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D I P L O M A R B E I T

László Zechmeister – From Pioneering Work in Chromatography to the Foundation of the Series „Progress in the Chemistry of Organic Natural Products“

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2. Introduction

Much thought, work and effort was involved in the many inventions and developments of instruments and procedures of both the scientific world as well as the everyday life, which we take for granted and do not spare a thought about. The German word “Sternstunde”[1] is a good expression which characterizes “the once-in-a-lifetime opportunity some people have of being able to provide a lasting contribution to the evolution of mankind” (Ettre 1979, p.506). Many people fail in utilizing this moment, this once-in-a-lifetime opportunity.

László Zechmeister was for sure not one of them. He recognized the potential of the chromatographic method and made extensive use of it for his research about natural products. Zechmeister promoted the use and success of chromatography in chemistry by citing the technique in many of his papers and by additionally providing monographs about this analytical method. His work represents “the fundamentals on which the development of modern chromatography was based” (Ettre 1972, p.317).

This genius, however, will not only be remembered for his achievements in the field of chromatography, but also for the foundation of the series *Progress in the Chemistry of Organic Natural Products*, a journal including articles on contemporary research by masters in their fields of expertise. The aim of this thesis is to cast light on Zechmeister’s life and his pioneering role in chromatography, and to provide a more detailed insight on the aforementioned journal series.

[1] Engl.: Moment of glory

3. The Life of László Zechmeister

3.1. Biographical dates and events

László Zechmeister was born on May 14th, 1889[2] in the city of Györ, a town in the north-west of Hungary. At a time when the majority of the population was working as artisans, merchants and farmers, his father Karl Zechmeister held the position of mayor and crown counsel[3] of the city of Györ (Zechmeister 1913, p.74). During his time of mayoralty, the town developed to the third most important industrial centre in the country (Ettre 1979[1], p.503). With the intention to provide László with the best possible education, his son attended grammar school and acquired his "Maturitätszeugnis"[4] in June 1906. He was recruited to serve in the Hungarian military for one year from October 1906 onwards (Zechmeister 1913, p.74). In 1907, Zechmeister commenced his studies in chemistry at the highly reputable Swiss Federal Institute of Technology[5] Zürich. In the following five years, he enjoyed the lectures and guidance of Richard Willstätter[6]. After 7 semesters of studies, László received his degree as technical chemist on March 20, 1911. When Willstätter left for Berlin in 1912, Zechmeister followed and worked as his assistant from 1912 to 1914. During this period, he wrote his doctorate thesis *Zur Kenntnis der Cellulose und des Lignins* in order to attain the Dr. Ing. degree. [7] Experiments were conducted both at the analytical-chemical laboratories at the ETH Zürich until July 1912 and the

[2] The obituary published on the website of the Caltech Office of Public Relations indicates 1890 as his year of birth (Hawley 2011).
[3] Germ.: Königlicher Rat
[4] Engl.: certificate of eligibility for university entrance
[5] Eidgenössische Technische Hochschule, short: ETH
[6] 1872-1942; Willstätter won the Nobel Prize in Chemistry in 1927
[7] The paper amounts to 75 pages and is divided into two parts, a theoretical part and an experimental part, each dealing with investigations of the cellulose and the lignin of trees. At the beginning of the paper, a short line is printed indicating that the work is dedicated to Zechmeister's dear father. He also pointed out that it is his desire to thank his teacher Willstätter for his guidance.

Kaiser-Wilhelm-Institute for Chemistry in Berlin-Dahlem until July 1913 (Zechmeister 1913).

However, his scientific career was interrupted when the political instabilities of the early 20th Century resulted in the start of World War I in 1914. Again, Zechmeister was enlisted for the Hungarian army and had to fight on the front line where he was injured twice. He was taken captive and sent to a Russian prison camp in Siberia. One attempt to escape imprisonment failed, and he was interned again (Hawley 2011). During the time of captivity he taught himself the English language with the help of an English – Russian dictionary, and needless to say, the acquisition of another foreign language added on to his set of skills (Hawley 2011). In 1919, he was released and returned to Munich first in order to rejoin Willstätter, and then moved back to Hungary. But due to the post war chaos in his home country and in Germany, he could only find temporary positions (Ettre 2007, p.6), such as the work of a scientific leader in a pharmaceutical factory in Hungary, where he conducted industrial chemical research (Hawley 2011; Simon 1998, p.230). However, also financial problems troubled him, and László had to move to a country with a more stable currency (Ettre 1979, p.503). He was offered a teaching appointment at the Royal Danish Agriculture and Veterinary Academy in Copenhagen, where he worked as an instructor and scientific assistant of Niels Bjerrum from 1921 to 1923 (Hawley 2011). Zechmeister loved Denmark and the Danes, and this was no one-sided affection, which is evident by him being elected a foreign member of the Royal Danish Academy of Science later on (Ettre 1979, p.503). Then, finally, he was offered professorship of medical chemistry and directorship of the chemistry laboratory of the medical school at the newly established University of Pécs[8]. This was of course a great honor, as Zechmeister was only 33 years old, and there had

[8] *In the treaty of Trianon (1920), Hungary lost two-thirds of its former territory to the successor states. Two Hungarian universities were in these are, and therefore new universities had to be established. One was settled in Pècs, as there had already existed a university in medieval times* (Ettre 2008, p.173).

never been such a young person holding this position in Hungary before (Ettre 2007, p.6).

However, being of young age was not his only obstacle. The university as an institution had operated in earlier years in Pozsony (today Bratislava). In respect to equipment everything stayed in Bratislava (Ettre 2008, p.173), only the name was transferred to the new university. Zechmeister was mainly involved in organizational work, such as the building process of the premises and the laboratories and the hiring of scientific staff. It has to be taken into consideration that in the twenties, during the period between the world wars, money and workforce was scarce (Ettre 2007, p.6). Also, the size of his team of scientists was small. There was one associate professor, László Cholnoky[9] - who was his close collaborator, co-author of various monographs and eventually his successor - and a few graduate students (Ettre 2007, p.6). It is very likely that the reason for Zechmeister working with or publishing about chromatographic analysis later than Richard Kuhn[10] und Paul Karrer[11] did was this disadvantaged position regarding the poor state of his laboratory. Kuhn in Heidelberg and Karrer in Zürich, on the contrary, were generously funded and could avail themselves of a large staff and well equipped laboratories. Even though the knowledge of the chromatographic method might have been there already, Zechmeister's team faced a lack of instruments. In the first year, László used the time to write textbooks[12] on analytical chemistry and organic chemistry (Ettre 2008, p.173). After having established and equipped the laboratories, investigations could be started in the second half of the 1920s (Ettre 2007, p.6). It is no surprise that he maintained contact with Willstätter, who was then working in Munich. Consequently, the first projects were collaborations of their institutes (Ettre 2008, p.173). László Zechmeister plunged into working with the

[9] 1899 – 1967
[10] 1900-1967; Kuhn won the Nobel Prize in Chemistry in 1938.
[11] 1889 – 1971; Karrer won the Nobel Prize in Chemistry in 1937.
[12] He was the first to provide a modern Hungarian textbook on organic chemistry.

pigments of the Hungarian red paprika, as well as within the field of carotenoids in which he would become a real expert. Within a period of 10 years, he had published more than 12 papers (Ettre 2007, p.6). In order to bring in his expertise, he was offered to contribute a chapter on carotenoids for the *Handbook of Plant Analysis*[13] published in 1932. Zechmeister then used this as an impetus to write a whole book about this subject (Ettre 2007, p.6).[14] It is not well reported when Zechmeister turned to chromatography as his choice of investigative method of plant compounds. The first explicit reference to chromatography can only be found two years later when his article *Untersuchungen über den Paprika-Farbstoff. VII (Adsorptionsanalyse des Pigment*)[15] was published (Ettre 2007, p.6). Nevertheless, he continued writing papers on the use of chromatography.

László Zechmeister worked hard in his field and by the end of the 1930s he had gained several awards and a well-deserved reputation in Europe, as well as in the USA. He was also often invited to teach at various universities (Ettre 2008, p.175). Again, these prolific years of scientific research were interrupted by political events. The Nazi movement, which was triggered by Hitler and the NSDAP in Germany, spread throughout the German speaking countries and gained more and more power. The outbreak of the Second World War in 1939 reinsured Zechmeister to leave Hungary. He accepted an invitation by Linus Pauling[16] to work at the Gates and Crellin Laboratories of Chemistry at the California Institute of Technology in Pasadena, USA. In a letter to Warren Weaver, Pauling cited Zechmeister:

> *We have now made up our minds in respect to a possible change. My position here is not such as would suggest a change in an imperative way, perhaps even not in the long run, but I do not like the atmosphere very much. We are inclined to leave if conditions were offered which would enable me to carry on with my work possibly on a larger scale than in this country. (Pauling 1939)*

[13] See further literature.
[14] See Zechmeister 1934, in further literature.
[15] See Zechmeister et al.1934, in further literature.
[16] 1901 – 1994; Pauling won the Nobel Prize for Chemistry in 1954 and the Nobel Peace Prize in 1962.

One has to give him great credit for taking this life-changing step, as he was already 51 years old. Due to the illness of his first wife – she had tuberculosis (Ettre 1979[1], p.504) -, their departure was postponed again and again, until it was decided that Zechmeister would leave without her, and his wife would follow once her health was in better condition.[17] László escaped the Nazi regime and again another military service with the last ship leaving from an Italian port and heading to the United States in February 1940 (Ettre 1979[1], p.504). In Pasadena, he was able to continue his work on pigments and carotenoids with better laboratory equipment than he had available at the University of Pécs. His research was also perceived as satisfying by his co-workers. In another letter to Weaver (Pauling 1941), Linus Pauling writes that Zechmeister had fitted to their department adequately and that "there has been no trouble at all of the sort that sometimes accompanies the appointment of a European professor". Once having arrived in the United States, Pauling took him under his wings in order to make this new beginning in a foreign country easier. This becomes evident if one has a look at pictures of the two men published online by the Oregon state university.[18] One photograph depicts László together with Pauling's wife and children, and that makes one assume that they were bound by a deep friendship. However, Zechmeister had to face further obstacles. For instance, he found out that he would not receive any royalties for the English edition of his book *The Principles and Practice of Chromatography*. He was awarded £50 as recognition of his work eight years later, though (Ettre 1979, p.504).[19]

Considering the past years, László did not cut all ties with Europe. He was concerned about the ongoing events. In a letter to Arthur Stoll, he writes:

[17] Unfortunately, László's wife never recovered from her illness and died in 1941.
[18] See for instance http://osulibrary.orst.edu/specialcollections/coll/pauling/chronology/images/1940i.19-900w.jpg
[19] See also Parr 1949.

> *I am homesick for Europe. […] They* [his family members] *are all alive (only the son of my sister was deported), but could not exist without my parcels.* (translated [20] from Zechmeister 1946*)*

In addition, plans were made to visit Europe (especially Switzerland and Hungary) again and again after the war, but due to the strict entry requirements, this was an organizational challenge every time.

In 1949, Zechmeister married the young Elizabeth Sulzer of Zürich. They became acquainted with each other through Elizabeth's brother Fritz Sulzer, who was one of his graduate students. Fritz fell ill with tuberculosis and László "who was very concerned about this young man, went back to Switzerland to tell Fritz's mother that what Fritz needed was not the treatment of tuberculosis; Fritz needed his family to come over…" (Cohen 2002, p.9). The family acted on his advice and travelled to California, and shortly after Elizabeth and László, who was nearly as old as her mother, got engaged. It should be pointed out that his wife played an important part in both his private life and his career. She undertook the work of editing and translating, especially for the *Progress in the Chemistry of Organic Natural Products (Hawley 2011)*.

Zechmeister did not only stay in touch with his European friends via letters and short visits, he also observed and appreciated the work done in the field of chemistry in the German speaking countries in the post war time. This is indicated in a letter to the library of the California Institute of Technology from August 6, 1948:

> *A number of German periodicals referring to Chemistry have been appearing regularily throughout the years 1947 and 1948 but none of these important issues ever reaches the Chemistry library. […] At least, in Chemistry, it is absolutely necessary to be informed on the pertinent activities in that country, not only for our research purpose but also in graduate teaching. (Zechmeister 1948[2])*

[20] *„Ich habe ein Heimweh nach Europa. […] Ich habe meine Angehörigen noch nicht über diese Pläne orientiert. Sie sind alle am Leben (nur der Sohn meiner Schwester ist verschleppt worden), doch würden sie ohne meine Pakete nicht existieren können."*

László Zechmeister worked at the Department of Organic Chemistry until 1959, when he became professor emeritus. Nevertheless, he remained active even after his retirement. In 1962, he published a monograph on *cis* and *trans* isomeric carotenoids (Ettre 2007, p.7). He continued teaching and research until summer 1971 when he became ill. It is reported that after his death on February 28, 1972, no services were held – at his own request (Hawley 2011).

Even though, László Zechmeister was a devoted researcher, he turned to sports as compensation in his private life. He regularly used the swimming pool of the university and played tennis with the Athenaeum headwaiter on Sundays. It was required by the Athenaeum to be dressed in coat and tie, which László one day executed by wearing both tennis pants **and** coat and tie. This led to the Athenaeum hostess reporting to the manager that "Professor Zechmeister has forgotten his pants" (Hawley 2011).

3.2. László Zechmeister's personality

When reading through short biographies or obituaries, one is often informed about Zechmeister's excellence and integrity. Even though it is hard to reconstruct the character of a person fifty years after his passing away, I would like to point out two instances where Zechmeister' s character shimmers through and where his appreciation for scientific truth is well emphasized.

On April 2, 1942 Zechmeister prepared a letter to the publishing house *John Wiley and Sons, Inc*. (Zechmeister 1942[1]) notifying them about the illegal reproduction of two figures from his monograph *Principles and Practice of Chromatography* by the

Fisher Scientific Co in "The Laboratory"[21]. He criticized that there had not only been a misdemeanor, but that the caption had also been changed and was therefore misleading. Martin Matheson from *John Wiley & Sons, Inc*. wrote back that

> *[a]lthough we do not condone this action, we feel, as a matter of fact, that what they have done represents excellent advertising for the book and is precisely the sort of publicity which we solicit in the usual routine of business. (Matheson 1942)*

However, the author was not very pleased with the answer of the publishing house, and pointed out that he did not share their opinion in this matter. He continued by writing (Zechmeister 1942[2]):

> *[…] my duty as a scientist is to fight against any distortion of scientific truth. I would not have minded a publication with the right caption but as a latter has been changed, the photographs now represent an obvious absurdity […] If you say that the article in question represents "precisely the sort of publicity which we solicit" I may remark that the distortion of scientific facts, established by long years of effort is just the sort of publicity which no scientist can desire.*

Another instance where it can be seen that Zechmeister believed in scientific truth and especially in accuracy and fairness, is his reaction to a review of *Progress in Chromatography 1938-1947* published in an issue of the journal well-known *Nature*. The author, Dr. Consdon claimed that the book was not up-to-date which Zechmeister felt was unfair to criticize as the book provided a retrospect on chromatographic developments in a certain period of time, as it is already indicated in the title. In a letter to Mr. Parr from the publishing house *Chapman and Hall, Ltd*. (Zechmeister 1951[1]) he indicated his intention to write a brief reply to the editors of *Nature* in order to give a short defense to this injustice. The publisher advised that it was "best to preserve a dignified silence" (Parr 1951), but László could not be dissuaded from turning to the editors of *Nature,* "strictly for their personal information and in order to keep my standing with them in the future" (Zechmeister 1951[2]).

[21] Vol. 13/ 2, p. 40-41, 1942

3.3. Awards and Honors

- 1935: Pasteur Medal of the French Biochemical Society (Hawley 2011)
- 1938: Honorary membership of the *Gesellschaft Österreichischer Chemiker* (Markl 1997)
- 1949: Claude Bernard Medal (Hawley 2011)
- 1960: Semmelweis Medal (Ettre 1972)
- 1962: National Award in Chromatography of the American Chemical Society (Gehrke 2001)
- 1972: Honorary degree of Doctor of Medicine from The University of Pecs (Hawley 2011)
- Member of the editorial board of the *Journal of the American Chemical Society* (Hawley 2011)
- Honorary member of the Hungarian Academy of Sciences and holder of its Grand Prize (Hawley 2011)
- Foreign member of the Royal Danish Academy of Science (Ettre 1972)

4. Zechmeister's Influence on the Development of Chromatography

Nowadays, there is practically no laboratory where no kind of chromatographic analysis is employed. It has developed to a technique which provides detailed information about a substance in quite a small amount of time. Leslie S. Ettre mentions that "[a]ll of us who are active in this field should therefore appreciate the genius of the pioneers of this technique" (Ettre 1971, p.31). When flipping through books about the history of chromatography, one will certainly take notice that László Zechmeister is always mentioned among the pioneers in this field of chemistry, and among these geniuses. McCollum suggests in his review (McCollum 1951, p.430) that "Zechmeister was among the earliest to recognize the high resolving power, great versatility, and analytical usefulness of the technics of selective adsorption". Unfortunately, it is often not ventilated in how far his work contributed to the development in this field. It takes a more detailed look at his merits, as nowadays other scientists who had been working with this investigative method are better known than Zechmeister, such as Martin and Synge[22], or Tiselius[23].

It is uncontested today, that Mikhail Tsvett [24] is to be named as the *inventor* of chromatography[25]. In fact, by labeling Tsvett the true inventor of chromatography, Zechmeister even initiated a written debate argued out in the journal *Nature*. H. Weil and T. I. Williams responded to this certain claim by accusing Zechmeister of refusing to acknowledge D.T. Day's[26] pioneering role. László politely countered in a further letter to the journal that he had indeed mentioned Day's contributions

[22] A.J.P. Martin (1910 – 2002) and R.L.M. Synge (1904 – 1994) received the Nobel Prize in Chemistry in 1952 for their pioneering work in partition chromatography (The Nobel Foundation 1952).
[23] A.W.K. Tiselius (1902 – 1971) received the Nobel Prize in Chemistry in 1948 for his research in electrophoresis and adsorption analysis (The Nobel Foundation 1948).
[24] 1872 - 1919
[25] "*Such a preparation I term a chromatogram and the corresponding method, a chromatographic method*" (Tsvett cited in Zechmeister 1948[1]).
[26] 1859-1925

(Zechmeister 1951). Weil and Williams, on the other hand, expressed their opinion that Zechmeister had ignored really important papers written by Day (Weil et al. 1951). In the end, László did not give in to any further argument.[27] In a paper about the historical development of chromatography, though, he stated that "[t]hese experiments […] might well, under favorable conditions, have developed into systematic chromatography" (Zechmeister 1948[1], p.147). That shows that he payed attention to the potential that lay in Day's experiments and theories[28], but did not see a fundamental milestone in the invention of chromatography. He also argued that, as opposed to Day, Tsvett "recognized and correctly interpreted chromatographic processes" and that he "devised a useful laboratory method" (Ettre 1971, p.27). Today, it is universally acknowledged that Tsvett was the inventor of the method, even though there had been forerunners in adsorption analysis in the 19th century, such as D. T. Day in the US, or Schönbein and Göppelsröder (Zechmeister 1948[1], p.145) in Germany, to name but a few.

The "invention" of chromatography, however, is dated to 1906 (the publication of Tsvett's papers[29]), and it took nearly 30 years until chemical laboratories started using it again. Zechmeister referred to the time until the method was rediscovered as the "Latenzzeit"[30] (Engl. dormant period) (Ettre 2004, p.613). It is important to note that, in fact, three graduates from the ETH Zürich are among the pioneers: Richard Kuhn, Paul Karrer and László Zechmeister. They all worked together with Richard Willstätter, but not at the same time.[31] It is reported (Ettre et al. 1975, p.426)

[27] Interestingly enough, the polemics continued between Russian scientists and Weil and Williams, as the latter two challenged Tsvett's priority, which was of course not accepted by the Russians. The communist East would not approve of the bourgeois West "stealing" a Russian invention – even though, Tsvett being born in Italy, being educated in Switzerland, and having worked in Poland, was more of a cosmopolite than Russian (Ettre 2008).
[28] In 1897, Day formulated a paper explaining selective adsorption when Pennsylvania earth oil is pressed through limestone (Zechmeister 1948).
[29] See Tsvett 1906[1], and Tsvett 1906[2], in further literature.
[30] „*Man kann das von 1906 bis 1931 reichende Vierteljahr-hundert als die Latenzzeit in der Geschichte der Chromatographie bezeichnen*" (Zechmeister 1936).
[31] Willstätter occupied the chair of chemistry at the ETH Zürich from 1905 until 1912 (Ettre et al. 1975).

that the latter was in possession of a German translation of Tsvett's book[32], which had been translated into German especially for him. Willstätter himself did not acknowledge the value of chromatography, but his disciples did. Edgar Lederer[33] assumed that Willstätter had rejected chromatography because he could not obtain any valuable results for chlorophyll due to the inadequate adsorbent for the packaging of his columns (Ettre et al. 1975, p.426).

4.1. Literary Contributions to the History of Chromatography

As already mentioned in the chapter before, it is difficult to pin down the exact time when Zechmeister started using the technique, but he certainly took a major role in the expansion of its use from the 1930s onwards (Ettre 2007, p.6). Leslie S. Ettre claims that his most important contribution was the book *Die Chromatographische Adsorptionsmethode* published in 1937 together with his collaborator and later successor at the University of Pécs László v. Cholnoky[34] (Ettre 2008, p.175). The text was composed in German, the language of science at that time. In a letter from 1939, the German publisher Julius Springer reports to Zechmeister that sales for the book were very satisfying and that a substantial amount of volumes were sold to foreign countries (Springer 1939). It was so popular that it had to be reprinted in a second edition one year later. This second edition was translated into English by A. L. Bacharach and F. A. Robinson (McCollum 1951, p.430) and made available for purchase in 1941 under the title *Principles and Practice of Chromatography*. Ettre also states that "[t]his was the right book, published at the right time…" (Ettre 2008, p.175). What made this monograph such a bestseller was the fact that it contained methodology and detailed instructions on the analyses of various substances. In

[32] See Tsvett 1910, in further literature.
[33] 1908 – 1988; in 1931, Lederer made chromatography well-known through his demonstration of separating xanthophylls in egg yolk in 1931; during that time he was working with Kuhn (Heftmann1975).
[34] 1899 - 1967

addition, Ettre mentions that Zechmeister is to be accredited for making classical column chromatography a simple tool (Ettre 1979[1], p.500). F.P. Zscheile, for instance, recommends this book especially to biological chemists as the technique was very useful for the separation and purification of compounds found in plants (Zscheile 1938).

Letters between the publishing house *John Wiley & Sons, Inc.* and Zechmeister illustrate the many decisions that had to be taken concerning further editions of the *Principles and Practice of Chromatography*. The author wanted to add a more extended bibliography and changes, as at that point of time the book was already seven years old, and a bit out-of-date (Zechmeister 1944). Wiley refused to that considering the high manufacturing costs and argued "that the sale is not large enough to warrant extensive changes in this reprinting" (Triest 1944). One year later, Zechmeister approved of the reprint of the monograph as it stood, since he wished "to keep it absolutely on the American market" as, to his perception, "the interest for it is rather increasing than decreasing" (Zechmeister 1945). As a reprint of the book including changes had been refused before, László intended to publish a second volume under the title *Principles and Practice in Chromatography, Volume II. Progress in Chromatography 1938 – 1947* in 1949 (Zechmeister 1949). This volume was compiled in order to review the literature on this scientific field in the mentioned years. Indeed, the book entered the market in 1950 under the shortened title *Progress in Chromatography 1938 – 1947*. This time, he had learnt from his mistakes from the past and conducted negotiations regarding the royalties for his book more wisely. In a letter to Mr. Parr from the publishing house, he wrote (Zechmeister 1950):

> *I absolutely protest against providing Wiley's with sheets of the new book unless the royalty question is settled beforehand to my satisfaction. […] According to my estimate, the "Principles and Practice of Chromatography" represented a turnover of about*

> *$20 000.- of which, as you know, I did not get out practically anything. This is now a matter of the past, but you will understand that I am not willing and cannot afford even a partial repetition of this situation.*

According to Ettre (Ettre 2008, p.176), "[t]his book received excellent reviews, calling him 'a master in the application of chromatography' who can make 'chromatography interesting and easy to use for every biochemist'".

László Zechmeister wrote many articles about the history of chromatography. There is one introductory chapter to the first edition of the book *Chromatography* by Erich Heftmann[35] that I would like to go in detail with. The *Caltech archives* store 8 letters of the conversation between Zechmeister and Heftmann about this contribution. The latter stated that László's "historical introduction is a very stimulating and attractive account of the beginnings of chromatographic methods and will be a great asset to our book" (Heftmann 1960[1]). Most of the content of the letters relates to editing and corrections. What catches the eye is a postscript (Zechmeister 1960), where Zechmeister wrote: "Please do not print my first name anywhere; it is unpronounceable and being invariably misspelled". Indeed, he always signed letters and articles by using the abbreviation '*L.'* for his first name. Heftmann reacted to that the following way: "I don't think it's unpronouncable – I once had a very dear friend by that name. But that was long ago and far away…" (Heftmann 1960[2]). Erich Heftmann was born in Vienna (Ettre 1979[2], p.126f), and his familiarity with this name or the Hungarian language might be explicable considering the proximity of this town to Hungary.

For the third edition of Chromatography, several changes were made. In 1975, the year of its publication, Zechmeister had been dead for some years. Therefore, the

[35] Heftmann was born in Vienna in 1918 and studied medicine from 1936 to 1938. In 1939, Heftmann had to emigrate due to the political situation in Austria. From 1959 to 1969, he was research fellow at the Caltech (Ettre 1979[2], p. 125).

historical introduction was rewritten by Heftmann himself, probably modeled on the former version. [36]

4.2. National Award in Chromatography of the American Chemical Society

In 1962, Zechmeister received the National Award in Chromatography of the A.C.S. for his outstanding contributions in this field and for the development of new methods. He was the second person to win this award, and his address dealt with "Column Chromatography and Geometrical Isomerism", combining the two subjects in which he had gained quite some reputation, chromatography and the separation of cis/trans- isomers (Ettre 1979[2], p.493). The prize was originally titled the *American Chemical Society Award in Chromatography and Electrophoresis*, but was reduced to chromatography in 1971. This accolade is normally assigned to one scientist every year, regardless of their nationality. However, the majority of recipients were Americans (Gehrke 2001, p.43).

4.3. Working with Chromatography

The post-war period was the time when the superiority of the method had well been accepted (Ettre 2002, p.4). As the technique became more and more popular, so did the term "chromatographer", about which Zechmeister was not pleased. He addressed this unfortunate expression in a lecture he gave in 1950 at a meeting of the local Southern California section of the American Chemical Society:

> *"Recently chromatography became so popular that the English language has been enriched by a new noun "the chromatographer". I would protest against such a label. In research chromatography*

[36] "*Death has taken two of our coauthors – L. Zechmeister and […] Therefore, I have had to substitute as the author of the history of chromatography*" (Heftmann 1975, p.xiv).

> *should be considered first of all a tool like e.g. fractional distillation; and those of our colleagues who have achieved success by using distillation methods should certainly not be named "distillers".*[37]

The term "chromatogram" actually referred to the column with the separated rings of the sample components (Ettre 2002, p.4). Ettre also delivers an explanation about how the adsorption analysis with the classical column – as used by Tsvett and Zechmeister – was conducted:

> *[T]he adsorbent had to be prepared and packed into a small tube, the sample solution added to the top of the column and then developed using various solvents. The process was stopped before the first sample component emerged from the column. Next, the contents of the tube, with the separated colored rings, was carefully pushed out and the individual rings separated with a sharp knife. Finally, the compounds present in these separate adsorbent fractions were extracted, the solutions were characterized by spectroscopy or by other means, and the pure compounds were obtained by evaporating the solvent.* (Ettre 2002, p.4)

Even though, Zechmeister is credited with making column chromatography easy and accessible to everyone, Ettre added to his description that this method actually required considerable skill, and that, hence, an easier method, the flow-through chromatogram was developed in the late 1930s.The implementation differs from what is today known as liquid chromatography in that no pressure was applied in order to make the eluent (the mobile phase) pass through the column.

As regards the technique of packing a chromatography column, Zechmeister described that they were using columns of the size 10 x 150mm to 60 x 260mm in his laboratories. A perforated porcelain disc was inserted to the lower end of the tube in order to prevent the packaging from dropping out, and a small portion of cotton wool was piled up on the disc. Then the dried and sieved adsorbent could be funneled. Normally, calcium carbonate or calcium hydroxide were used, but also powdered sugar or fuller's earth were applied (Zechmeister 1936, p.72).

[37] As cited in Ettre 1979[2], p.493.

In the last years of his live, Zechmeister worked on using the chromatographic technique for the separation of stereoisomers. His last monograph, in fact, was about cis- and trans- isomers of carotenoids. I would like to conclude by quoting Leslie S. Ettre (Ettre 1979[1], p.503f) once again:

> *It is true that Zechmeister was an internationally-accepted authority in the fields of carotenoids, enzymes and other complex organic substances, for example geometric isomers.*

László Zechmeister himself stated once that the direction and rate of progress in organic chemistry depended on the availability and effectiveness of physical methods (Zechmeister 1948[1], p.145), and I would also like to add, that without the technique of chromatography many of his research results and scientific achievements in organic chemistry would probably not have been possible.

5. Hitherto mostly disregarded contributions to the development of the chromatographic method made by Austrian chemists

In context with the history of chromatography, it is noteworthy to also mention the work of Austrian chemists. Unfortunately, they are not considered pioneers in this field, therefore, the following section is meant to pay credit to the achievements of two chemists, namely Zdenko Hans Skraup and Fritz Prior. In addition, little is known about Fritz Feigl's [38] contribution to the development of paper chromatography (Beneke 1999, p. 216). Fritz Feigl is mainly known to be the inventor of the spot test analysis, a micro-analytical method which uses only small amounts of chemicals and is therefore an economic technique. This invention is based on the works of H. Schiff, C. F. Schönbein and F. Göppelsröder (Beneke 1999, p. 231). The latter two have already been mentioned in this chapter as forerunners of the chromatographic method. Feigl, on the other hand, contributed to the development so far in that he also studied the influence of the capillary effect of filter paper on the detection of compounds.

5.1. Zdenko Hans Skraup

Skraup[39] is known to organic chemists for the development of the synthesis of quinolines, a reaction that carries his name[40]. He studied at the Technical University Prague and at the University of Vienna, for instance under Adolf Lieben. In the last few years of his life, Skraup was occupied with the investigation of capillary actions on paper. These observations were again based on the work of Schönbein, and Holmgren (Skraup 1909[1], p. 675). Skraup realized that the capillary rise of a certain chemical solution on a vertically positioned blotting paper depends on the properties

[38] * 1891 in Vienna - †1971 in Rio de Janeiro
[39] * 1850 in Prague - †1910 in Vienna
[40] Skraup synthesis

of the solution, and that different substances have different capillary rises. In his paper on the chemical behavior of aqueous solutions in terms of capillary effects, he pointed out that different resolved substances remained on the paper with different distances to the water front (Skraup 1909[2], p. 773). This is certainly the principle of paper chromatography. Skraup published various papers on this matter in reference to acids, salts, amines and phenols, together with Ernst Philippi, E. Kraus, A. von Bieler and others[41].

5.2. Fritz Prior

A possible wide spread phenomenon in the history of science was that teachers carried off the laurels for achievements of their students. This happened to Austrian chemist Fritz Prior[42]. It is known that Erika Cremer was pioneering in gas chromatography. However, it was not her, but her doctoral student Fritz Prior, who put much thought and effort into the development of this method. As Fritz Feigl, Prior commenced his studies of chemistry at the University of Technology in Vienna, but then transferred to the University of Innsbruck. He was already working as chemistry teacher at a grammar school, when he applied for a doctoral position at the Institute of physical chemistry of the University of Innsbruck in 1945.

Cremer was working on the assay of adsorption heat by measuring the pass-through time of one or more substances through a chromatographic column. As these studies had been conducted in the liquid phase, Prior was appointed the task to refine the chromatographic method and apply it to the gas phase (Prior in Pohl 1996, pp. 4-10). He built an apparatus consisting of a U-shaped tube with a diameter of 1 cm and a length of 20 cm which contained the adsorbent. Hydrogen gas was used as carrier gas and a thermal conductivity detector measured the

[41] See further literature by Skraup.
[42] *1921 - †1996

resistance that occurred when a substance passed the cell. Hence, the first gas chromatograph was built and the first chromatographic separation of organic substances could be performed (Prior in Pohl 1996, pp 5-8).

6. The Series "Progress in the Chemistry of Organic Natural Products"

László Zechmeister was not only an authority in the field of chromatography and well-known for his research about pigments and stereoisomers, he is also the founder of the journal "*Progress in the Chemistry of Organic Natural Products*"[43]. The first volume was inaugurated in 1938, and it is absolutely remarkable that the series has not yet come to a close and that the publishing of the 95th issue is soon to come.[44] Ever since, the *Julius Springer Verlag Wien* has undertook the task of printing and publishing the series. While in former times, when German was still the language of science, the series was simply referred to as "Fortschritte", it is now also known under the short term *Zechmeister* in memory of its founder. The intention behind this project was to produce an anthology of contributions about the contemporary research in various fields of chemistry[45], such as "topics related to the origin, distribution, chemistry, synthesis, biochemistry, function or use of various classes of naturally occurring substances ranging from small molecules to biopolymers" (Springer-Verlag 2012). Even though the title refers to the field of organic chemistry, it was very important to Zechmeister to deliver a good variety of approaches. After he had retired, he wrote to one of his successive editors Dr. Werner Herz in reference to the 28th volume of the series:

> *I […] would like to point out that the Volume is mainly of biochemical nature (which, of course, is not a shortcoming); could I suggest that you attempt to secure for forthcoming Volumes also papers in which the emphasis is more on physical methods*. (Zechmeister 1971)

Looking through the various issues, one can clearly see that he was careful also to include papers dealing with physical methods, such as x-ray diffraction or radiography, or papers dealing with spectrochemistry or electron configuration.

[43] Germ:. *Fortschritte der Chemie Organischer Naturstoffe*
[44] Volume 94 was published in 2011.
[45] As the subtitle of the first four editions of the series implies: „Eine Sammlung von zusammenfassenden Berichten" (Engl.: A collection of summarizing reports).

Needless to say, that Zechmeister could win a great number of experts and authorities in their fields of research. Among those who have contributed to Volumes 1 to 27, there are ten Nobel Prize laureates: Kurt Alder and Otto P.H. Diels (1950), Derek H.R. Barton (1969), George W. Beadle (1958 Nobel Prize in Physiology or Medicine), Hans v. Euler-Chelpin (1929), Paul Karrer (1937), Luis F. Leloir (1970), Linus Pauling (1954), Vladimir Prelog (1975), and one woman, Dorothy Crowfoot Hodgkin (1964). László especially tried to induce friends and acquaintances, such as Arthur Stoll and Albert Frey-Wyssling, and scientists from the universities he had worked at to introduce the newest results from their research to the readers. There are, for instance, 8 contributions from researchers of the ETH, and 23 from researchers from the Caltech[46]. A correspondence between Zechmeister and Albert Frey-Wyssling illustrates László's courtship for authors. He wrote that he would most politely invite Frey-Wyssling to write a summarizing article for the journal, and that he would like to win his valuable cooperation for the sixth volume (Zechmeister 1949[1]).[47] He added that it would be of extraordinary value for the readers to read about his achievements in the next issue. Indeed, Frey-Wyssling made one article, *The Fine Structure of Cellulose*, available for publishing in Volume 8.

In general, the history of the journal may be divided into three phases. In the early years of its existence, Zechmeister was still operating at the University of Pécs, in his home country Hungary. The first three volumes fall into this period. For issue 1 and 2, Zechmeister shared the editorship with Adolf Butenandt, Walter Norman Haworth, Fritz Kögl, and Ernst Späth.

[46] Short for: California Institute of Technology, Pasadena, California
[47] Original: *"[…] möchte ich Sie höflichst einladen, einen zusammenfassenden Artikel für die „Fortschritte der Chemie organischer Naturstoffe", deren Herausgabe ich wieder übernommen habe, zu schreiben. Band V dieses Unternehmens wird in wenigen Wochen fertig vorliegen, und ich möchte Ihre werte Mitarbeit für Band VI gewinnen".*

- **Adolf Frederick Johann Butenandt** (1903-1995) studied chemistry at the universities of Marburg and Göttingen. He was appointed professor at the University of Berlin and at the University of Munich, and Director of the Max Planck Institute for Biochemistry, Berlin-Dahlem, and of the Institute of Physiological Chemistry at the University of Munich. In 1939, he was awarded the Nobel Prize in Chemistry for his work about sex hormones (The Nobel Foundation 1939[1]).
- **Walter Norman Haworth** (1883-1950) was a British chemist operating in the fields of organic chemistry and natural products chemistry, which made him a good choice as co-editor for the "Zechmeister". He studied at the universities of Manchester and Göttingen, and after several years, he was appointed Professor and Director of the Department of Chemistry at the University of Birmingham in 1925. In 1937, Haworth was awarded "for his investigations on carbohydrates and vitamin C" with the Nobel Prize in Chemistry, and he was knighted ten years later. His name lives on in the term Haworth-projection, describing the cyclic structure of monosaccharides (The Nobel Foundation 1937[1])
- **Fritz Kögl** (1897-1959) was a German chemist, who knew Butenandt from the time when they were both assistant researchers at the University of Göttingen (Schiede et al. 2004). He studied chemistry in Munich, and was a student of Heinrich Wieland[48]. In 1930, he became the successor of Leopold Ružička[49] at the University of Utrecht. He gained fame for researching

[48] 1877-1957; Wieland worked, among others, at the Kaiser-Wilhelm-Institute in Berlin-Dahlem. In 1925, he succeeded Richard Willstätter in his chair at the University of Munich. Wieland was editor of the Justus *Liebigs Annalen der Chemie* for twenty years, and received the Nobel Prize in Chemistry in 1927 for his investigations of the constitution of the bile acids and related substances (The Nobel Foundation 1927).

[49] 1887-1976; Ružička was professor for organic chemistry at the University of Utrecht and successor to Richard Kuhn at the ETH Zürich. In 1939, the same year as Adolf Butenandt, he received the Nobel Prize in Chemistry for his work on polymethylenes and higher terpenes (The Nobel Foundation 1939[2]).

cancer and substances influencing the growth of cells in plants (Havinga 1960).

- **Ernst Späth** (1886-1946) was an Austrian chemist who became famous for his discovery of the hallucinatory alkaloid mescaline. He was elected Rector of the University of Vienna in 1937. From 1938 to 1945, he held the position of general secretary of the Austrian Academy of Science, of which he became president for one year in 1945. Späth received many awards for his research in alkaloid chemistry, and is also known as an editor of the *Monatshefte für Chemie/Chemical Monthly* (Soukup 2005).

Zechmeister's team of four participant editors was reduced to three for volume 3, as Haworth did not continue editing. After three successful issues of the journal, Zechmeister decided to take a break due to the instable political conditions in Europe and the turmoil of the beginning of war in 1939. The war and the actions of the Nazi regime hindered scientific progress to a large extent. On the one hand, young scientists were recruited to serve in the military and therefore there was a shortage of staff, but in addition it could become very dangerous for scientists in case they were not supporting the Nazi regime or uttered criticism. As usual, the intellectual elite of the mother country or occupied countries posed a danger to dictatorial establishments. One should also consider that many great minds in the academia had a Jewish background, Willstätter for instance. Zechmeister's decision to pause his project was probably based on the inability to find enough contributors who were in a proper position to conduct research and hand in papers about that. Moreover, László had planned to leave Europe himself, and was uncertain what to expect from the future. He left Hungary with a heavy heart, since he could not bear the atmosphere there anymore, and in addition, he was hoping that he could continue his investigations on a larger scale at the *California Institute of Technology*

in Pasadena. Julius Springer, who was in charge of the production and publishing of the journal, shared his feelings with Zechmeister and wrote:

> *Your latest letter confirms the veracity of my suggestion to hold the "Fortschritte" in abeyance until fundamentally different circumstances will eventuate, or until the current conditions will have adopted an order internationally so that the writing of reports would be again possible and also interesting for the respecting authors (translation from the original, see Springer, 1939).*[50]

It was only six years later, when Zechmeister had settled in the US and found himself in a position to continue with the "Zechmeister". In 1945, the fourth volume was published. For this issue of the journal, only Butenandt remained part of the project. However, Ulrich Westphal was brought in as a supporting publisher.

- **Ulrich Westphal** was a student and for many years an assistant of Butenandt. He habilitated in 1941, and became professor seven years later. From 1949, Westphal worked at the *Field Research Laboratory* in Kentucky/USA (Hermann et al. 1980, p.72). His fields of research were the enzyme activity in cancerous organisms, peptide hormones and the biochemical investigation of pituitary hormones (Deichmann 2004, pp.21-22).

This forth edition heralded the start of the second phase, the years where Zechmeister was operating from Pasadena. However, what differs from the other volumes of this period is that he still had co-editors for volume 4, but then proceeded without any other co-publishers (volumes 5 to 27). He found support in his second wife, Elizabeth (née Sulzer), who took on the task of editing and translating. Aside

[50] Original: „*Ihr neuer Brief bestätigt die Richtigkeit meines Vorschlages, die „Fortschritte" solange ruhen zu lassen, bis entweder grundlegend andere Verhältnisse wieder eingetreten sein werden, oder bis die heutigen Verhältnisse im internationalen Verkehr eine Ordnung angenommen haben werden, unter der die Abfassung von Arbeiten wieder möglich sein wird, und auch für die betreffenden Verfasser wieder interessant genug sein wird".*

from that, she compiled the index of subjects and index of names (Grisebach 1971).[51]

During his active years, Zechmeister contributed four articles to the series. In Volume 2, his work about chitin and its cleavage products together with Géza Tóth was released. Volume 8 contains an article about enzyme chromatography together with Margarete Rohdewald, and there are two reviews on carotenoids (Vols. 15 and 18) which he presented as sole author.

This era ended in 1970, when László Zechmeister retired from the project, probably due to his age and illness. The 28th edition carries his name as founder, but lists three new faces on the editorial board: Werner Herz of the Florida State University in Tallahassee[52], Hans Grisebach, a biochemist from the University of Freiburg, and Alastair Ian Scott[53] from the Yale University in New Haven. László remained in contact with Grisebach and Herz, and they reported to him about the progress of the preparation of the issue, which had to face two obstacles already at the beginning. Firstly, the publishing of the issue was delayed as the person responsible for producing the index at the Springer publishing house fell sick, and as it seemed, could not be replaced as quickly as had been desired. On the letter by Herz informing Zechmeister about this problem, the latter typewrote on the very same page that "this should not be a problem in a city as Vienna" (Herz 1971[1]). Two weeks later, Grisebach stated that it would be hardly possible to find someone compiling the index due to the little remuneration that the Springer publishing house

[51] „*Soweit mir bekannt ist, hat Ihre Frau Gemahlin das Sach- und Autorenregister der früheren Bände der "Fortschritte" angefertigt*" (Grisebach 1971).
[52] Herz worked at that university from 1949 until 1994; he is now still listed as professor emeritus on the faculty website (FSU 1996).
[53] 1928-2007. Born in Scotland, Scott was educated at universities in Glasgow, London and New Haven. At the Imperial College London, Scott worked with the Nobel Prize laureate Derek Barton (Chemistry at Illinois 2011), who contributed to the "Zechmeister" with a report on the analysis of steroids in Vol. 19.

is willing to pay. He also put the blame for the four month delay on them (Grisebach 1971). What a delay in publishing means in the world of natural sciences becomes clear in a message from Herz to Dr. Schwabl from the Springer publishing house:

> *It appears to me that any further delay in publication of Volume 28 will be extremely damaging to the reputation of the series. I have already had a number of inquiries from authors of contributions who complain that their manuscripts will be quite out of date when the volume finally appears (Herz 1971²).*

The second drawback was the resignation of A. I. Scott from his position as coeditor. Zechmeister responded to that by writing that he had "been annoyed by Scott's resignation; he should have not accepted co-editorship in the first place" (Herz 1971[1]). Albeit the displeasure that Scott's withdrawal had caused, a compensatory editor was found quickly. Gordon William Kirby [54] from the Loughborough University of Technology in Leicestershire succeeded to the task. This professor for organic chemistry appeared to be a good choice since the other editors "wanted someone who works in England and is interested mainly in nitrogen compounds" (Herz 1971³).

Finally, in the early fall 1971, number 28 of the series was published. Zechmeister, as the founder, of course received a complimentary copy and believed that "Vol. 28 is in every respect excellent" and offered his sincere congratulations (Zechmeister 1971). As it had been custom in the years before, the Institute for Chemistry of the University of Pécs received a free copy as well.

In a preface to the volume, Zechmeister had the opportunity to have his say one last time. He wrote that he regretted that he had to ask the publishing house to relieve him from his duties due to his advanced age. In addition, he would miss the contact with the many scientists who had contributed to the series. Finally, he wished the

[54] 1934-2011; Kirby was a Barton student as well.

new editorial board much success and that they would enjoy the work with the authors and the increasing readership.[55] On the subsequent page, the new editors added a few lines themselves, emphasizing that they hoped "to emulate the example he has set and to maintain the high level of the Series in the future"[56].

[55] Cf. *Progress in the Chemistry of Organic Natural Products* Vol. 28
[56] As cited in the preface to *Progress in the Chemistry of Organic Natural Products* Vol. 28.

7. Progress in the Chemistry of Organic Natural Products – A closer look

The following chapter comprises a discussion of volumes 1 to 27 of the journal. A description of the articles published as well as of most of the contributors is provided.

7.1. Fortschritte der Chemie organischer Naturstoffe – Volume 1 (1938)

László Zechmeister succeeded in engaging well-known and outstanding masters in their fields of chemistry for the first issue of the journal. For the opening article, he was able to bring on board his fellow countryman Professor Dr. **Géza Zemplén** (1883-1956) from the Budapest University of Technology. The author discusses the newest approaches to the synthesis of glycosides, for instance, working with sugar, alcohol or acetohalogen compounds, as well as a certain mercury method. Zemplén had had joined research staffs in Berlin (working with Emil Abderhalden[57]) and also had become associated with Emil Fischer[58] at the same place. He was the founder of the first school for organic chemistry in Hungary and was researching glycosides and carbohydrates. Further achievements were the saponification method and an approach of how to decompose sugar (Simon 1998, p.225).

The second review, "The Component Glycerides of Vegetable Fats", was contributed by Professor **Thomas Percy Hilditch**, a professor at the University of Liverpool. We owe the knowledge we have today of the structure of fat in terms of

[57] 1877-1950; Abderhalden studied at the University of Zürich, received chemical education under Emil Fischer, and held the chair of physiology at the veterinary university Berlin and the chair for physiological chemistry at the University of Zürich. Even though he was not part of the NSDAP, he is attributed of being strongly in favor of the National Socialist's health policy (Stolberg-Wernigerode, 1953; and Koelbing 2002).

[58] 1852-1919; Fischer was the second person to be awarded the Nobel Prize in Chemistry in 1902 for his achievements in the syntheses of sugar and purine (The Nobel Foundation 1902).

glycerol esters and acids mainly to his researches during 1926 and 1951 (Gunstone 2003). As a matter of course, being in the midst of this research, his contribution to the "Zechmeister" in 1938 dealt with this certain field, explaining the isolation of glycerides from fats by crystallization and further quantitative studies of this substance.

The work reviewed in the third article is also credited to two British chemists, namely Professor **I. M. Heilbronn** from the Imperial College of Science and Technology London and Dr**. F. S. Spring** from the University of Manchester. Both held a chair of organic chemistry (Heilbronn in Liverpool and Manchester, Spring in Glasgow) and might have become acquainted during mutual time in Manchester (Nature 1938).Their contribution deals with the then recent advances in the chemistry of sterols, the field of expertise of both of them. They discuss the stereochemistry of the substance, as well as methods to oxidate and brominate it, and the occurrence of steroids in lower animals, especially in yeast.

Their elaboration is followed by a study about cozymase by Professor Dr. **Hans von Euler-Chelpin** and his co-worker Dr. **F. Schlenk** from the Institute of Biochemistry at the University of Stockholm. Their treatises include the biological implications of cozymase, its description and derivates. It was a great honor that Euler-Chelpin contributed to the first issue of the "Zechmeister", given that he had received the Nobel Prize in Chemistry nine years before (The Nobel Foundation 1929). Another review published in volume 1 was written by Dr. **Hellmuth Bredereck** and deals with the general importance of nucleic acids and the constitution of some nucleosides, nucleotides and polynucleotides.

László was for sure delighted that his friend **Arthur Stoll**, with whom he had studied under Richard Willstätter at the ETH in Zürich, also provided a glimpse into his

research about chlorophyll which he had undertaken together with Dr. **E. Wiedemann** at the Scientific Laboratory “Sandoz” in Basel, Switzerland.

There is also involvement of Austrian chemists in the first issue of the series. Dr. **Otto Kratky** and Professor Dr. **Hermann Mark** shared their achievements in the application of radiography in order to measure the shape and size of dispersed molecules in natural compounds. Kratky (1902-1995) studied at the University of Technology Vienna and received his doctorate degree in 1929. After World War II, he was appointed Professor of physical chemistry at the University of Graz (Stadt Graz 2012). Hermann Mark (1895-1992), who emigrated to the United States in 1938, was known for his essential accomplishments in polymer chemistry.

7.2. Fortschritte der Chemie Organischer Naturstoffe Volume 2 (1938)

The leading review was provided by **Karl Johann Freudenberg** (1886-1983) explaining various characteristics of lignin, a phenolic macromolecule found in wood (lat. *lignum*, therefore the name lignin). Freudenberg had worked with Emil Fischer in Berlin in earlier years, and also with Richard Willstätter in Munich. It is probable that Zechmeister became acquainted with Freudenberg through his former mentor. What is remarkable about this chemist, apart from his success in researching lignin and, is his resistance against the forced dismissal of Jewish university staff from 1933 onwards. In addition, as member of the Swedish Academy of Sciences, he was in charge of nominating scientific projects for the Nobel Prizes in Chemistry and Physics (Kipnis 2007).

Another article enriching the collection are Professor **Dr. Asahina**’s (University Tokyo) account on substances found in lichen describing various benzene-based compounds and compounds of the group of fats. It is followed by **Dr. H. Rudy**’s

review on flavins, where Rudy explains general characteristic, methods for their synthesis and their role as hydrogen-transferring co-ferments.

Professor **C. R. Harington**, from the University College Hospital Medical School London, shares his investigation of the chemistry of the iodine compounds of the thyroid, a field where he had established his reputation (Nature 1942). He was also member of the Biochemical Society and senior editor of the *Biochemical Journal* (Biochemical Journal 1943).

The fifth article in Volume 2 was contributed by **E. L. Hirst**, who held the position of professor at the University of Bristol. It is to assume that the co-editor Haworth arranged for this chemist to write a review, as they had published a work about the chemistry of carbohydrates and glycosides together in the *Annual Review of Biochemistry* in 1937 (Annual Reviews 2012). The paper in the "Zechmeister", however, contains information about the structure and synthesis of vitamin C and its analogues.

The next two contributions can be traced back to Hungary again. **Géza Zemplén** had his second chance to report about his research with sugar, this time focusing on the various ways for the synthesis of oligosaccharides. Naturally, also **László Zechmeister** could not refrain from sharing the results of his research about chitin and its cleavage products. This work was conducted together with **Géza Tóth**, a member of the scientific staff of Zechmeister's department at the University of Pécs. In the paper, they discuss the occurrence of chitin in plants and animals, its characteristics, and their analysis via radioscopy. It is also explained which intermediate products may be isolated and they also give a more detailed account about the d-glucosamine (or chitosamine).

Remarkably enough, this volume comprises papers from two of the editors of the journal. Professor Dr. **Ernst Späth**, together with **Dr. Kuffner** from the *II. Chemische Universitätslaboratorium Wien*, provided an account about alkaloids found in tobacco. Späth's scientific focus lay on alkaloids and his lifework comprises the clarification of the constitution of more than 120 plant compounds. He was also the first to synthesize ephedrine, which is delivered in cases of circulatory insufficiency and hypotonia, and mescaline, as mentioned before (Wilhelm-Exner-Medaillen-Stiftung 2012).

The closing article is devoted to the spectrochemistry of molecules in biological products leading to their fluorescent attributes. This work was contributed by **Charles Dhéré** (1876-1955), another genius in the field of chromatography. Fluorescence was his main field of interest, which resulted in the publishing of the book *La fluorescence en biochimie* in 1937 (Fritzsche 2011).

7.3. Fortschritte der Chemie organischer Naturstoffe – Volume 3 (1939)

The third volume of the series contains five articles, of which two were composed by Nobel Prize laureates. One of them**, Otto Diels** (1876-1954) from the University of Kiel and former student of Emil Fischer[59], opened this issue with an article about the role of the synthesis of diene on the formation, structure and research of natural compounds. This was indeed his field of expertise. In 1950, he received the Nobel Prize in Chemistry, together with his pupil Kurt Alder, for the development of the diene synthesis. It is probably one of the most productive reactions of organic chemistry, as it allows monounsaturated carbon compounds and compounds with conjugated double bonds to be coupled (Wieland 1957).

[59] 1852-1919; Fischer won the Nobel Prize in Chemistry in 1902.

Franz Gottwalt Fischer (1902-1960), a student of Heinrich Wieland, was Professor of Chemistry at the University of Würzburg (Kalb 2005, p.4). For the *Zechmeister*, he wrote a paper about biochemical hydrogenation dealing with the hydrogenation of the ethylene bond by yeast and bacteria and the hydrogenation of specific substances such as steroids or fatty acids.

The third article, written by university lecturer **W. Siedel** of the University of Technology Munich, treats various aspects about bile pigments. It is followed by a treatise about lipoids of the tubercle bacillus and other microorganisms by **Rudolph J. Anderson** (1879–1961), a Swedish-born professor at Yale University, who started as a laboratory boy with no money and family in America and therefore experienced rough years in his academic career. About ten years later than Otto Diels, he also admitted to Emil Fischer's laboratory, but due to overcrowding had to leave the group. From 1937 until 1959, he held the position of Managing Editor for the *Journal of Biological Chemistry* (Kresge et al. 2008).

The last article in Volume 3 was contributed by **Linus Pauling**, Zechmeister's American mentor. This work already indicated his major research interest, namely the electronic structure of molecules and the chemical bond with a focus on natural products. However, in the same year as this issue of the *Zechmeister* was released, Pauling also produced his well-known book about the nature of the chemical bond. Fifteen years later he would be awarded the Nobel Prize for exactly the same topic.

7.4. Fortschritte der Chemie organischer Naturstoffe – Volume 4 (1945)

The first article written by **Rudolf Tschesche** deals with the chemistry of herbal substances that are poisonous to the heart, toad venom, and saponins and alkaloids of the group of steroids. Tschesche (1905 -1981) habilitated at the university in Göttingen and worked at the *Schering AG* in Berlin and at the universities of Hamburg and Bonn. In addition, he was council at the Kaiser-Wilhelm-Institute for Biochemistry at Berlin-Dahlem, where Zechmeister had worked about twenty years before (Behrens 2012).

Subsequently, the reader will find an article by **Theodor Wieland**, together with Irmentraut Löw (the first woman to contribute to the *Zechmeister*). Theodor Wieland (1913-1995) was born to Heinrich Wieland, who was Nobel Prize laureate in Chemistry. Consequently, his son could look back on a good educational upbringing, and as his father, he developed an interest for biochemistry. He had worked as an assistant of Richard Kuhn in Heidelberg, before being appointed professor at the University of Mainz (Universität Frankfurt 2012). Together with Irmentraut Löw, who was working at the Max-Planck-Institute for Medical Research in Heidelberg, he contributed an account on the biochemistry of the vitamin B – group, focusing on pantothenic acid and vitamin B6.

The third article by **Robert Purrmann** (1914-1992) elaborates the topic of pterin, a pigment found in butterflies. He was son of the painter Hans Purrmann and studied at the University of Munich under Heinrich Wieland. His dissertation already dealt with the xanthopterins and leucopterins, and given the many years of research, he was an expert in this field. Purrmann is also known to have taken Jewish university staff under his wing during the Nazi-Regime, for instance, he employed a so called “half-Jewish” female assistant (Kraus 2008, p.334).

Gerhard Schramm submitted a nearly 100-pages long paper on different species of viruses, therefore, another biochemical review. This scientist (1910-1969) is classed among the pioneers in virology and in the field of genetics. As other contributors in Volume 4, Schramm was a student of Heinrich Wieland, as well as of Adolf Butenandt. When the latter moved to the Kaiser-Wilhelm-Institute for Biochemistry in Berlin-Dahlem, Schramm followed him, and some years later habilitated with his work about the biochemistry of viruses (Wikipedia 2012).

Further articles were contributed by **Karl Bernhard** and **Harold Lincke** with their voluminous account on biological oxidation, and by **H. J. Trurnit** reviewing monomolecular films on water interfaces.

7.5. Fortschritte der Chemie organischer Naturstoffe – Progress in the Chemistry of Organic Natural Products – Progrès dans la Chimie des Substances organiques naturelles - Volume 5 (1948)

The fifth issue of the Zechmeister contains eleven articles, of which two were written by Nobel Prize laureates. It also strikes the eye that five contributions were composed by scientists operating in California. Two colleagues of Zechmeister at the California Institute of Technology present a review on their research. One of them, **Arie Jan Haagen-Smit** (1900-1977) studied at the University of Utrecht, therefore, he was acquainted with Fritz Kögl, a former editor of the *Zechmeister*. In 1940, he was appointed professor for bio-organic chemistry at the Caltech. Haagen-Smit is also known to have contributed majorly to the research about smog and to be an advocate for the establishment of air pollution standards. The article in this issue, however, deals with azulenes, a topic which he had already treated in his doctoral dissertation in 1929 (World of Chemistry 2005; Havinga 1977). The second

author having a position at the Caltech was **George Wells Beadle** (1903-1989). Certainly, his article "Some recent developments in chemical genetics" entails a review about his field of expertise, for which he also received the Nobel Prize in Physiology and Medicine in 1958 (The Nobel Foundation 1958).

The opening article in this volume reviews epoxies and furanic oxides of carotenoids pigments. The account was delivered by **Paul Karrer** (1889-1971), a Swiss scientist who was awarded the Nobel Prize in Chemistry in 1937, therefore, eleven years before this issue was printed. Carotenoids were certainly his specialty. Karrer studied and worked at the University of Zurich. It is not known to the author of this thesis whether he knew László Zechmeister personally, even though they resided at Zurich at the same time, but at different universities (The Nobel Foundation 1937[2]).

Appositely to the predecessor text, **D. L. Fox** (University of California, La Jolla) present a study on carotenoids as well, but in this case, deal with biochemical aspects of marine carotenoids. Further Californian contributions were **W. Z. Hassid** and **Michael Doudoroff's** account on enzymatically synthesized polysaccharides and disaccharides (University of California, Berkeley), **E. Geiger's** review on the biochemistry of fish proteins (University of Southern California), and **R.S. Rasmussen**'s article on "*Infrared spectroscopy in structure determination and its application to penicillin*"(Shell Development Company Emeryville).

Thomas Percy Hilditch issued his second paper in this journal series, dealing again with component acids and component glycerides of natural fats which were his main subjects during these years. **Venancio Deulofeu** from the Facultad de Ciencias Exactas elaborated on Wieland's account (see Volume 4) on toad venom. Further treatises were **E. Pacsu's** review on the development in the structural

problem of cellulose (Princeton University) and **Friedrich Emil Brauns'** work on lignin (The Institute of Paper Chemistry Appleton).

7.6. Progress in the Chemistry of Organic Natural Products – Volume 6 (1950)

(For the purpose of simplification, only the English title of the series is used from now on, even though volumes 5 to 25 carry the French and German titles as well)

Harry James Deuel Jr. (1897-1956) and **S. M. Greenberg** of the University of Southern California open Volume 6 with their review on biochemical and nutritional aspects in fat chemistry. Zechmeister had composed various papers about vitamins together with Deuel in the years before, therefore, he was acquainted with him and his research. It is also reported that Deuel had a home in Pasadena which was "the mecca of biochemists who visited the Los Angeles area" (Kummerov 1956).

There are two Austrian contributions to Volume 6. **Edgar Lederer** (1908-1988) provided a glimpse into his study about scents and perfumes of animals. He received his PhD at the University of Vienna in 1930 and later worked with Richard Kuhn at the Kaiser-Wilhelm-Institute for Medical Research in Heidelberg. Due to the rise in power of the Nazis in Germany, Lederer emigrated to France and became a French citizen (Ettre 1979, pp.237f). He will be remembered for his pioneering work in chromatography, as the collaborative work of Kuhn, Lederer and Winterstein about xanthophylls (1931) marks the rediscovery of this investigative method.

The second Austrian contribution to this issue was delivered by biochemist **Otto Hoffmann-Ostenhof** (1914-1992), who obtained his doctorate at the University of Zurich under Paul Karrer. His article explains the distribution and biochemical

behavior of quinones. Indeed, he was greatly interested in molecular biology and biochemistry of plants. However, in Austria, Hoffmann-Ostenhof will also be remembered as one of the founders of the student resistance group “Tomsk” against the Nazi regime, which regularly assembled in the basement of the Chemical Laboratory of the University of Vienna (Karlson 1984; Bauer et al. 2005; and ÖH Uni Wien 2012).

Charles Dhéré of the Université de Genéve presented his second article in the *Zechmeister* with a continuation and elaboration of the first one about spectrochemical aspects leading to the fluorescence of natural compounds. Further reviews were submitted by Argentinean scientist **L. Reti** writing about alkaloids found in cactus plants and their related compounds, and **James Bonner** reviewing his study on plant proteins. Bonner (1910-1996) was an undergraduate student of Linus Pauling and was working at the biology division of the Caltech at that time. Moreover, he also studied and worked at the University of Utrecht and the ETH Zurich (with A. Frey-Wyssling), therefore, he was a colleague of Arie J. Haagen-Smit and George W. Beadle, and was also probably acquainted with László Zechmeister personally (Berry 1980).

7.7. Progress in the Chemistry of Organic Natural Products – Volume 7 (1950)

The first review about the constitution of triterpenes was written by **Oskar Jeger**, who was of Polish origin and professor for organic chemistry at the ETH Zurich (Weber 2010, p.269). Subsequently, the reader will find an account by **H. Heusser**, who was operating at the same university. His account treats the constitution, configuration and synthesis of aglycone found in foxgloves. There is a third article

written by Swiss-based scientists. Zechmeister's friend **Arthur Stoll** and **B. Becker** present their research about sennosides A and B, a field in which they worked together and published several papers[60] about.

László's colleague from the Caltech, **Carl Niemann**, submitted a treatise about thyroxine and its related compounds. Niemann (1909-1964) joined the Caltech faculty staff in 1937 and was appointed full professor in 1945. Through his research, he contributed to the advances in the understanding of enzymes in living cells (Hawley 2011[3]). Niemann also had a teaching position, therefore, he worked as instructor together with László Zechmeister in various courses. In 1940, for instance, they lectured "The Reactions of Organic Compounds" and "The Synthesis of Organic Compounds", and in 1942, they managed the "Advanced Organic Laboratory" (California Institute of Technology 1940; California Institute of Technology 1942).

A.H. Cook of *The Brewing Industry Research Foundation* in Nutfield discussed penicillin and its role in science. Cook worked together with British chemist Ian Heilbron (Chain 1946, p.110), who had already contributed to Volume 1 of the *Zechmeister.* The sixth and last paper in this issue was written by **John W. Williams**, professor of physical chemistry at the University of Wisconsin, who also worked together with Nobel Prize winner Theodor Svedberg (Holde 2008). It is a reflection about the latest developments in the chemistry of antibodies.

[60] See Stoll et al. 1950[1]; Stoll et al. 1950[2]

7.8. Progress in the Chemistry of Organic Natural Products – Volume 8 (1951)

Felix Haurowitz stated that, as its predecessors, this issue comprised a wealth of valuable reviews (Haurowitz 1953). The opening article “The Fine Structure of Cellulose” was composed by **Albert Frey-Wyssling** and his colleague **K. Mühlethaler**. In a letter to Frey-Wyssling, Zechmeister asked for his contribution to Volume 6. He expected a continuation to Pacsu’s paper about the structural problem of cellulose in Volume 5 (Zechmeister 1949). Indeed, Frey-Wyssling responded to László’s request and sent his article, which, according to Zechmeister, was “a wonderful work, which would give great pleasure to our readers” (Zechmeister 1950).

Two scientists of the *Second Chemical Institute* of the University of Vienna presented their work about alkaloids. **Friedrich Galinovsky**’s text treats alkaloids found in lupines, and **Matthias Pailer** (1911-2011), whose doctoral advisor was former editor Ernst Späth (Fleischhacker 2011), discussed alkaloids found in the *cephaelis ipecacuanha*. **Louis F. Leloir** (1906-1987), from Buenos Aires, reviewed sugar phosphates, a field of chemistry in which he would receive the Nobel Prize in 1970 (The Nobel Foundation 1970).

Haurowitz stated that “biochemists will be particularly grateful to **Robert Brainard Corey** for his contribution in which the evaluation of x-ray diagrams of amino acids and peptides is explained” (Haurowitz 1953). Corey had begun to study the structure of amino acids and small peptides together with Linus Pauling in 1930, a work that was conducive to Pauling’s findings about the chemical bond (Encyclopedia of World Biography 2012). As instructor at the Caltech, for instance, he taught courses on physical chemistry (California Institute of Technology 1942). In addition, he

worked with chromatographic methods and delivered a paper on the "Chromatographic Investigations of the Structure of Proteins" in 1954.

Further contributions were **M. Stacey** and **C. R. Ricketts'** account on bacterial dextrans (University of Birmingham), **G. W. Kenner's** article on the chemistry of nucleotides (Cambridge University), **H. Schinz**'s paper on violet odorants (ETH Zürich), and **Y. Asahina's** second paper in a *Zechmeister* delivering the newest developments in the field of lichens compounds (Research Institute of Natural Resources Tokyo).

The closing article was written by **László Zechmeister** himself, in collaboration with **Margarete Rohdewald** (1900-1994) from the University of Bonn. They reviewed some aspects about chromatographic analysis of enzymes. Rohdewald studied chemistry under Richard Willstätter and Heinrich Wieland in Munich, and obtained her doctorate under Richard Kuhn (Strohmeier 1998). After Willstätter had resigned from his duties as professor at the University of Munich in 1924, due to strong currents of anti-Semitism at the faculty, Rohdewald became his loyal assistant for many years (Robinson 1953). However, she was working at a small laboratory space made available by Wieland, and as Willstätter had sworn to never enter the campus area again, they mainly communicated via telephone (Berson 2003). When Willstätter emigrated to Switzerland in 1939, it was due to Arthur Stoll who tried to convince him of the urgency of this measure and later also helped him in this venture.[61] It was also Stoll who established the contact between Margarete Rohdewald and László Zechmeister, as he supported her being able to conduct research at the *California Institute of Technology*. Arthur Stoll emphasized in a letter to Zechmeister that he "would be glad if this most loyal disciple of Willstätter could be supported in utilizing her enormous experience, which she had acquired from our

[61] Cf. Willstätter 1958, p. 401

master, for scientific purposes" (translated[62] from Stoll 1948). In 1949, Margarete Rohdewald was permitted to work as research fellow at the *Gates and Crellin Laboratories* under Zechmeister, and the paper in Volume 8 of this series is a proof of their prolific collaboration (California Institute of Technology 1949).

7.9. Progress in the Chemistry of Organic Natural Products – Volume 9 (1952)

Hans Herloff Inhoffen and his colleague **H. Siemer** from the University of Technology Braunschweig opened up Volume 9 of the series with their article about the synthetic chemistry of carotenoids, a topic which Zechmeister himself was involved with to a large extent. Inhoffen (1906-1992) was a disciple of Adolf Windaus[63] and obtained his doctorate degree in 1931 under H. O. L. Fischer. From 1947 to 1950, he was head of the University of Technology Braunschweig, which is the oldest polytechnic university in Germany (Quinkert 2004).

Henry Borsook (1897-1984) delivered an account about the biosynthesis of proteins and peptides, including isotopic tracer studies. Borsook (1897-1984) was a graduate from the University of Toronto and was working as professor of biochemistry at the division of biology at the Caltech from 1935 onwards. His teaching focus lay on courses in the fields of biology and biochemistry (California Institute of Technology 1940). Two of his main fields of interest were the biochemistry of protein synthesis and human nutrition (Horowitz 1984, p.24).

[62] Original: *"und wäre froh, wenn man dieser treuesten Schülerin Willstätters helfen könnte, ihre grossen Erfahrungen, die sie von unserem Meister übernommen hat, wissenschaftlich zu verwerten".*
[63] 1876-1959; Windaus received the Nobel Prize in Chemistry in 1928.

Two further colleagues from Zechmeister at the –Caltech, **Dan Hampton Campbell** and **Norman Bulman** discussed current concepts in the chemical nature of antigens and antibodies. Campbell (1907-1974) was professor of immunochemistry and had been a faculty member of the Caltech for 32 years. Similarly to Zechmeister, this chemist also accepted a teaching position at the invitation of Linus Pauling in 1942. He was a pioneer in the field of antigen-antibody reactions, hence the article in this issue (Hawley 2011[2]). Further reviews that biologist would welcome were contributed by **P. Meunier** (Faculté des Sciences Lyon) writing about antivitamins, and **Herman Moritz Kalckar**'s article about the enzymes of the nucleoside metabolism (University of Copenhagen). Kalckar was appointed a Rockefeller Research fellow at the Caltech in 1939, and during his year of postdoctoral study, he became acquainted with Linus Pauling, who encouraged him to prepare a review on bioenergetics (Kennedy 1996).

Readers who are more interested in organic chemistry will find reports on the synthesis and properties of vitamin A and related compounds (**James G. Baxter** from the *Distillation Products Industries* Rochester), on recent investigations on ergot alkaloids (**Arthur Stoll**), on the alkaloids of plants of the group of *menispermaceae* (**M. Tomita** from the University of Tokyo), on naturally occurring coumarins (**F. M. Dean** from the University of Liverpool), and on nucleosides and nucleotides as growth substances for microorganisms (**W. S. McNutt**, from the School of Medicine Nashville).

7.10. Progress in the Chemistry of Organic Natural Products – Volume 10 (1953)

Volume 10 contains six articles, again written by masters in their fields. The first one explains the practice of the diene synthesis for the study of natural compounds written by **Kurt Alder** and **Marianne Schumacher** from the University of Cologne. Kurt Alder (1902-1958) had received the Nobel Prize in Chemistry three years before, together with his doctoral advisor Otto Diels. The Prize awarded the discovery and development of the synthesis (The Nobel Foundation 1950).

Another well-known specialist in his field of research, **Hermann Mark**, continued with an account about the chemistry of rubbers. Mark (1895-1992) had worked at universities and industrial laboratories and was “most influential in the phenomenal growth of the polymer industry” (Morawetz 1995). As Zechmeister, he also conducted research at the Kaiser-Wilhelm-Institute (1922-1926). Before his emigration to the United States, Hermann Mark had a position as professor at the University of Vienna (1932-1938), but was dismissed due to his friendship to Chancellor Engelbert Dollfuss, who had fought against the takeover of political affairs in Austria by the Nazis. Austrian-born chemist **Edgar Lederer** and his co-worker **Jean Asselineau** report about chemistry of lipids found in bacteria. Asselineau had already dealt with this topic in his doctorial thesis (Lederer 2007), and after 1947, Lederer had also focused on research about mycobacteria (Koertge 2008).

The forth review was contributed by **George Rosenkranz** (*1916), a pioneer in steroid chemistry, and **Franz Sondheimer** (1926-1981), who were both working at *Syntex S.A*. in Mexico city at that time. Sondheimer was appointed head of research after Carl Djerassi had retired from this position. The company was leading in

steroid production and research, therefore it is no wonder that they discuss the syntheses of cortisone in this article (Jones et al. 1981, p.506).

Asima Chatterjee's report provides a more detailed look at alkaloids found in rauwolfia plants. Chatterjee (1917-2006), a chemist from the University College of Science and Technology Calcutta, was the first woman to obtain a doctorate degree in India. Being interested in natural product chemistry, she personally worked together with László Zechmeister at the Caltech (1948-1949) carrying out investigations about carotenoids and provitamins (Pakrashi 2007). The concluding article was written by **L. Feinstein** and **M. Jacobson** from the *United States Department of Agriculture*, dealing with insecticides that occur in higher plants.

7.11. Progress in the Chemistry of Organic Natural Products – Volume 11 (1954)

The eleventh volume of the series is again of great interest for biochemists.
Stanley Peat from the University College of North Wales made the start by explaining various aspects of starch, such as its constitution, enzymic synthesis and degradation. Peat (1902-1969) was a disciple of Sir Norman Haworth. He contributed to our knowledge about the carbohydrate group (Hirst et al. 1970).

Already known to readers was **Karl Freudenberg** (University of Heidelberg) who reported on the latest results in the research of lignin and lignifications, a topic which he had introduced in Volume 2 of the series. Another familiar chemist, **Hans Inhoffen** discussed problems and the latest results in the chemistry of the vitamin D, together with his colleague **K. Brückner**. The forth contribution to this issue dealt with naturally occurring chromones by **Hans Schmid** from the University of Zürich.

These reviews are followed by two papers from the California Institute of Technology. **Linus Pauling** and **Robert B. Corey** explain the configuration of polypeptide chains in proteins. Their colleague, **Walter A. Schroeder**, examined proteins by means of column chromatography, and hence, he presented a different approach to this subject. Schroeder obtained his PhD at the Caltech in 1943 and worked as a research associate at the time the article was published (California Institute of Technology 1957).

Max Rudolf Lemberg (1896-1975) was a Polish biochemist who had worked at universities in Munich (1915) and Heidelberg (1916). From 1935 onwards he worked as director of the biochemical laboratories at the Royal North Shore Hospital in Sydney. In this issue of the *Zechmeister*, he gave an account on the progress in the chemistry and biosynthesis of porphyrins (Bhathal 2000). This review is followed by another Australian contribution. **Adrien Albert** (1907-1989) from the Australian National University Canberra reported on pteridines. Albert was a medical chemist, and was appointed the first professor of chemistry in the John Curtin School for Medical Research at the Australian National University (Brown 2007).

7.12. Progress in the Chemistry of Organic Natural Products – Volume 12 (1955)

In a review published in 1956, Felix Haurowitz stated that this issue was “one of the best of this valuable series of progress reports” (Haurowitz 1956). The first four articles treat terpenes and their derivatives. **A.J. Haagen-Smit** (Caltech) presented his research on sesquiterpenes and diterpenes, **E. R. H. Jones** and **T.G. Halsall** (University of Manchester) discussed tetracyclic triterpenes, **Rudolf Tschesche** (University of Hamburg) reported on the biosynthesis of steroids and its related

compounds, and **F. T. Haxo** (University of California) explained some biochemical aspects of fungal carotenoids. As a response to Schroeder's account in Volume 11, **E. O. P. Thompson** and **A. R. Thompson** from the *Wool Textile Research Laboratories Melbourne* reported on the practice of paper chromatography in the study of the structure of peptides and proteins.

Karl Heinrich Slotta (1895-1987) contributed with his review on the chemistry of snake venoms. Slotta was a German biochemist, who is also considered one of the developers of birth control pills. In addition, he was one of the many scientists who had to flee Germany and emigrated to Brazil because of the rising power of the Nazis (Hawgood 2000).

In addition to all these reviews, Volume 12 also contains a report by **F. L. Warren** (University of Natal) about pyrrolizidine alkaloids, by **Jean Roche** and **Raymond Michel** (Collège de France) about the properties of iodinated amino acids, and by **George W. Beadle,** who allowed another insight into his research on genes, more precisely on gene structure and gene action.

7.13. Progress in the Chemistry of Organic Natural Products – Volume 13 (1956)

In the first of the articles of Volume 13, **Andrew R.H. Cole** (*1924), from the University of Western Australia described infrared spectra of natural products. Cole had been educated at the University of Oxford and the Massachusetts Institute of Technology, USA. He was also Dean of the Faculty of Science (1975-1977) and

Head of the Department of Physical and Organic Chemistry at the University of Western Australia (National Library of Australia 2012).[64]

The chemistry of gallotannins and ellagentannins was discussed by **O. Th. Schmidt** from the University of Heidelberg. He was known to be an expert in the field of ellagentannins (Universität Heidelberg 2002). This review was followed by an account by **Christoph Tamm** (*1932) from the University of Basel about recent investigations of glycosidic heart poisons. Tamm habilitated under Tadeusz Reichstein[65] and also worked at *Sandoz AG*. In addition, he was known for his position as Rector of the University of Basel from 1977 to 1979 (Universität Basel 2012).

Tetsuo Nozoe (1902-1996) from Tohoku University contributed with a review on natural tropolones and related troponoids. Nozoe was a specialist in the field of troponoid chemistry, a field in which he continued research many years after his retirement in 1966 (Asao et al. 2004). **Asima Chatterjee** provided a further review on rauwolfia alkaloids together with co-writers **Satyesh C. Pakrashi** (University of Calcutta) and **G. Werner** (University of Sao Paulo). Pakrashi (*1930) received his PhD for this subject from Calcutta University in 1954. Afterwards, he conducted postdoctoral research with Carl Djerassi at Wayne State University (Indian National Science Academy 2012). Further reports were contributed by **J. R. Price** (Commonwealth Scientific and Industrial Research Organization Melbourne) about alkaloids related to anthranilic acid, and by **Wolfgang Grassmann** and **Erich Wünsch** (Max-Planck-Institute of Protein and Leather Research Regensburg) about the syntheses of peptides. Grassmann was a disciple of Willstätter and Wieland, and was director of the institute at that time (Brocke et al. 1996).

[64] 1971-1973; 1987-1989
[65] 1897-1996; Reichstein was a Swiss chemist and botanist.

7.14. Progress in the Chemistry of Organic Natural Products – Volume 14 (1957)

The first article was written by **Ferdinand Bohlmann** and **H. J. Mannhardt** from the University of Technology Braunschweig, and dealt with acetylene compounds in the plant kingdom. Bohlmann worked with Hans Brockmann and Hans H. Inhoffen (both contributed to the *Zechmeister* as well), and his field of interest lay in the isolation, structural clarification and synthesis of natural compounds, especially terpenes and polyynes (Technische Universität Berlin 2004). His teacher **Hans Brockmann** (1903-1988) from the University of Göttingen contributed to this issue with a review on photosensitizing plant pigments. Brockmann worked as a research assistant of Adolf Butenandt and found recognition for his work with antibiotics (Beer 1996).

The biosynthetic relations of natural phenolic and enolic compounds were reviewed by **Arthur John Birch** (1915-1995) from the University of Manchester. He is remembered for the reduction of aromatic compounds by using solutions of sodium and ethanol in liquid ammonia, the so-called *Birch reduction* (Rickards et al. 2007).

Harrison Scott Brown (1917-1986), who was professor for geochemistry at the Caltech, explained in his article the carbon cycle in nature, namely the equilibration of terrestrial, oceanic, and atmospheric carbon (Revelle 1994). The reader will also find reviews by **Harry Sobotka, Norman Barsel**, and **J. D. Chanley** (Mount Sinai Hospital, New York) about aminochromes, an article by **R. A. Morton** and **G. A. J. Pitt** (University of Liverpool) about visual pigments, and the continuation of **Christoph Tamm**'s first article in Volume 13 about glycosidic heart poisons.

7.15. Progress in the Chemistry of Organic Natural Products – Volume 15 (1958)

Volume 15 is made up of four reviews and was introduced by **Hans Heinrich Schlubach** from the University of Hamburg. His article describes the carbohydrate metabolism in grasses. Schlubach (1989-1975) had worked as an assistant of Hermann Staudinger[66] at the ETH Zürich in 1913 to 1914 (Behrens 2011). The second report was composed by **László Zechmeister**. Zechmeister discussed conversions of naturally occurring carotenoids brought about by the action of bromosuccinimide or boron trifluoride. **J. L. Hartwell** and **A. W. Schrecker** of the *US Department of Health* continued by describing the chemistry of podophyllum. The last contribution of this issue was submitted by **Dorothy Crowfoot Hodgkin** (1910-1994) from the University of Oxford. Hodgkin's article "X-ray analysis and the structure of vitamin B12" provided an overview over a topic which engaged her for many years and for which she gained the Nobel Prize in Chemistry in 1964 (The Nobel Foundation 1964).

7.16. Progress in the Chemistry of Organic Natural Products – Volume 16 (1958)

The first three articles in Volume 16 treat the structure of organic natural products. **Karl Freudenberg** and **Klaus Weinges** (University of Heidelberg) report on catechine, and derivatives of hydroxylated flavans. Weinges received his doctorate degree in 1954 under Freudenberg, and held the position as professor from 1968 until his retirement in 1992 (Arbeitsgruppe Prof. Dr. K. Weinges 2012).

[66] 1881-1965

Two chemists of the University of New Brunswick in Canada presented their results in the study of the chemistry of the aconite-garrya alkaloids. **Karel Wiesner** (1919-1986) was a native of Prague and studied organic chemistry under Vladimir Prelog at the ETH Zürich. In 1948, he became professor at the University of New Brunswick (UNB Archives 2001[1]). **Zdenek Valenta** (*1927) has a similar curriculum vitae, as he was born in Czechoslovakia as well and attended the ETH Zürich from 1946 to 1950. He commenced his studies under Wiesner and became full professor in 1963 (UNB Archives 2001[2]).

Eugene E.van Tamelen contributed the third article to Volume 16. His article discussed the structural chemistry of actinomycetes antibiotics. Van Tamelen (1925-2009) studied and worked at Harvard, the University of Wisconsin and at the Stanford University. He was known for his biomimetic approach to the synthesis of organic natural compounds (Stanford University 2009).

The last two contributions were made of chemists that were both active in Pauling's laboratory at the Caltech for some time. **James Bonner** reported on the protein synthesis in plants, and **Hans Kuhn** presented the electron gas theory of the color of natural and artificial dyes. Kuhn (*1919) studied at the ETH Zürich and at the University of Basel. In 1946 to 1947 he conducted postdoctoral research in Pauling's research group. He was appointed full professor for physical chemistry at the University of Marburg in 1953 (Theoretical Chemistry Genealogy Project 2012).

7.17. Progress in the Chemistry of Organic Natural Products – Volume 17 (1959)

Volume 17 of the series was published in 1959, after László Zechmeister had retired from his duties as professor, but was still active as professor emeritus. It contains eight articles. **Krishnaswami Venkataraman** (1901-1981) from the National Chemical Laboratory Poona introduced his research about flavones and isoflavones. In 1957, he was appointed the first Indian Director of the National Chemical Laboratory. One of his main contributions was the development of the synthesis of flavonoids, which was named the *Baker-Venkataraman reaction* (Nagendrappa 2004).

A scientist who is already familiar to readers of the *Zechmeister* and who is a pioneer in the field of vitamin D derivatives, **Hans H. Inhoffen,** submitted an account about the progress in the chemistry of vitamin D and its derivatives together with colleague **K. Irmscher**. This account is followed by a presentation of **Friedhelm Korte, H. Barkemeyer** and **I. Korte** from the University of Bonn. They report on the recent results in the chemistry of botanical bitter constituents. Friedhelm Korte (*1923) studied at universities in Freiburg and Marburg, and is considered to have originated the field of environmental chemistry (News Analytik 2004).

Both **Walter A. Schroeder** (Caltech) and **Hans Kuhn** (University of Marburg) contributed to the series a second time in this volume. Schroeder reviewed the chemical structure of human hemoglobins, and Kuhn provided a continuation to his first article about the electron gas theory of the color of natural and artificial dyes, with a focus on applications and extensions.

Albert E. Dimond allowed a glimpse into his research about biochemical aspects of disease in plants. Dimond (1914-1972) was especially concerned with plant pathology and chemotherapy. He was working at the *Connecticut Agricultural Experiment Station* New Haven since his graduation in 1939 (Rich 1973).

Philip Hauge Abelson (1913-2004) of the *Carnegie Institution of Washington* contributed a report on paleobiochemistry and organic geochemistry. Being a scientist of many talents, he had studied chemistry and physics, and received his PhD in nuclear physics in 1939. From 1962 to 1984, he was editor of the well-known journal *Science* (Gibbons 2005).

Botanist and forestry expert, **Bruce B. Stowe**, from Harvard University, provided an account on the occurrence and metabolism of simple indoles in plants. Stowe (1928-2003) attended the *California Institute of Technology* after the war, where he graduated with honors. He taught plant physiology and biochemistry at Harvard University and at Yale University (Yale University 2003). The last paper of this volume was written by **K. Bernauer** from the University of Zürich and dealt with alkaloids of curare and South American strychnos types.

7.18. Progress in the Chemistry of Organic Natural Products – Volume 18 (1960)

Volume 18 includes nine papers of already familiar scientists and some, who had not yet contributed. The first article was composed by **Hans Brockmann** (University of Göttingen) and covered the subject of actinomycine. It is followed by a report by **Matthias Pailer** (University of Vienna) about naturally occurring nitrogen compounds. **Nguyen van Thoai** and **Jean Roche** (Collège de France) provided an

account about guanidine derivatives. **Andreas Kjaer** reviewed the topic of naturally derived isothiocyanates (of mustard oils) and their parent glucosides. As Zechmeister had done many years before, Kjaer was working at the Royal Veterinary and Agricultural College Copenhagen.

The reader will find two papers dealing with carotenoids. **Otto Völker** from the Justus Liebig University in Gießen provided a review about the pigments in the feathers of birds. Dyestuffs in feathering were Völker's specialty. The second paper was written by **László Zechmeister** and described a wealth of cis and trans isomeric carotenoids found in pigments. A team of three, **P. W. Brian, John Frederick Grove** (1921-2003), and **Jake MacMillan**, from the *Akers Research Laboratories* discussed the chemistry and occurrence of gibberellins, as well as their effects on plant growth and development. **J. W. Williams** from the University of Wisconsin treated selected subjects in sedimentation analysis with some applications to biochemistry.

Another author, **Michael Heidelberger** (1888-1991) received university education at Columbia University and obtained his PhD in 1911. He also spent a postdoctoral year at the ETH in Willstätter's laboratory and, considering the time and place, it may well be that he became acquainted with Zechmeister back then. In addition, he worked with Karl Landsteiner, who was a well-known immunologist (Eisen 2001, p.4-5). The paper that Heidelberger contributed to Volume 18 covered the structure and immunological specificity of polysaccharides.

7.19. Progress in the Chemistry of Organic Natural Products – Volume 19 (1961)

František Šorm was the first scientist to present his research about medium-ring terpenes in Volume 19 of the *Zechmeister*. Šorm (1913-1980) was president of the Czechoslovak Academy of Science from 1962 until 1969 and Director of the Institute of Organic Chemistry and Biochemistry. Even though, he was a convinced Communist, he voted in Parliament against the Soviet occupation of the country, which cost him his position as president and made his academic career much more difficult (Garfield 1992).

Leslie Crombie from King's College London and his former fellow student and friend **Michael Elliott** (1924-2007) from the Department of Insecticides and Fungicides Herts reported on their collaborative work about the chemistry of the natural pyrethrins. Leslie Crombie (1923-1999) completed his PhD in 1948 dealing with exactly this topic, which also remained his lifelong project. He was appointed to an assistant lectureship at the Imperial College, and worked under D. H. R. Barton, who held the position of professor of organic chemistry (Pattenden 2001). The aforementioned Nobelist **Derek Harold Richard Barton** (1918-1998) contributed to this issue as well. Together with G. A. Morrison from the Imperial College of Science and Technology, he described conformational analysis of steroids and related natural compounds. Barton had introduced conformational analysis to the world of chemistry, and showed the relationship between conformation and configuration of molecules and the resulting chemical and physical properties. In 1969, Barton received the Nobel Prize in Chemistry for his contributions to the concept of conformation (The Nobel Foundation 1969).

Jean-Emile Courtois and **Andréa Lino** of the Faculté de Pharmacie de Paris provided an account about the distribution and action of phosphatases in higher plants. Courtois (1907-1989) studied pharmacy at university, as it was tradition in his family. He will be remembered for his work with sugars and enzymology. He was not only very active in his scientific life, but also displayed courage by hiding members of the resistance against the German occupation during the Second World War (Percheron 1990).

Further progress reports were delivered by already familiar authors**: Eugene E.van Tamelen** (University of Wisconsin) described biogenetic-type syntheses of natural products; **Hans H. Schlubach** (University of Munich) provided a continuation to his article about the carbohydrate metabolism, focusing on rye and wheat; and **Tetsuo Nozoe** and **Sho Ito** (Tohoku University) discussed the recent advances in the chemistry of azulenes and natural hydro-azulenes.

7.20. Progress in the Chemistry of Organic Natural Products – Volume 20 (1962)

The twentieth issue of the series includes ten articles. **J. H. Birkinshaw** and **C. E. Stickings**, from the London School of Hygiene and Tropical Medicine, break the ground and report about nitrogen-containing metabolites of fungi. The second article was contributed by **Karl Freudenberg** (University of Heidelberg), who provided an insight into his further research about lignin. The Swiss chemist **O. Schindler** (Research institute *Dr. A. Wander AG* Bern) continued by discussing the ubiquinone, especially the coenzyme Q. The forth article by **Walter B. Mors, Mauro T. Magalhaes** and **Otto R. Gottlieb** from the Instituto de Quimica Agricola Rio de Janeiro reviewed naturally occurring aromatic derivatives of monocyclic α –pyrones.

Otto Richard Gottlieb (1920-2011) was born in Brno, Czechoslovakia, but emigrated to Brazil. He obtained a degree in industrial chemistry, and joined the Instituto de Quimica Agricola in 1955, where he could pursue his interests in phytochemistry (Bolzani et al 2004).

Jeffrey Barry Harborne (John Innes Institute Bayfordbury) provided an account about anthocyanins and their sugar components. Harborne (1928-2002) was a major contributor to the discipline of phytochemistry. He had studied at the University of Bristol, and had taken up a postdoctoral fellowship at the University of California, before he came to the John Innes Institute, where his research of the anthocyanins began (Prebble 2010).

Two fellow researcher from the California Institute of Technology, **John E. Hearst** and **Jerome Vinograd**, report about equilibrium sedimentation of macromolecules and viruses in a density gradient. Hearst was born in Vienna (*1935), but grew up in the United States, after the family had emigrated in 1938. He joined the Caltech faculty in 1962, and became acquainted with Vinograd of whom he spoke highly (UC Berkeley 2012). Jerome Vinograd (1913-1976) studied at universities in Europe and the United States and became a Caltech faculty member in 1951. In 1966 he was appointed professor for chemistry and biology. He was best known for his theory and application of the density gradient ultracentrifugation, and achievements in the study of closed circular DNA rings (Sinsheimer 2007).

Another Caltech fellow who was professor of biology, **Norman Harold Horowitz**, conducted research about the origins of life, together with specialist **Stanley l. Miller** from the Scripps Institution for Oceanography La Jolla. Miller (1930-2007) was best known for an experiment he conducted in 1953 with Harold Urey. They simulated

the original atmosphere at the early beginnings of our planet and showed how amino acids could develop from this primeval soup of gases (Wade 2007).

Further contributions to Volume 20 were submitted by **Gerhard Baschang** (Max-Planck-Institute for Medical Research Heidelberg) about the occurrence and synthesis of aminosugars in natural products, by **Karel Wiesner** (University of New Brunswick) about the structure and stereochemistry of the lycopodium alkaloids, and by **C. R. Narayanan** (National Chemical Laboratory Poona) about the latest developments in the field of veratrum alkaloids.

7.21. Progress in the Chemistry of Organic Natural Products – Volume 21 (1963)

The 21st Volume of the Zechmeister was introduced by **James Bonner** from the Caltech, who had already contributed to this series twice. His article dealt with the biosynthesis of rubber. It was then followed by **W. Oroshnik** (Central Research Laboratory Shulton) and **A. D. Mebane's** (Ortho Research Foundation Raritan) account about polyene antifungal antibiotics.

German-born **Hans Muxfeldt** and **R. Bangert** from the University of Wisconsin discussed the chemistry of tetracycline. Muxfeldt had received his doctorate from the University of Göttingen and had taught at the University of Technology Braunschweig, before joining the University of Wisconsin in 1961 (University of Wisconsin 1964). The following paper was **Hans Brockmann's** third contribution to the series. He discussed the group of anthracyclins, such as rhodomycinons, pyrromycinons and its glycosides. **Lothar Jaenicke** and **C. Kutzbach** (University of Cologne) provided an account about folic acid. Jaenicke's (*1923) main fields of

research were enzymology and biosynthetic group transfers (AWK 2012). The last article in this volume was delivered by **Leslie Crombie** (King's College) and treated the chemistry of the natural rotenoids.

7.22. Progress in the Chemistry of Organic Natural Products – Volume 22 (1964)

The first article in this Volume was contributed by **Kurt Schaffner** from the ETH Zürich. His article discussed the photochemical transformation of selected natural compounds. Schaffner (*1931) studied and worked at the ETH for many years, and his main research interest covered the fields of photobiophysics and photobiology (MPI 2012). Another contribution from the ETH Zürich was delivered by **W. Keller-Schierlein, Vladimir Prelog** and **H. Zähner** with their article about siderochromes. **Gerhard Billek** (1925-2004) from the University of Vienna reported on stilbene in the plant kingdom. **T. G. Halsall** provided a further account to his paper on triterpenes (published in Volume 12) by discussing the pattern of development together with **R. T. Aplin** (University of Oxford). **John Frederick Grove** (1921-2003) from the London School of Hygiene and Tropical Medicine presented his study on the antifungal drug griseofulvin and some of its analogues.

A pioneer in the investigation of marine natural products, **Paul J. Scheuer** from the University of Hawaii, described the chemistry of toxins isolated from marine organisms. Scheuer (1915-2003) was born in Germany, but had to flee during Hitler's dominance because of its Jewish heritage. He joined the chemistry department of the University of Hawaii in 1950, after he had studied at the Northeastern University and at Harvard (Lum 2003).

7.23. Progress in the Chemistry of Organic Natural Products – Volume 23 (1965)

A specialist of the carbohydrate group **Stanley Peat** and his colleague from the University College of North Wales **J. R. Turvey** introduced Volume 23 with their paper about polysaccharides of marine algae. Another familiar face to the readers of the *Zechmeister* **Hans H. Schlubach** (University of Munich) provided an additional review of his study on the carbohydrate metabolism, focusing on barley, oats and proso millet.

German-born **Fritz Schlenk** from the Argonne National Laboratory Illinois described the chemistry of biological sulfonium compounds. Schlenk (1909-1998) received his PhD in 1934 in Berlin. His doctorate advisor was his father Wilhelm Schlenk who faced many problems in his academic career due to his loyalty to Jewish scientists, such as Haber, Willstätter, and Bergmann. In 1940, Fritz emigrated to the United States and pursued a career at the University of Illinois (Tidwell 2001).

Another sedulous contributor to the series, **Walter A. Schroeder** presented the results of his collaborative work with **Richard T. Jones** from the University of Oregon Medical School. Their paper discussed some aspects of the chemistry and function of human and animal hemoglobins. Jones (*1929) worked at the California Institute of Technology from 1957 to 1961 in order to gain his PhD. His areas of expertise were hemoglobins and protein chemistry (Oregon Health & Science University 2012).

In addition, **Wolfgang Grassmann** and five co-workers **J. Engel, K. Hannig, H. Hörmann, K. Kühn**, and **A. Nordwig** (Max-Planck-Institute of Protein and Leather Research Munich) report on collagen, and **Lloyd Miles Jackman** (University of

Melbourne) provided a description of some applications of nuclear magnetic resonance spectroscopy in natural product chemistry.

7.24. Progress in the Chemistry of Organic Natural Products – Volume 24 (1966)

The opening article of Volume 24 was contributed by the Austrian chemist **Klaus Biemann**. He was born in 1926 in Vienna and earned his PhD in organic chemistry at the University of Innsbruck. However, as so many other Austrian scientists, Biemann moved to the United States and continued to pursue his career at the MIT from 1955 onwards. Biemann is a pioneer in the development of mass spectrometry, and naturally his article in the *Zechmeister* covered mass spectrometry of natural products. Another Austrian contribution was made by the biochemist **Helmut Kindl** and **Otto Hoffmann-Ostenhof** from the University of Vienna. Kindl (*1936) studied and worked in Vienna and Marburg. His main fields of research were the syntheses of cyclites in plants and the metabolism of aromatic amino acids in plants (Feußner et al. 2006). As a matter of course, the article published in this issue dealt with the biosynthesis, metabolism and occurrence of cyclites.

H. Erdtman from the Royal Institute of Technology and **Torbjörn Norin** (*1933) from the Swedish Forest Products Research Laboratory[67] reported on the chemistry of the order cupressales. Norin held the position as Director of Research and Head of the Chemistry Department of the STFI from 1966 to 1972. Since then he has had great influence on the chemical landscape in Sweden and served on boards of various organization (Bohlin et al. 2008).

[67] Short: STFI

Heinz Fraenkel-Conrat (1910-1999) discussed some aspects of virus chemistry in his contributions. Fraenkel-Conrat received his MD from the University of Breslau, but he was forced to leave the country due to Hitler's rise in power in Germany. He had left for Scotland and had earned his PhD degree at the University of Edinburgh, before he joined the University of California in 1952. Fraenkel-Conrat was the first scientist to dissemble and rebuild a virus out of its constituents, and his most important discovery was that the nucleic acid core of each virus particle contains the information that controls virus reproduction (Scalise 1999).

Further papers in Volume 24 are **Rudolf Tschesche**'s second contribution to a Zechmeister reporting on steroids with 21 carbon atoms in plants, **Alan B. Turner**'s account on quinine methides in nature (University of Aberdeen), and **F.L. Warren**'s paper on the pyrrolizidine alkaloids (University of Cape Town).

7.25. Progress in the Chemistry of Organic Natural Products – Volume 25 (1967)

The opening article of Volume 25 was written by **Ferdinand Bohlmann**, who had already contributed to Volume 14. His paper discussed the biogenetic relations of natural acetylene compounds. The subsequent paper provided an account of the chemistry of hop resins by **Philip R. Ashurst** from the *Brewing Industry Research Foundation* Nutfield. A graduate in the chemistry of natural products from the Imperial College London, Ashurst's fields of expertise are food science and microbiology, and he is still working with these matters, mainly performing consultations of the technical, financial and legal kind to beverage industries worldwide (ExpertSearch 2012).

Jesús Romo Armería (1922-1977) and his co-worker **Alfonso Romo de Vivar** (*1928) from the Universidad Nacional Autonoma de Mexico described the pseudoguaianolides. Armería's most prominent achievement was the development of a cost-efficient method to synthesize the female estradiol and progesterone from the *dioscoreas*. In addition, he worked at the *Syntex* company, where he conducted research together with George Rosenkranz, Carl Djerassi, and others (Olivares 2007).

The collaborative work about the chemistry of hashish was presented by **Raphael Mechoulam** (*1930) from the Hebrew University Jerusalem and **Yehiel Gaoni** from the Weizmann Institute of Science. In 1964, they isolated tetrahydrocannabinol, which would become known as a drug under the name of THC. Professor Mechoulam worked at the Department of Medicinal Chemistry and Natural Products and was former Rector of the university. He published an extensive amount of papers about cannabinoids and their pharmacological activities (Hebrew University of Jerusalem 2008).

Two disciples of Géza Zemplén (TU Budapest 1998), **Loránd Farkas** and **László Pallos** from the University of Technology Budapest, provided a review about naturally occurring auronglycosids. Readers that are interested in nonadrides, especially glauconic acid, glaucanic acid and byssochlamic acid will enjoy the article written by **J. K. Sutherland** from the Imperial College of Science and Technology London. **Theodor Wieland**, who had already contributed an article to an earlier issue, focused on the toxic principles of the *amanita phalloides*, a species of fungus. Further studies covered the plant storage glycol-protein prolamin (**E. Waldschmidt-Leitz** and **H. Kling** from the Institute for Experimental Biology Baden) and presented an extension on conformational analysis of selected alkaloids (**G. A. Morrison**).

7.26. Progress in the Chemistry of Organic Natural Products – Volume 26 (1968)

Volume 26 comprises eight articles, of which three were composed in the German language and five in English. The first article addressed the subject of x-ray diffraction in relation to crystalline amino acids, peptides and proteins. Its authors, **Robert Brainard Corey** and **Richard Edward Marsh**, were both active at the Caltech. In 1968, Marsh was working as senior research fellow at the department of chemistry, and Corey, after his retirement, still remained active as one of the five professor emeriti, just as László Zechmeister did (California Institute of Technology 1968).

There is also a contribution made by scientists from private industrial firms. **E. Schröder** and **K. Lübke,** who were working at the German pharmaceutical company *Schering AG* in Berlin, report on methods how to synthesize peptides and on syntheses of active ingredients based on peptides. The reader will also find a review of a project performed at another pharmaceutical company. **K. Bernauer** and **W. Hofheinz** from the *F. Hoffmann-La. Roche and Co*. Basel published results of their study on proaporphine alkaloids.

Anthony C. Trakatellis and **Gerald P. Schwartz** delivered a report on another non-university project. They were conducting research on hormones at the *Brookhaven National Laboratory* New York[68], and their article focused on the structure, the chemical synthesis and biosynthesis of insulin. **David L. Dreyer**, a scientist from another departmental institution, namely the *Fruit and Vegetable Chemistry*

[68] The laboratory belongs to the US Department of Energy.

Laboratory Pasadena[69] provided an account on the chemistry of limonoid and further aspects, such as biological properties and botanical distribution.

Two chemists from the ETH Zürich, **W. Keller-Schierlein** and **H. Gerlach**, provided a review on their work with macrotetrolids, especially describing the constitution of nonactin and its analogues, the stereochemistry and the biological effect of this group. Furthermore, the very productive contributor to the *Zechmeister*, **Hans H. Inhoffen** allowed an insight into his collaborative research with **Johann Walter Buchler** and **P. Jäger** at the Technical University Braunschweig. They described the chemistry of chlorin and porphyrin concerning aspects about chlorophyll as well as porphyrins in general. Today, Buchler works as professor emeritus at the University of Technology Darmstadt, and together with his research group studies the coordination chemistry of metal poryphyrins (Wannowius 2003). The last paper in Volume 26 was submitted by **Dieter Dütting** from the Max-Planck-Institute for Virology[70] in Tübingen and presented methods and results on the sequence analysis of the ribonucleic acids.

7.27. Progress in the Chemistry of Organic Natural Products – Volume 27 (1969)

The last volume of the *Zechmeister* which was produced with László Zechmeister as editor comprises a mix of articles by new names as well as already familiar chemists who have contributed studies to the series before. At the beginning, the reader will find a review of the Swiss botanist **Albert Frey-Wyssling** on the ultrastructure and biosynthesis of cellulose, and he also included a glossary of cytological, histological and crystallographic terms. In the second chapter, ethylene expert **Mary Spencer**

[69] The laboratory belongs to the US Department of Agriculture.
[70] Today: Max-Planck-Institute for Developmental Biology

from the University of Alberta discussed the metabolism and physiological activity of ethylene in nature. Spencer is professor emeritus of plant biochemistry and physiology, and has acted as a role model for female scientists in Canada for many years (University of Alberta Alumni Association 1990).

Basil Charles Leicester Weedon (1923-2003) was professor of organic chemistry at Queen Mary College London. Weedon gained his PhD degree under the joint supervision of I. M. Heilbron and E. R. H. Jones and had been working alongside other talented scientists as Derek Barton or Franz Sondheimer. In 1960, he conducted a collaborative study with Lloyd Miles Jackman and used proton magnetic resonance spectroscopy to study the structural and stereochemical properties of natural carotenoids. Throughout the 60s and 70s, Weedon and his research group were able to clarify the structure of a wide range of carotenoids pigments. Hence, the article in Volume 27 of the Zechmeister was a progress review about the elucidation of the structure of carotenoids by means of various spectroscopic methods (Pattenden 2005).

The forth review was contributed by **Georgine M. Sanders**, **J. Pot and Egbert Havinga** (1909-1988) from the Rijksuniversiteit Leiden. Their report treated the recent results in the chemistry and stereochemistry of vitamin D and its isomers. Professor Havinga had been a student of Fritz Kögl, one of the former *Zechmeister* editors. His academic achievements in the fields of vitamin D chemistry, stereochemistry and peptide and enzyme chemistry brought him wide recognition. In addition, Havinga was knighted *Ridder in de Orde van de Nederlandse Leeuw,* which is the highest Order of Merit in the Netherlands (Cornelisse et al. 1988).

Klaus Weinges, together with **Wolfgang Bähr, W. Ebert, K. Göritz**, and **H.-D. Marx** (University of Heidelberg) provided insight into their research about the constitution, development and role of flavonoid-based tannins.

Conrad Hans Eugster reported on the chemistry of the active ingredients of the amanita muscaria. Eugster had obtained his doctorate in 1953 under Paul Karrer and became full professor of organic chemistry at the University of Zürich sixteen years later. He contributed largely to alkaloid chemistry and isolated many natural products from fungi. In addition, he also kept studying terpenes and carotenoids, a field in which his teacher had been a specialist and had been awarded the Nobel Prize (UZH 2011).

Paul J. Scheuer from the University of Hawaii contributed to the series a second time describing the chemistry of toxins isolated from marine organisms, especially chordates, echinoderms, mollusks, coelenterates, and protozoans. The final paper in Volume 27 was written by chemists from the Caltech. **Michael A. Raftery** and **Frederick Willis Dahlquist** reviewed the chemistry of lysozyme, and discussed inhibitors and substrates, as well as the mechanism of catalysis of this enzyme. Michael Raftery studied in Ireland and at the California Institute of Technology, and became assistant professor of chemical biology in 1967. Frederick Dahlquist was a research fellow in 1968/69, and is still publishing in the field of biochemistry (California Institute of Technology 1969).

8. Summary

The purpose of this work is to provide a summary and description of the life of László Zechmeister (1889-1972), as well as his scientific achievements. Zechmeister is said to be one of the pioneers in the development of chromatography and is an expert for the early history of this analytic method. During his studies under Richard Willstätter at the Swiss Federal Institute of Technology Zurich, he learnt about the column chromatography and used it to separate and isolate natural products, especially carotenoids and pigments. His successful research led to him being appointed professor of organic chemistry at the University of Pécs, where he was able to shape the scientific landscape in Hungary. Besides publishing a textbook on organic chemistry and books about the chromatographic method, he also founded the journal series "Progress in the Chemistry of Organic Natural Products". Apart from a recess during the Second World War, it has been published by the Julius Springer Verlag Vienna from 1938 until today. Therefore, Zechmeister took a significant part in publishing the recent results of research in this field of chemistry. After his emigration to the United States of America in 1940, Zechmeister worked and taught at the California Institute of Technology in Pasadena. This paper lays the focus on Volume 1 to Volume 27 of the series, when Zechmeister was concerned with the redaction of the journal. Descriptions of the printed articles and short biographies of contributors, which were excellent scientists and Nobel Prize laureates such as Kurt Alder, Otto Diels or Linus Pauling, are included.

9. Zusammenfassung

Das Ziel dieser Arbeit ist das Leben von László Zechmeister (1889-1972) und seine Errungenschaften zusammenzufassen und zu beschreiben. Zechmeister gilt als Pionier in der Entwicklung der Chromatographie sowie als Experte der frühen Geschichte dieser Analysenmethode. Als Student unter Richard Willstätter an der Eidgenössischen Technischen Hochschule Zürich lernte er die Säulenchromatographie kennen und nützte sie um Naturstoffe, insbesondere Carotenoide und Farbstoffe, aufzutrennen. Seine erfolgreichen Forschungen führten dazu, dass Zechmeister an der Universität Pécs zum Professor berufen wurde und er dadurch die wissenschaftliche Landschaft in Ungarn prägte. Neben der Veröffentlichung eines Lehrbuches über Organische Chemie und Bücher über Chromatographie, gründete er außerdem die Zeitschrift "Fortschritte der Chemie Organischer Naturstoffe", die abgesehen von einer Unterbrechung während des Zweiten Weltkrieges, von 1938 bis heute beim Julius Springer Verlag Wien herausgegeben wird.

Damit war Zechmeister maßgeblich an den Publikationen der neuesten Forschungsergebnisse auf diesem Gebiet beteiligt. Nach seiner Emigration in die USA 1940, arbeitete und lehrte Zechmeister am California Institute of Technology in Pasadena. Diese Arbeit beleuchtet Band 1 bis Band 27 genauer, also jene Zeit in der Zechmeister aktiv an der Herausgabe beteiligt war. Beschrieben werden abgedruckte Artikeln und Kurzbiographien von exzellenten Wissenschaftern und Nobelpreisträger, wie Kurt Alder, Otto Diels und Linus Pauling.

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11. Appendix

11.1. Content of “Progress in the Chemistry of Organic Natural Products, Volumes 1 to 28”

VOL	YEAR	TITEL	AUTHOR(S)	INSTITUTION	LANGUAGE
1	1938	Neuere Richtungen der Glykosidsynthese	G. Zemplén	Technische Universität Budapest	German
		The Component Glycerides of Vegetable Fats	T. P. Hilditch	University of Liverpool	English
		Recent Advances in the Chemistry of Sterols	I. M. Heilbron F. S. Spring	Imperial College of Science and Technology London, and University of Manchester	English
		Cozymase	F. Schlenk, H. v. Euler	Universität Stockholm	German
		Nucleinsäuren	H. Bredereck	Universität Leipzig	German
		Chlorophyll	A. Stoll, E. Wiedemann	Wissenschaftliches Labor „Sandoz“, Basel	German
		Anwendung physikalischer Methoden zur Erforschung von Naturstoffen: Form und Größe dispergierter Moleküle - Röntgenographie	O. Kratky, H. Mark	1.Chem. Laboratorium der Uni Wien	German
2	1939	Lignin	K. Freudenberg	Universität Heidelberg	German
		Flechtenstoffe	Y. Asahina	Universität Tokyo	German
		Flavine	H. Rudy	Universität Erlangen	German
		Chemistry of the iodine compounds of the thyroid	C.R. Harington	University College Hospital Medical School London	English
		The structure and synthesis of vitamin C (ascorbic acid) and its analogues	E. L. Hirst	University Bristol	English
		Neuere Richtungen der Oligosaccharid-Synthese	G. Zemplén	Technische Universität Budapest	German
		Chitin und seine Spaltprodukte	L. Zechmeister, G. Tóth	Uni Pécs	German
		Tabak-Alkaloide	E. Späth, F. Kuffner	I. Chemisches Universitäts-Laboratorium Wien	German
		Le spectrochimie de fluorescence dans l‘étude des produits biologiques	Ch. Dhéré	Université de Fribourg, Suisse	French
3	1939	Bedeutung der Dien-Synthese für Bildung, Aufbau und Erforschung von Naturstoffen	O. Diels	Universität Kiel	German
		Biochemische Hydrierung	F. G. Fischer	Universität Würzburg	German
		Gallenfarbstoffe	W. Siedel	Technische Universität München	German
		The chemistry of the lipoids of the tubercle bacillus and certain other microorganism	R. J. Anderson	Yale University, New Haven	English
		Recent work on the configuration and electronic structure of molecules; with some applications to natural products	Linus Pauling	California University of Technology Pasadena	English
4	1945	Die Chemie der pflanzlichen Herzgifte, Krötengifte, Saponine und Alkaloids der Steroidgruppe	R. Tschesche	Berlin	German
		Zur Biochemie der Vitamin B-Gruppe (Pantothensäure und Vitamin B_6)	Theodor Wieland, Irmentraut Löw	Heidelberg	German
		Pterine	R. Purrmann	München	German
		Die Biochemie der Virusarten	G. Schramm	Berlin-Dahlem	German
		Biologische Oxydationen	K. Bernhard, Harold Lincke	Zürich	German
		Über monomolekulare Filme an Wassergrenzflächen und über	H.J. Trurnit	Heidelberg	German

		Schichtfilme			
5	1948	Carotenoid-epoxyde und furanoide Oxyde von Carotenoidfarbstoffen	P. Karrer	Universität Zürich	German
		Some biochemical Aspects of Marine Carotenoids	D. L. Fox	Scripps Institution of Oceanography of the Uni of California, La Jolla	English
		Azulenes	A. J. Haagen-Smit	California University of Technology Pasadena	English
		Recent Advance in the Study of Component Acids and Component Glycerides of Natural Fats	T. P. Hilditch	University of Liverpool	English
		Enzymatically Synthesized Polysaccharides and Disaccharides	W. Z. Hassid, M. Doudoroff	University of California, Berkeley	English
		Recent Developments in the Structural Problem of Cellulose	E. Pacsu	Princeton University, New Jersey	English
		Lignin	F.E. Brauns	The Institute of Paper Chemistry, Appleton, Wisconsin	English
		The Chemistry of the Constituents of Toad Venoms	V. Deulofeu	Facultad de Ciencias Exactas, Fisicas y Naturales, Buenos Aires	English
		Biochemistry of Fish Proteins	E. Geiger	University of Southern California, L.A.	English
		Some Recent Developments in Chemical Genetics	G.W. Beadle	California University of Technology Pasadena	English
		Infrared Spectroscopy in Structure Determination and its Application to Penicillin	R.S. Rasmussen	Shell Development Company, Emeryville, California	English
6	1950	Some Biochemical and Nutritional Aspects in Fat Chemistry	H. J. Deuel Jr., S. M. Greenberg	University of Southern California	English
		Odeurs et parfums des animaux	E. Lederer	Paris	French
		Vorkommen und biochemisches Verhalten der Chinone	O. Hoffmann-Ostenhof	1. Chemisches Laboratorium der Uni Wien	German
		Cactus Alkaloids and Some Related Compounds	L. Reti	Buenos Aires	English
		Progrés récents en spectrochimie de fluorescence des produits biologiques	Ch. Dhéré	Université de Genève, Suisse	French
7	1950	Über die Konstitution der Triterpene	O. Jeger	ETH Zürich	German
		Konstitution, Konfiguration und Synthese digitaloider Aglykone und Glykoside	H. Heusser	ETH Zürich	German
		Thyroxine and Related Compounds	C. Niemann	California Institute of Technology, Pasadena	English
		Penicillin and its Place in Science	A. H. Cook	Brewing Industry Research Foundation Nutfield (GB)	English
		Sennosides A and B, the Active Principles of Senna	A. Stoll, B. Becker	Wissenschaftliches Labor „Sandoz“, Basel	English
		Some Recent Developments in the Chemistry of Antibodies	J. W. Williams	University of Wisconsin, Madison	English
8	1951	The Fine Structure of Cellulose	A. Frey-Wyssling, K. Mühlthaler	ETH Zürich	English
		Bacterial Dextrans	M. Stacey, C.R. Ricketts	The University of Birmingham	English
		Sugar Phosphates	L. F. Leloir	Buenos Aires	English
		The Chemistry of Nucleotides	G. W. Kenner	The University Chemical Laboratory, Cambridge	English
		Die Veilchenriechstoffe	H. Schinz	ETH Zürich	German
		Neuere Entwicklungen auf dem Gebiete der Flechtenstoffe	Y. Asahina	Research Institute of Natural Resources, Tokyo	German
		Lupinen-Alkaloide und verwandte Verbindungen	F. Galinovsky	II. Chem. Universitätslaboratorium Wien	German

		Brechwurzel-Alkaloide	M. Pailer	II. Chem. Universitätslaboratorium Wien	German
		X-Ray Diffraction Studies of Crystalline Amino Acids and Peptides	R. B. Corey	California Institute of Technology, Pasadena	English
		Some Aspects of Enzyme Chromatography	L. Zechmeister M. Rohdewald	California Institute of Technology, Pasadena AND Universität Bonn	English
9	1952	Synthetische Chemie der Carotenoide	H. H. Inhoffen, H. Siemer	Technische Hochschule Braunschweig	German
		Synthesis ad Properties of Vitamin A and Some Related Compounds	J.G. Baxter	Distillation Products Industries Rochester, New York	English
		Les Antivitamines	P. Meunier	Laboratoire de chimie biologique de la Faculté des Sciences, Lyon	French
		Recent Investigations on Ergot Alkaloids	A. Stoll	Wissenschaftliches Labor „Sandoz“, Basel	English
		Die Alkaloids der Menispermaceae	M. Tomita	University of Kyoto	German
		Naturally Occurring Coumarins	F.M. Dean	University of Liverpool	English
		The Biosynthesis of Proteins and Peptides, including Isotopic Tracer Studies	H. Borsook	California Institute of Technology, Pasadena	English
		The Enzymes of Nucleoside Metabolism	Herman M. Kalckar	University of Copenhagen	English
		Nucleosides and Nucleotides as Growth Substances for Microorganisms	W. S. McNutt	Vanderbilt University, Nashville	English
		Some Current Concepts of the Chemical Nature of Antigens	Dan H. Campbell, N. Bulman	California Institute of Technology, Pasadena	English
10	1953	Anwendungen der Dien-Synthese für die Erforschung von Naturstoffen	K. Alder, Marianne Schumacher	Universität Köln	German
		Physical Chemistry of Rubbers	H. Mark	Polytechnic Institute of Brooklyn	English
		Chimie des lipids bactériens	J. Asselineau, E. Lederer	Institut de biologique physico-chimique Paris	French
		Syntheses of Cortisone	G. Rosenkranz, F. Sondheimer	Syntex S.A. Mexico City	English
		Rauwolfia Alkaloids	Asima Chatterjee	University College of Science and Technology, Calcutta	English
		Insecticides Occurring in Higher Plants	L. Feinstein, M. Jacobson	US Dept. of Agriculture, Beltsville, Maryland	English
11	1954	Starch: Its Constitution, Enzymic Synthesis and Degradation	Stanley Peat	University of North Wales, Bangor	English
		Neuere Ergebnisse auf dem Gebiete des Lignins und der Verholzung	K. Freudenberger	Universität Heidelberg	German
		Probleme und neuere Ergebnisse in der Vitamin D-Chemie	H. H. Inhoffen, K. Brückner	Technische Hochschule Braunschweig	German
		Natürlich vorkommende Chromone	H. Schmid	Chemisches Institut der Universität Zürich	German
		The Configuration of Polypeptide Chains in Proteins	Linus Pauling, Robert B. Corey	California Institute of Technology, Pasadena	English
		Column Chromatography in the Study of the Structure of Peptides and Proteins	W.A. Schroeder	California Institute of Technology, Pasadena	English
		Porphyrins in Nature	R. Lemberg	Royal North Shore Hospital, St. Leondards, Sydney	English
		The Pteridines	Adrien Albert	Australian National University, Canberra	English
		Sesquiterpenes and Diterpenes	A. J. Haagen-Smit	California Institute of	English

12	1955			Technology, Pasadena	
		Tetracyclic Triterpenes	E. R. H. Jones, T. G. Halsall	University of Manchester	English
		Neuere Vorstellungen auf dem Gebiete der Biosynthese der Steroide und verwandter Naturstoffe	R. Tschesche	Universität Hamburg	German
		Some Biochemical Aspects of Fungal Carotenoids	F. T. Haxo	Scripps Institution of Oceanography of the Uni of California, La Jolla	English
		The Pyrrolizidine Alkaloids	F. L. Warren	University of Natal, Pietermaritzburg, SA	English
		Paper Chromatography in the Study of the Structure of Peptides and Proteins	E. O. P. Thompson, A. R. Thompson	Commonwealth Scientific and Industrial Research Organization Melbourne	English
		Acides Aminés iodés et iodoprotéins	Jean Roche, Raymond Michel	Collége de France	French
		Chemistry and Biochemistry of Snake Venoms	Karl Slotta	Caixa Postal 4790, Sao Paulo, Brazil	English
		Gene Structure and Gene Action	G.W. Beadle	California University of Technology Pasadena	English
13	1956	Infrared Spectra of Natural Products	A. R. H. Cole	The University of West Australia, Nedlands	English
		Gallotannine und Ellagen-gerbstoffe	O. Th. Schmidt	Universität Heidelberg	German
		Neuere Ergebnisse auf dem Gebiete der glykosidischen Herzgifte: Grundlagen und die Aglykone	CH. Tamm	Universität Basel	German
		Natural Tropolones and Some Related Troponoids	Tetsuo Nozoe	Tohoku University, Sendai, Japan	English
		Alkaloids Related to Anthranilic Acid	J. R. Price	Commonwealth Scientific and Industrial Research Organization Melbourne	English
		Recent Developments in the Chemistry and Pharmacology of Rauwolfia Alkaloids	Asima Chatterjee, Satyesh C. Pakrashi G. Werner	University of Calcutta, India, and Universidade de Sao Paulo	English
		Synthese von Peptiden	W. Grassmann, E. Wünsch	Max-Planck-Institut, Regensburg	German
14	1957	Acetylenverbindungen im Pflanzenbereich	F. Bohlmann, H. J. Mannhardt	Technische Hochschule Braunschweig	German
		Neuere Ergebnisse auf dem Gebiete der glykosidischen Herzgifte: Zucker und Glykoside	Ch. Tamm	Universität Basel	German
		Photodynamisch wirksame Pflanzenfarbstoffe	Hans Brockmann	Universität Göttingen	German
		Biosynthetic Relations of Some Natural Phenolic and Enolic Compounds	A. J. Birch	University of Manchester	English
		The Aminochromes	Harry Sobotka, Norman Barsel, J. D. Chanley	Dep. Of Chemistry, Mount Sinai Hospital, and International Hormones, Inc., New York	English
		Visual Pigments	R. A. Morton, G. A. J. Pitt	University of Liverpool	English
		The Carbon Cycle in Nature	Harrison Brown	California University of Technology Pasadena	English
15	1958	Der Kohlenhydratstoffwechsel der Gräser	H. H. Schlubach	Universität Hamburg	German
		Some in vitro Conversions of Naturally Occurring Carotenoids	L. Zechmeister	California University of Technology Pasadena	English
		The Chemistry of Podophyllum	J. L. Hartwell, A. W. Schrecker	US Dep. of Health, Maryland	English
		X-ray Analysis and the Structure of	Dorothy Crowfoot	University Museum,	English

		Vitamin B12	Hodgkin	Oxford	
16	1958	Catechine, andere Hydroxy-flavane und Hodroxy-flavene	Klaus Weinges	Universität Heidelberg	German
		Recent Progress in the Chemistry of the Aconite-Garrya Alkaloids	Karel Wiesner, Zdenek Valenta	University of New Brunswick, Canada	English
		Structural Chemistry of Actinomycetes Antibiotics	E. E. van Tamelen	University of Wisconsin, Madison	English
		Protein Synthesis in Plants	James Bonner	California University of Technology Pasadena	English
		The Electron Gas Theory of the Colour of Natural and Artificial Dyes: Problems and Principles	Hans Kuhn	Universität Marburg	English
17	1959	Flavones and Isoflavones	K. Venkatamaran	National Chemical Laboratory, Poona, India	English
		Fortschritte der Chemie der Vitamine D und ihrer Abkömmlinge	H. H. Inhoffen, K. Irmscher	Technische Hochschule Braunschweig	German
		Neuere Ergebnisse der Chemie pflanzlicher Bitterstoffe	F. Korte, H. Barkenmeyer, I. Korte	Universität Bonn	German
		Alkaloide aus Calebassencurare und südamerikanischen Strychnosarten	K. Bernauer	Universität Zürich	German
		Occurrence and Metabolism of Simple Indoles in Plants	Bruce B. Stowe	Harvard University	English
		Some Biochemical Aspects of Disease in Plants	A. E. Dimond	Connecticut Agricultural Experiment Station, New Haven	English
		The Chemical Structure of the Normal Human Hemoglobins	W. A. Schroeder	California University of Technology Pasadena	English
		Paleobiochemistry and Organic Geochemistry	Philip H. Abelson	Carnegie Institution of Washington, D.C.	English
		The Electron Gas Theory of the Colour of Natural and Artificial Dyes: Applications and Extensions	Hans Kuhn	Universität Marburg	English
18	1960	Die Actinomycine	H. Brockmann	Universität Göttingen	German
		Natürlich vorkommende Nitroverbindungen	M. Pailer	Universität Wien	German
		Dérivés guanidique biologiques	Nguyen van Thoai, J. Roche	Collège de France, Paris	French
		Naturally Derived *iso*Thiocyanates (Mustard Oils) and Their Parent Glucosides	Anders Kjaer	Royal Veterinary and Agricultural College, Copenhagen	English
		Die Farbstoffe im Gefieder der Vögel	Otto Völker	Justus-Liebig-Hochschule Gießen	German
		Cis-trans Isomeric Carotenoid Pigments	L. Zechmeister	California University of Technology Pasadena	English
		The Gibberellins	P. W. Brian, John Frederick Grove, J. MacMillan	Akers Research Laboratories, Hertfortshire	English
		Selected Subjects in Sedimentation Analysis, with Some Applications to Biochemistry	J. W. Williams	University of Wisconsin	English
		Structure and Immunological Specificity of Polysaccharides	Michael Heidelberger	Columbia University New York and State University New Jersey	English
19	1961	Medium-ring Terpenes	F. Sorm	Czechoslovak Academy of Science, Prague	English
		Recent Advances in the Chemistry of Azulenes and Natural Hydroazulenes	Tetsuo Nozoe, Sho Ito	Tohuku University, Japan	English
		Chemistry of the Natural Pyrethrins	L. Crombie, M. Elliott	King's College London + Rothamsted Experimental Station, Harpenden, Herts	English
		Conformational Analysis of Steroids and	D. H. R. Barton, G.	Imperial College of	English

		Related Natural Products	A. Morrison	Science and Technology London	
		Biogenetic-type Syntheses of Natural Products	E. E. van Tamelen	University of Wisconsin	English
		Der Kohlenhydratstoffwechsel im Roggen und Weizen	H. H. Schlubach	Universität München	German
		Les phosphatases des végétaux supérieurs: répartition et action	J. E. Courtois, A. Lino	Faculté de Pharmacie de Paris	French
20	1962	Nitrogen-containing Metabolites of Fungi	J. H. Birkinshaw, C. E. Stickings	London School of Hygiene and Tropical Medicine	English
		Forschungen am Lignin	K. Freudenberger	Universität Heidelberg	German
		Die Ubichinone (Coenzyme Q)	O. Schindler	Forschungsinstitut Dr. A. Wander A.-G. Bern	German
		Naturally Occurring Aromatic Derivatives of Monocyclic alpha-Pyrones	Walter B. Mors, Mauro Taveira Magalhaes, Otto R. Gottlieb	Instituto de Quimica Agricola, Rio de Janeiro	English
		Anthocyanines and their Sugar Components	J. B. Harborne	John Innes Institute, Hertford, Herts	English
		Aminozucker, Synthesen und Vorkommen in Naturstoffen	Gerhard Baschang	Max Planck Heidelberg + The Rockefeller Institute New York	German
		Structure and Stereochemistry of the Lycopodium Alkaloids	Karel Wiesner	University of Brunswick, Canada	English
		New Developments in the Field of Veratrum Alkaloids	C. R. Narayanan	National Chemical Laboratory, Poona, India	English
		Equilibrium Sedimentation of Macromolecules and Viruses in a Density Gradient	Jerome Vinograd, John E. Hearst	California University of Technology Pasadena	English
		Current Theories on the Origin of Life	N. H. Horowitz, Stanley L. Miller	California University of Technology Pasadena, and Institute Of Oceanography, La Jolla	English
	1964	Generalregister 1-20			
21	1963	The Biosynthesis of Rubber	James Bonner	California University of Technology Pasadena	English
		The Polyene Antifungal Antibiotics	W. Oroshnik, A. D. Mebane	Central Research Laboratory Shulton, New Jersey Ortho Research Foundation, New Jersey	English
		Die Chemie der Tetracycline	H. Muxfeldt, R. Bangert	University of Wisconsin	German
		Anthracyclinone und Anthracyclinen (Rhodomycinone, Pyrromycinone und ihre Glykoside)	Hans Brockmann	Universität Göttingen	German
		Folsäure und Folat-Enzyme	L. Jaenicke, C. Kutzbach	Physiologisch-chemisches Institut der Uni Köln	German
		Chemistry of the Natural Rotenoids	L. Crombie	London King's College	English
22	1964	Photochemische Umwandlungen ausgewählter Naturstoffe	Kurt Schaffner	ETH Zürich	German
		Stilbene im Pflanzenreich	Gerhard Billek	Universität Wien	German
		A Pattern of Development in the Chemistry of Pentacyclic Triterpenes	T. G. Halsall, R. T. Aplin	University of Oxford	English
		Griseofulvin and Some Analogues	J. F. Grove	London School of Hygiene and Tropical Medicine	English
		The Chemistry of Toxins Isolated from Some Marine Organisms	P. J. Scheuer	University of Hawaii	English
		Siderochrome (Natürliche Eisen(III)-trihydroxamat-Komplexe)	W. Keller-Schierlein, V. Prelog, H. Zähner	ETH Zürich	German

23	1965	Polysaccharides of Marine Algae	Stanley Peat, J. R. Turvey	University College of North Wales, Bangor	English
		Der Kohlenhydratstoffwechsel in Gerste, Hafer und Rispenhirse	H. H. Schlubach	Uni München	German
		The Chemistry of Biological Sulfonium Compounds	Fritz Schlenk	Argonne National Laboratory, Illinois	English
		Some Aspects of the Chemistry and Function of Human and Animal Hemoglobins	W. A. Schroeder, R. T. Jones	California University of Technology Pasadena, and University of Oregon Medical School	English
		Kollagen	W. Grassmann, J. Engel, K. Hannig, H. Hörmann, K. Kühn, A. Nordwig	Max-Planck-Institut für Eiweiß- und Lederforschung München	German
		Some Applications of Nuclear Magnetic Resonance Spectroscopy in Natural Product Chemistry	L. M. Jackman	University of Melbourne	English
24	1966	Mass Spectrometry of Selected Natural Products	Klaus Biemann	Massachusetts Institute of Technology	English
		Pflanzliche Steroide mit 21 Kohlenstoffatomen	Rudolf Tschesche	Universität Bonn	German
		Cyclite: Biosynthese, Stoffwechsel und Vorkommen	H. Kindl, O. Hoffmann-Ostenhof	Universität Wien	German
		The Chemistry of the Order Cupressales	H. Erdtmann, T. Norin	Royal Institute of Technology, Swedish Forest Products Research Laboratory Stockholm	English
		Quinone Methides in Nature	A. B. Turner	University of Aberdeen	English
		The Pyrrolizidine Alkaloids. II.	F. L. Warren	University of Cape Town	English
		Some Aspects of Virus Chemistry	H. Fraenkel-Conrat	University of California, Berkeley	English
25	1967	Biogenetische Beziehungen der natürlichen Acetylenverbindungen	F. Bohlmann	TU Berlin	German
		The Chemistry of the Hop Resins	P. R. Ashurst	The Brewing Industry Research Foundation, Surrey	English
		The Pseudoguaianolides	J. Romo, A. Romo de Vivar	Universidad Nacional Autonoma de Mexico	English
		The Nonadrides	J. K. Sutherland	Imperial College of Science and Technology London	English
		Natürlich vorkommende Auronglykoside	L. Farkas, L. Pallos	TU Budapest	English
		Recent Advances in the Chemistry of Hashish	R. Mechoulam, Y. Gaoni	The Hebrew University, Jerusalem Weizmann Institute of Science Rehovoth	English
		The Toxic Peptides of Amanita Phalloides	Theodor Wieland	Goethe-Universität Frankfurt	English
		Die Prolamine	E. Waldschmidt-Leitz, H. Kling	Institut für experimentelle Biologie, Baden	German
		Conformational Analysis of Some Alkaloids	G. A. Morrison	The University Leeds	English
26	1968	X-Ray Diffraction Studies of Crystalline Amino Acids, Peptides and Proteins	R. B. Corey, R. E. Marsh	California University of Technology Pasadena	English
		Synthese von Peptiden und Peptidwirkstoffen	E. Schröder, K. Lübke	Schering A.G., Berlin	German
		Insulin, Structure, Synthesis and Biosynthesis of the Hormone	A. C. Trakatellis, G. P. Schwartz	Brookhaven National Laboratory, Upton, New York	English
		Makrotetrolide	W. Keller-Schierlein, H. Gerlach	ETH Zürich	German

		Limonoid Bitter Principles	David L. Dreyer	US Department of Agriculture Pasadena	English
		Proapophin-Alkaloide	K. Bernauer, W. Hofheinz	F. Hoffmann -La Roche und Co Basel	German
		Chemie der Chlorine und Porphyrine	H. H. Inhoffen, J. W. Buchler, P. Jäger	Technische Hochschule Braunschweig	German
		Methoden und Ergebnisse der Sequenzanalyse von Ribonucleinsäuren	Dieter Dütting	Max-Planck-Institut für Virusforschung, Tübingen	German
27	1969	The Ultrastructure and Biogenesis of Native Cellulose	A. Frey-Wyssling	ETH Zürich	English
		Ethylene in Nature	Mary Spencer	University of Alberta, Canada	English
		Spectroscopic Methods for Elucidating the Structures of Carotenoids	B. C. L. Weedon	University of London	English
		Some Recent Results in the Chemistry and Stereochemistry of Vitamin D and Its Isomers	Georgine M. Sanders, J. Pot, E. Havinga	Rijksuniversiteit, Leiden	English
		Konstitution, Entstehung und Bedeutung der Flavonoid-Gerbstoffe	K. Weinges, W. Bähr, W. Ebert, K. Göritz, H.-D. Marx	Universität Heidelberg	German
		Chemie der Wirkstoffe aus dem Fliegenpilz (Amanita muscaria)	C. H. Eugster	Universität Zürich	German
		The Chemistry of Some Toxins Isolated from Marine Organisms	P. J. Scheuer	University of Hawaii	English
		The Chemistry of Lysozyme	M. A. Raftery, F. W. Dahlquist	California University of Technology Pasadena	English
28	1970	Structural and Biogenetic Relationships of Isoflavonoids	E. Wong	Applied Biochemistry Division, Palmerston North, New Zealand	English
		Recent Advances in the Chemistry of Cyanogenic Glycosides	R. Eyjolfsson	The Royal Danish School of Pharmacy, Copenhagen	English
		Naturstoffe mit Pyridinstruktur und ihre Biosynthese	D. Gross	Institut für Biochemie der Pflanzen, Halle, DDR	German
		Peptide Alkaloids	E. W. Warnhoff	University of Western Ontario, Canada	English
		Insektensexuallockstoffe	K. Eiter	Bayerwerke Leverkusen, BRD	German
		Anthropod Molting Hormones	H. Hikino, Y. Hikino	Tohoku University, Japan	English
		Total Synthesis of Prostaglandis	J. E. Pike	The Upjohn Company, Michigan	English
		Chemistry of Cephalosporin Antibiotics	R. B. Morin, B. G. Jackson	University of Wisconsin	English
		Oligosaccharide der Frauenmilch	H. Wiegandt, H. Egge	Universität Marburg, BRD	German
		Glucagon: Chemistry and Action	W. Bromer	Eli Lilly and Company, Indiana	English