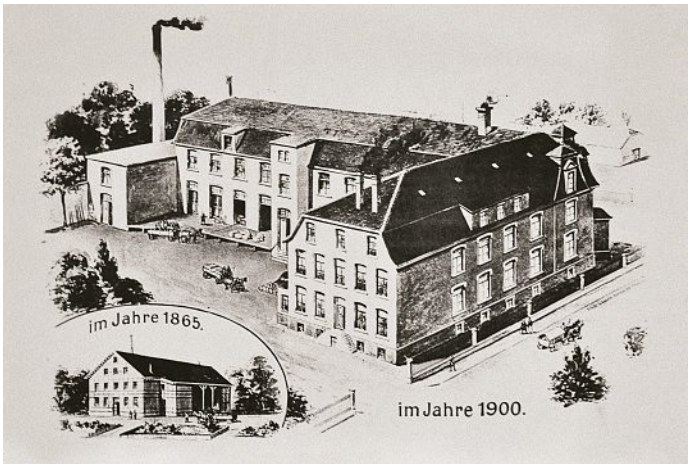
sc | nat
Chemistry
Platform of the Swiss Academy of Sciences

Chemical Landmark 2018 – Birthplace of Ovomaltine§

Felix Escher*

*Correspondence: Dr. F. Escher, Emeritus Professor of Food Technology, ETH Zürich, E-mail: escher@ethz.ch, Robänkli 9, CH-8607 Aathal-Seegräben. §Adapted version of a presentation at the Chemical Landmarks ceremony in Bern, October 26, 2018

The Chemical Landmark is a distinction of 'historical sites of chemistry' in Switzerland, awarded annually by the «Platform Chemistry» of the Swiss Academy of Sciences (SCNAT). Last year the tenth award went to the former headquarter building of **Wander Ltd. at Holzikofenweg 36 in Bern**. In 1904 it was the birthplace of **Ovomaltine**, in English known as **Ovaltine**.



The original building where Ovomaltine was developed in 1904. (picture: Wander Ltd.)

The family business Wander was founded in 1865 by Dr. Georg Wander (1841–1897), a graduate chemist and pharmacist who had immigrated to Bern from Germany. He soon started to manufacture and sell concentrated malt extract as a pharmaceutical product in liquid and crystallized form. As a second business area he ran a 'chemical-technical and analytical laboratory'. Later on he worked intensively on the improvement of malt extract products together with his son Dr. Albert Wander (1867–1950), also pharmacist and chemist. It was then Albert Wander who took over the business after the early death of his father, moved the company in 1900 from its old place at Stadtbachstrasse to the new and larger building at Holzikofenweg and successfully finished the development of what became Ovomaltine. Under the leadership of Albert Wander and of his son Dr. Georg Wander (1898–1969), again pharmacist and chemist, the company gradually expanded with the development and manufacturing of numerous pharmaceutical and dietetic products. The continuing growth of the business was supported by equally increasing efforts in basic and applied research, part of it in-house und part of it by research collaborations with universities. Dr. A. Wander Ltd. had reached a considerable size in Switzerland and world-wide when the company merged with and into the Basle based Sandoz Corporation in 1967.

Before and after this merger, Ovomaltine had its own success story. In 1904 it was launched as a medical or dietetic preparation and only in 1922 free sale as a general food item was accepted. The image changed rapidly and Ovaltine became and still is one of the most popular sports drinks. Today, Ovomaltine in various forms is the leading product of Wander Ltd., a subsidiary of Associated British Foods, with headquarter and production site in Neuenegg near Bern.

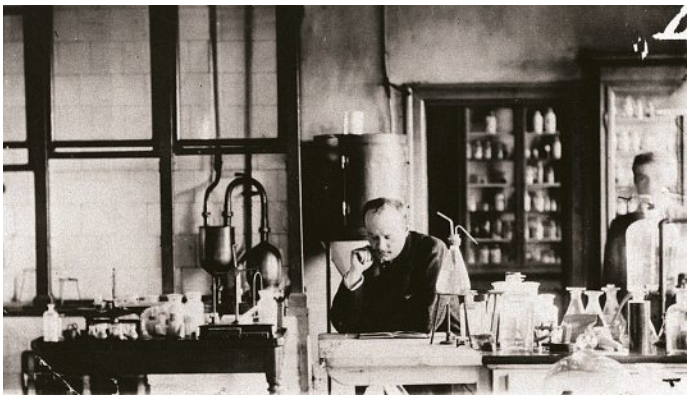
Ovomaltine in its typical orange cans through the years. (picture: Wander Ltd.)

Food and Science

The history of Ovomaltine illustrates the fact that food has always been object of scientific research even if the term 'Food Science' for a domain of system-oriented research was established world-wide only mid-20th century. Chemists in particular, but also physicists, biologists and engineers were interested in the many questions and problems around food along the scientific development of their own field.

When Georg Wander opened the chemical-technical and analytical laboratory in 1865 he could take advantage of the chemical research which at that time was flourishing in universities all over Europe. This was of particular importance for analytical investigations as there was a need to have methods available for detecting food fraud. In the second half of the 19th century the rise of chemistry led to an increased tendency of food fraud and adulteration. It was tempting to exploit the new findings in chemistry and by this to gain economic benefits. According to information on dairy products in German cities whole milk was not only diluted with skim milk, whey or water, but thereafter blended with flour, starch and cheap fat in order to restore the consistency of the diluted liquid. Sodium carbonate, sodium bicarbonate, boric acid and hydrogen peroxide were used to prevent the lactic acid fermentation. The addition of butter yellow, which is a purely synthetic azo colorant, was able to mask the oxidative loss of natural color of butter.

Therefore, food analysis received an important place in food research already very early in time and is still a pivotal and indispensable domain in food science. Of course, analytical food chemistry is not limited to the detection of adulterations. A much more general and relevant task is the determination of the food composition, then the detailed qualitative and quantitative



Albert Wander in the laboratory. (picture: Wander Ltd.)

description on how food components react with each other during preparation, processing and storage, and finally how the components and their reactions influence the overall food quality. It seems quite obvious that Georg Wander was already able to apply results from scientific research on malting, malt and malt extract to the formulation of his products even if the theory of that time on enzymatic degradation of starch to maltose cannot compare with the knowledge which we have today on starch as multi-phase biopolymer and on the molecular action of starch-degrading enzymes.

Georg Wander could base a further step in manufacturing concentrated malt extract on an important result of research of the early 19th century in thermodynamics. While he gained the initial malt extract by the classic method of beer brewing according to old brewers' tradition, the subsequent concentration of the extract to concentrated syrup had to be carried out under vacuum. Boiling at atmospheric pressure, *i.e.* at 100 °C and higher would cause heat damage and loss of quality of the syrup. The vacuum evaporator was developed in 1812 by the British chemist Charles Howard (1774–1816) for the concentration of raw sugar solution and the subsequent crystallization. By this invention, it became possible at an early stage in the industrial period to concentrate liquid food, in particular milk, with a very mild process.

An old sample box of Wander pharmaceuticals was exhibited at the «Chemical Landmark» celebration. (photo: H. Kolb)

In the 19th and early 20th century food processing developed in the interplay of empiricism, *i.e.* tradition and experience, and use of research in chemical, physical and biological research. This holds true also for preparation of Ovomaltine. At least part of its historical recipe, which contained malt extract, concentrated skim milk, egg, cocoa and various additives, was based on new knowledge in food chemistry, especially on the detailed chemical composition of the various compounds. For the next step it was logic that the concentrated thick mixture had to be dried under vacuum in order to suppress heat damage. In turn, the fact that the slurry-type mixture starts to foam in the vacuum drier so that the final dry powder is porous and exhibits a high wettability was not a result of scientific development but rather pure coincidence.

Only much later the conditions for the formation of stable foam during vacuum drying of liquid food were investigated in a systematic way. The foam drying, either batch-wise in vacuum ovens or continuous in vacuum belt dryers, offers the possibility to obtain powders with favorable instant characteristics due their pronounced porosity. As second criterion besides sufficient foam formation in the wet state the foam must solidify at the end of drying in the crystalline or amorphous form. Otherwise the foam would collapse upon breaking the vacuum and loose porosity. The composition of Ovomaltine in the original form as well as in the new form without egg fulfills both criteria: the protein fraction is responsible for foaming in the wet state and the high sugar content (maltose and lactose) leads to solidification of the dried product already under vacuum conditions.

On the other hand Ovomaltine powder is quite sensitive to humidity due to its high sugar content. Already a small amount of water from moist ambient air causes a sticky product and leads to caking. Therefore, Ovomaltine was packed right from the beginning in tightly sealable cans made of material with low water vapor permeability. Systematic investigations on the quantitative description of moisture sensitivity of dry food were started around 1950. The theory of water vapor sorption to dry material and the introduction of the concept of water activity helped to deal with problems around shelf life of food and to select packaging material for moisture protection. At the Wander laboratories the experimental determination of water vapor sorption isotherms of food powders and their interpretation for defining the necessary packaging system has been an important research activity.

Later on, the theory of water vapor sorption and water activity was complemented by the theory of glass transition of mono- and polymers (sugar, polysaccharides, proteins) with water as plasticizer. Food exhibits pronounced stability in the amorphous glassy state. State diagrams provide information on moisture content and temperature which should not be exceeded for maximal stability during storage of a food product.

The brief discussion on malt extract and Ovomaltine of the Wander Company exemplifies what happened and in part still happens today: chemical phenomena or process conditions could be or can be explained in detail only after a food product had long been developed empirically according to old tradition and already been introduced on the market. Frequently, a traditional process is investigated by respective research when this process has to be improved or modernized. Such an improvement is usually not successful unless the traditional process is fully understood in retrospective.

Today, it is evident that the development of food products and the solution of the immense world-wide challenges in food security, food safety and nutrition must be supported by intensive scientific research and innovative process and product development. This is the very reason why numerous universities and other public institutions are active in food science and why the food industry commits itself to food science either in its own research units or indirectly by financing research projects in public research institutions.

In spite of all these research efforts failure or wrong developments cannot always be prevented. In the fifties and sixties of the last century plant proteins were processed into

fibrous meat analogues as one form of so-called textured vegetable proteins (TVP). The idea was to apply a spinning process in analogy to the textile spinning process. The protein was dissolved in alkali and then expressed through fine nozzles into an acid bath for precipitation. The fibers were cut into short pieces, combined with a binding material to meat-type pieces and flavored. The Wander Company owned patents for this process and in parallel the Givaudan Company developed suitable flavoring systems. However, chemical investigations showed that the alkaline treatment causes molecular changes in the protein which are undesirable and unsafe from the nutritional point of view. Therefore, the process was dropped before it reached the stage of industrial production. Today it is known that food processing in alkaline condition is generally unfavorable for food safety reasons. Alkaline treatment of food is indeed rare traditionally. Lye rolls, croissants and pretzels are probably the only exception. As for TVP, the extrusion cooking technology presents a safe alternative to the spinning process.

This case shows that innovations must be accompanied scientifically with respect to food safety. Food chemistry, toxicology and nutritional science will continue to stay in high demand. In more general terms the motto "food as scientific object" with which the Wander Company made its successful way over a long time span will be valid in the future more than ever.

Unveiling of the «Chemical Landmark» plaque. (from left to right: Thomas Zimmermann, SECO; Helena Meier, Wander Ltd.; Shana Sturla, SCNAT/ETH Zürich; Silvio Decurtins, SCNAT/Uni Bern) (photo: H. Kolb)

Comprehensive information on the history of the Wander Company: Walter Thut, 'Vom Zwei-Mann-Labor zum Weltkonzern – Georg Wander, Albert Wander, Georg Wander', Schweizer Pioniere der Wirtschaft und Technik, Band 79, Verein für wirtschaftshistorische Studien, Zürich, **2005**.