were established under his guide at his institute. It must be emphasized that this is an extraordinary yield in academic education. And this is a point where Prof. Heidemann was very proud of.

As University Professor it is necessary to document your activities by publications. And so did Prof. Heidemann. As author and co-author he published more than 200 articles in national and international journals.

In 1965 Prof. Heidemann became responsible editor of the journal “Das Leder” (Picture cover Leder). Until the end of this journal in 1997, there was a merge with the Journal “Leder und Häute Markt”, he succeeded in finding interesting scientific and technical contributions about leather manufacturing which were published in “Das Leder”.

This experience as editor was a great help for him when he started to write a book about “Fundamentals of Leather Manufacturing” which was published in 1993 by Eduard Roether’s publisher house in Darmstadt.

It is a pity that this publisher house bankrupted in 2001. Because the book has become a must for anybody who is active in leather business. This very useful book is not any longer available. The last copies were saved by Prof. Heidemann’s wife together with a few very seldom copies of a leather dictionary with special tanner chemistry words in eight different languages.

Very early Prof. Heidemann became a member of the “Verein für Gerberei-Chemie und -Technik” (VGCT). That is the national association for “Tanning Chemistry and Technology”. Many years he was a member of the board. As chairman he was responsible for the commission of chemical leather testing. Additionally he belonged to the board of the award commission.

For many years he was responsible for the budget of the association as treasurer.

The national recognition and appreciation of Prof. Heidemann is best demonstrated by the VGCT “Year Award” in 1977 and the decoration with the “Stiasny Medal” in 1990.

On international level he was member of IULTCS where he too has been chairman of the commission for chemical leather testing.

It is worthwhile to mention that Prof. Heidemann initiated a collagen symposium which is preceding each IULTCS congress. The newest development in fundamental collagen research were presented and discussed. In London 1997 lastly he moderated it by himself.

The international recognition becomes obvious when we recollect all the places of the world where he was invited to give lectures and seminars like “Wilson-Memorial-Lecture“ in the USA or the “Procter-Memorial-Lecture” in Great Britain. All places of importance for leather manufacturing have been visited by him. He saw the important leather centres in China and India. Several times he was in Turkey. Regularly he gave lectures in the USA, Brazil and Mexico. Even in Costa Rica he has been.

After retirement he continued to join important congresses like the 3rd “International Asia Congress about Leather Science and Technology” in 1996. As a distinguished speaker he gave a presentation about “Process Control in the modern Tannery”. For this interesting contribution including his international activities for leather he was rewarded with a certificate. I want to show you this fascinating reward (Picture).

It is said: “You gave a precious presentation on this conference and you contributed a lot for leather institutes and the industrial world. We want to express our thanks with this certificate.” Executive chairman Sagita Masami.

The red stamp at the right bottom of the page is the seal of the president of the congress.

To illustrate the diversity of the subjects which were of interest for Prof. Heidemann it must be sufficient just to mention the headlines of the working fields. Otherwise it would be too time consuming.

In the beginning of his career he was very much interested in investigating the structure/property relationship of biochemical fibres. Particularly of interest were the structure of collagen and the stability of the collagen fibres. This included the question about the natural aging process of the skin by intrinsic cross linking of the collagen fibres and fibrils in the skin and aging of leather in use.

As aging of the human skin is an everlasting concern of our ladies Prof. Heidemann made a side step and encouraged his students to take lessons about dermatology. I joined those courses and I must confess it was very interesting and exciting.

As it is very difficult to understand the complicated interpenetrating network of collagen fibres Heidemann decided to go to the bases of the collagen structure. This was the reason for the synthesis of artificial peptides. He intended to be able to predict the biophysical properties of natural macromolecular proteins.

Especially the triplet Gly-Pro-Ala and modifications thereof were investigated itself and as polymers because the main structure of collagen is characterised by this repeating sequences.

Another approach to understand the relationship of primary, secondary and tertiary structure concerning the triple helix of collagen NaCl soluble calf skin collagen was isolated. On the native collagen the telopeptides were eliminated by digestion with trypsin. After denaturation the single chains were isolated by chromatography and renatured to build Segment Long Spacing (SLS) which were stained by uranyl-acetate. A cross striations pattern is created by polar and not polar amino acids and becomes visible in the electron microscope (Picture).

To get a deeper insight to the primary structure of collagen the isolated single chains were cleaved by several different methods. Cleavage was done by enzymes like collagenase and chymotrypsin or chemically by cyanogen bromide and hydroxylamine. The cleavage products were isolated and renatured. To determine the position of these shorter pieces they were renatured and analysed against the natural chain SLS according to the cross-striation pattern they revealed in the electron microscope after staining.

To learn more about the crosslinking of collagen chains lathyrin pig skin collagen was investigated and compared with normal collagen. This particular collagen was created by bringing up small pigs under a special diet that induced lathyrism that means collagen without any cross links.

Comparison of artificially induced covalent cross links with ordinary ones was another approach to determine the influence of these bonds.

For medical purposes the melting process of collagen to get gelatine was another interesting field of research as well as the production of very high quality photo gelatine.

The significance of the proteoglycans was observed and investigated in the process of cross linking. Noncovalent bonds like hydrogen bonds were studied with low molecular model substances. N-propyl-propionamide and phenols, diphenols and polyphenols were studied by infrared signals how they build hydrogen bonds. This is the basis of tanning with polyphenols. These weak bonds are the reason why from leather always small amounts of materials can be washed out.

Cleavage and additional cross linking of collagen chains under the influence of peracetic acid was another subject of investigation. This was induced by the lack of understanding what is happening with the hair under depilation conditions with peracetic acid.

Very important constituent parts of hides and skins are the keratin. In case of fur production the hair has to be fixed and in case of leather it must be eliminated. To understand the influence of the various methods for hair saving or destructing procedures it was necessary to study the hair follicle in detail. Much work was done to find out what was happening to the hair root and the outer and inner hair root sheath under oxidative or reductive depilation procedures (Picture). It was found that the solubility increased from hair to hair root to outer hair root sheath. The inner root sheath is resistant against oxidizing, reducing or other disaggregating agents due to a very high degree of cross linking. Remarkable contributions to this subject were made by Prof. T. Yakali in Darmstadt while he was elaborating his PhD. degree.

Unhairing is the first major chemical step in leather production, said Prof. Heidemann. Therefore this process was an everlasting field for his research. A good pelt has to be free of epidermis, hair and hair roots. This is achieved by drumming the hide in sodium sulphide under alkaline conditions. Swelling and opening of the structure takes place. Lots of variations in respect to time concentration of sulphide and alkalinity were investigated to find out what is the best recipe for combined unhairing and liming.

By these methods the keratin is destroyed. The created pulp is a nasty waste and difficult to dump therefore hair saving processes had to be developed. This was another field of Prof. Heidemann's research.

A wide field for research was the preservation and consecutive treatment of the freshly flayed hides in the beamhouse. Due to the stringent environmental laws in Germany it was of utmost interest to reduce the salt content and the chemical oxygen demand of the beamhouse effluent water. Prof. Heidemann anticipated the increase of legal regulations concerning environmental protection (Picture).

Methods to avoid salts completely like chilling of the fresh hides down to 20° C or lower were investigated. To avoid hide deterioration in the slaughterhouse it is necessary to chill down the hides immediately. Piling of the hides without direct salting deteriorates the grain due to bacterial degradation.

As the hides start to putrefy from the flesh side preservation was done with bactericides and small amounts of salts. Although this treatment is effective it is not very economic. Therefore were ever it is possible pro-cessing of the freshly frayed hide is the best choice because no washing out of salts and additional soaking is necessary.

Another biochemical approach to preserve the fresh hides was the treatments with whey were lactic acids producing bacteria prevented putrefactions. This method was effective. The resulting leather was smooth and had an excellent grain. But due to economic reasons it did not become an industrial process.

The most important step from hide to leather is the tanning step. To get good leather a high shrinkage temperature has to be achieved. Best results are obtained by chrome tanning. Nowadays after a few hours of pickling the consecutive step is tanning. As chrome tanning is the most important tanning procedure in the world Prof. Heidemann extensively investigated all the parameter influencing the character of the finished leather. He was always interested in cleaner and less time consuming processes. Were ever possible he reduced chemicals or recycled them to a certain extend to decrease environmental pollution. Especially counter current processes fascinated him. If possible he applied such methods.

Because of the importance of chrome tanning Prof. Heidemann analysed the chromium uptake of the pelt until full penetration. Then the pH was adjusted to a point were the chromium mainly builds dimer and a few trime complexes. It was found that only 70% of the carboxylic groups of the hide react with chromium. It was realised that penetration is fairly fast but the complex formation takes time. Leather tanned with aged chrome liquors bind the complexes tighter than leather tanned with masked chrome liquors. A lot of fundamental research on chromium complexes was done in Darmstadt. Prof. Stiasny and Prof. Kuentzel started the analytical investigation of chloride, sulphate and masked chrome complexes. Prof. Heidemann continued this research.

Chrome is detrimental to the environment. Leather scrap and blue shavings cannot any longer be dumped as fertiliser or landfill. Prof. Heidemann spent a lot of efforts in detanning these residues. Yet at the end it must be stated that under economic aspects no industrial applicable method was found. In vain did he struggle. Therefore he tried to substitute the chrome by other metals like aluminium, zirconium and titanium and at the end of his academic career even iron. He realised that chrome will never be substituted by any other metal but there are niches were other metals can do a good job for special leathers.

A lot of trial and error work was made by Prof. Heidemann with various polymers and wet blue to get white leather by retanning.

The chemical side of the tanning process were ever under scrutiny. Yet the mechanical aspects of drumming and the whole process control were further fields of interest. One remarkable result was the tanning machine so called by Prof. Heideman and Keller. In principle it was acting like a laundry washing machine.

Inspired by the use of continuously moving conveyer belts in car assembly lines Prof. Heidemann had the idea together with Rainer Dorstewitz to transform the beamhouse work accordingly. A completely new technique was introduced.

The process is called the “Continuous Flow Unhairing”, and as it was established in Darmstadt the “Darmstadt Principle”. It was designed for fresh or well soaked hides. The hides were hanged over bars the backbone hair side up to be sprayed with sodium sulphide. After a few minutes of incubation the hair is transformed into a pulp and stripped off with a special plastic blade. The resulting pelts are fleshed and subsequently split. By this treatment it was feasible to get a flesh split and a grain split separated from hair, subcutaneous fat and tissue.

All steps can be done in about half an hour. The stroke time was 2 hides per minute. Depilation was done in 20 minutes. For the 40 hides under process was a street length of more than 30 meters necessary including flesher, trimming lane and splitter. On industrial scale 1000 hides were processed in a 9 hour shift (Picture).

It is possible to work up the hair sludge in a column that is continuously acidified from top. The hydrogen sulphide bubbles out counter currently and is adsorbed in alkali. It can be recycled. The hair is filtered off dried and grinded.

With this process the opening effect of the grain split after liming is excellent. Yet the long time of conventional liming is detrimental. Therefore a 1 hour bleaching with sodium peroxide was taken as substitute for liming. The same effect could be achieved with 1% alcalase enzyme solution within 1 hour at 30° C. In consequence to this rapid depilation the continuous flow principle is applied to the grain splits. Hanging over bars they are transported through 3 chambers were counter current spraying with sodium peroxide of increasing concentration from 1%, to 5%, to 10% is applied. Afterwards remnants of hairs and epidermis are mechanically eliminated. It follows a 3 chamber spraying cascade were combined neutralisation, washing and pickling is done. Residence time is 20 minutes in each chamber. The float is a nearly 50/50% formic acid-sulphuric acid mixture with increasing pH starting at 6 over 4 to 3, 5 (Picture).

The following tanning to get boil fastness is done within 1 hour by spraying with chrome sulphate. The penetration starts at pH 3, 5. The tanning itself is done at pH 3, 8 to 4, 0. The leather obtained can be sammed, shaved, retanned, dried and finished as usual. Yet due to lack of movement during tanning the resulting leather were remarkably stiff. Best results were achieved when the piece by piece process for dehairing was followed by tanning in small drums. The penetration of chemicals from both sides of the pelt combined with the mechanical treatment enhances the tanning remarkably and leads to much softer leather.

Besides the beamhouse and the tanning processes Prof. Heidemann took care for all the other actions leading to good leather. This included dying, fat liquor influence, degreasing, fogging, drying, making the surface hydrophobic and other finishing steps.

I remember the experiments at the end of the sixties to get washable leather garments

As dry cleaning eludes a lot of fat it was recommended to do the washing with soaps and the cleaning with enzymes. 12 years later Pelckmanns et altera found out that alkylsulphonates with a low neutral fat contend are the best.

As a conclusion about Prof. Heidemann it might be that some persons believed him being a workaholic. This would mean there was no space left for private activities. I can insure you that were not the case with Prof. Heidemann. Besides chemistry he had some wonderful hobbies. At first I have to mention that he was a gifted handicraftsman. When his house was erected this feature became really obvious. My rough estimation would be at least 50% of the house was made by him. The house was built on a slope, so it was possible for him to use the basement as a well equipped working place. He was an excellent carpenter. He loved to work with wood. Therefore it

is not a surprise that quite a lot of the furniture in his house was made by him like tables, seats and boards (Picture).

The second hobby was his greenhouse and cactus house. Of course Prof. Heidemann himself planned and constructed it alone (Picture). Here he took care not for flowers but for his beloved cactus plants, especially succulents and mammillaria. He really had a so called “Green Thumb”. He knew what was necessary to make them blossom. In springtime or in summer it was a pleasure to visit his greenhouse to see these spiky plants with clusters of spines becoming multi-coloured (Picture).

After his retirement the activities were expanded to the whole garden. In respect to vegetables and greens family Heidemann became self-sufficient.

There was still another habit of Prof. Heidemann, he liked it very much to walk and talk together with his wife Dorothea. The forest in the vicinity and the hills were surrounding his nicely situated house. When ever there was time they took a walk.

At the 17th of November in 1999 Prof. Heidemann came back home from an afternoon walk which he made together with his wife. He took the newspaper and sat down in his favourite fauteuil to relax by reading. After a while he became a bit sleepy and put the newspaper a side to take a nap. He should never awake again. He passed away in a much unanticipated moment. It was much too early, because there were still so numerous things to do. For him it was a graceful death but for the family and his friends and colleges it happened much unexpected. Yet we can say Prof. Heidemann’s life was exciting and a fulfilment. The leather community will never forget him due to his valuable contributions he was able to give to the tanning business.

With Prof. Heinemann’s passing away the famous tradition of the “Darmstadt Institute for Macromolecular Chemistry, Protein and Leather” ended too. The subject leather is completely deleted from the curriculum of the Technical University Darmstadt. This is a loss for the future of scientific leather research.

What we must learn from the textile and dyestuff business is that the termination of fundamental research leads to deterioration. The business degrades to “Cash Cow”. Therefore my personal advice to the leather community would be the foundation of an “International Institute for Leather Science and Development”. Let us have a vision and say Istanbul is a wonderful place for such an institute.

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