BIOGRAPHICAL MEMOIRS

Arthur Stoll, 1887-1971

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ARTHUR STOLL

1887-1971

Elected For. Mem. R.S. 1958

Arthur Stoll died peacefully on 13 January 1971, six days after the end of his 84th year. In him we lost a man who occupied an exceptional position in the Swiss chemical industry. But Stoll’s importance certainly did not lie solely in perfect performance of his professional duties; he also made unusually great contributions to widely varying fields of science and to cultural life in general.

He was born on 8 January 1887, in the village Schinznach-Dorf in Aargau, where he went to the Volks- and Bezirksschule; his father was the Rector of the latter. In the autumn of 1906, having passed through the technical division of the Aarau Kantonschule where Albert Einstein preceded him by about 10 years, he entered the Eidgenössisches Polytechnikum in Zürich which a few years later was renamed, after the German pattern, the Eidgenössische Technische Hochschule (ETH). There he chose the science faculty, being interested especially in botany and geology. The study of these subjects included also attendance at the lectures on inorganic and organic chemistry that Richard Willstätter had been giving since 1905. Willstätter had previously been Associate (ausserordentlicher) Professor at the Chemical Institute of Munich University which was under the direction of the authoritarian and famous Professor Adolph von Baeyer.* Willstätter’s influence on the young Stoll was so great that he decided on a study of chemistry, but he was able to select botany and geology as subsidiary subjects. Willstätter (1949) has written in his Memoirs that he got to know Stoll in the course of elemental analysis, where he won the trust and affection of his teacher who soon took Stoll into his private laboratory for work on his Diploma and on his Doctor thesis whose title read ‘Ueber Chlorophyllase und Chlorophyllide (5)’†. In 1911 Stoll obtained his Dr.sc.nat.

Chlorophyll

In 1906 Willstätter had begun his famous pioneering work on the little investigated field of plant dyes—the green-leaf colouring matter chlorophyll, the yellow and orange-red carotenoids, and the blue and red colouring

* E.g. so long as Baeyer was in power, it was not possible for a Professor of Physical Chemistry to be appointed in Bavaria.
† The numbers in parentheses refer to the numbered Bibliography at the end of this Memoir.
matters of flowers and berries. Work on these three series was begun in the order just given. Until the end of Willstätter’s chlorophyll period (1917) Stoll remained his most important collaborator in that series. It was a very fruitful and indeed an ideal collaboration, which bound the two men in friendship for life. The methods that first permitted rational penetration into chlorophyll chemistry now appear very simple: isolation of the mixture of the two chlorophyll components a and b, and their separation from one another, depended on the skilled use of solvent mixtures such as alcohols or acetone (pure or diluted with a little water) on the one hand and light petroleum on the other. Work with the pure substances thus obtained then provided important insight into the molecular structures. It was possible to establish that the two chlorophyll components, which are both complexes of magnesium, differ only in that two hydrogen atoms of chlorophyll-a ($C_{55}H_{72}N_{4}O_{5}Mg$) were replaced in chlorophyll-b by one oxygen atom ($C_{55}H_{70}N_{4}O_{6}Mg$). Even at that time it was assumed that the ring skeleton of the two chlorophylls comprised the same porphine system as in the red blood colouring matter haemin, as was later conclusively proved by Hans Fischer. It was already known that haemin is a complex of iron. The iron can be removed from haemin by relatively energetic treatment with strong acids, whereas the magnesium is cleaved from chlorophyll even by treatment with mild acids. On the other hand, the bonding of the magnesium is very stable against alkali. However, on treatment with alkali the chlorophylls lose by hydrolysis the diterpene alcohol phytol that is bound as ester to a carboxyl group. If the enzyme chlorophyllase, which occurs in green leaves (cf. the title of Stoll’s thesis given above), acts on chlorophyll in methanolic solution, the well crystalline methyl chlorophyllide is produced by removal of the phytol by transesterification. I retain a lively memory of the scientific sensation, caused by these early results of chlorophyll research.

In September 1912, during the course of this work, Willstätter moved to the newly founded Kaiser-Wilhelm-Institut (now the Max-Planck-Institut) in Berlin, where he became the head of the laboratory for organic chemistry. He took with him almost all his prominent co-workers, and it was natural that his master pupil Stoll should be among them.

It was then that our paths crossed. At the same time as Willstätter moved, Hermann Staudinger left the oldest German Technische Hochschule of Karlsruhe (founded 1825) and moved to the 30-year younger ETH. He was promoted from Associate Professor in Karlsruhe to full Professor in the chair made vacant by Willstätter’s departure. In 1910 I obtained under Staudinger’s auspices my Dr.Ing. degree and in 1912 he took me with him as Private Assistant to Zurich. Willstätter and Stoll had left the Zurich laboratory some time before our arrival.

A short time previously, Paul Karrer, a pupil of Werner’s, left the laboratory of Zurich University after obtaining his Ph.D. degree, to work with Paul Ehrlich in Frankfurt am Main until 1917. In that year both Stoll and Karrer returned to Switzerland and in 1971 both departed from us.
The high esteem in which Stoll was held by his master was given eloquent expression in 1913 when there appeared the first comprehensive review of the current results briefly mentioned above and including those obtained by others than Stoll. This took the form of a book *Untersuchungen über Chlorophyll* (7) whose authors were given as Willstätter and Stoll. These achievements, together with results obtained for the other plant colouring matters referred to above, formed the basis for the Nobel Prize given to Willstätter in 1915 ‘for his pioneering work on plant colouring matters, and especially chlorophyll’.

Willstätter soon gave up the study of the structure of chlorophyll, and this was completed later by Hans Fischer in very extensive and original investigations.

Together with Stoll, Willstätter turned to a fresh chapter of chlorophyll chemistry, namely, investigation of the function of chlorophyll in the assimilation of carbon dioxide of the air to form sugars. The basic problem of the function of chlorophyll requires an answer to the question, how is the energy of sunlight transformed into chemical energy by the agency of chlorophyll? When one remembers that, in spite of repeated attempts by numerous excellent investigators, this question still awaits final answer, then it is not to be wondered that Willstätter and Stoll, and later Stoll and Wiedemann in Basle, obtained only partial answers which, although important, did not solve the fundamental problem. The results about the assimilation were summarized in 1917 by Willstätter and Stoll together in the book *Untersuchungen über die Assimilation der Kohlensäure* (13). The most important of their results was that the assimilation quotient (i.e. the ratio, assimilated carbon dioxide : oxygen liberated during assimilation), $\frac{CO_2}{O_2}$ equals 1. Pure chlorophyll does not catalyse assimilation; only the chlorophyll bound in the chloroplasts of the green leaf can do that.

The investigations of chlorophyll by the master Willstätter and his pupil Stoll did not actually reach a conclusion in any of their main directions, yet taken together they constitute one of the most important pioneering achievements of organic chemistry. Much that was not achieved was simply impracticable at that time, to a large part for lack of suitable methods. If in 1917 Willstätter had not decided to take up another field of study, namely enzymes, it might perhaps have been possible even then to proceed to elucidation of the chlorophyll structure. But in this matter there was a psychological obstacle. Willstätter proposed, purely hypothetically, a porphine formula (1) in which the four pyrrole rings of the skeleton are bound together in an unsatisfactory manner.* Yet there was already a hypothetical proposal (2) by W. Küster for the porphine skeleton which, as it turned out, was correct and was later proved unambiguously by Hans Fischer. I asked Stoll once why Willstätter and he had not accepted the Küster formula which was also aesthetically more pleasing; the answer was that he had directed the same question to the master and had received the

* I have taken formulae 1 and 3 from his Nobel lecture.
reply: 'In the Küster formula there is a 16-membered ring, and we cannot inflict that on Baeyer.' This reply refers to the strain theory set up by Baeyer in 1884, according to which such a many-membered ring should not be able to exist. Although Willstätter had recognized correctly that the magnesium was bound as a complex to the nitrogen atoms of the four pyrrole rings (3) he could not formulate the complex properly with his formula 1.

In 1916 Willstätter became successor to Adolph von Baeyer, in the famous Liebig chair of Munich University,† which he had left in 1905 to become Professor at ETH. The circular migration was thus complete. Stoll was there too, naturally, but only for a year, as will shortly transpire. In Munich Willstätter began to try to break into the enzyme field on a wide front, and the 29-year-old Stoll was again the pioneer contributor who began a study of peroxidase, which has a certain connexion with a biochemical problem in chlorophyll chemistry. Willstätter spent a further 15 years on his enzyme studies but these were not rewarding and, in part, delayed the advance of science. But he did these investigations without Stoll, for Stoll was approached by the 'Chemische Fabrik vormals Sandoz', the Basle firm which until then had been almost exclusively but very successfully a dyestuffs manufacturer. Sandoz invited him to extend their field of activities by founding a pharmaceutical-chemical division and Stoll accepted this challenging offer. He had just received the title of Professor at Munich University and would certainly have had a brilliant academic career before him. Later, so I heard, he was also twice offered the Professorship at ETH, Zürich; but that was at a time when the new pharmaceutical-chemical division of Sandoz had progressed too far, and moreover he had ascended so high in the hierarchy of the firm that he could decline with full conviction.

In the chemical work on the pharmacologically oriented problems that he set himself, Stoll remained true to the strict fundamental scientific principles of an organic chemist, with inflexible determination, from the moment of entry into the Sandoz firm. Such behaviour is considered normal today in the Swiss organic chemical industry and in many other industrial

† There he soon allowed Fajans to be installed as Professor of Physical Chemistry.
organizations in Switzerland and elsewhere, but it was by no means a matter of course in 1917. Looking back, one sees clearly that Stoll served chemical and medical science as well as industry always in the same faith.

When describing Stoll’s fields of work and his results for this biographical memoir I must, because of the wealth of material restrict myself to what constitutes pioneering achievements and, are of notable importance for chemistry and medicine as well as for industry. That work concerned mainly the isolation of pharmacologically active constituents from well-known drugs in a chemically pure form. Previous methods had often afforded only products that were unsatisfactory in medical practice, and they sometimes contained, not the important active compounds present in the plant, but products of rearrangement or degradation due to the unsuitable methods of preparation.

In his work, Stoll relied on the mild methods that had often been tested in the chlorophyll field, namely the use of neutral solvent mixtures. He was also always anxious to ensure that any enzyme present in the plant was removed or inactivated as early as possible during the isolation procedure, because undesirable change of the genuine active ingredient could be caused by the enzyme in the extract—and it was long known that a small chemical alteration to the active ingredient could produce large unfavourable changes in pharmacological properties.

Ergot

The very first problem that Stoll attacked, in 1917, was one of the most important. Ergot (Secale cornutum) is a material produced by a parasitic mould on rye grain; it has been used for centuries to stop post-natal bleeding, often in the form of a red extract containing a variety of active components; it was particularly troublesome that the activity of these extracts soon decreased and after some time had disappeared completely. Moreover, in the early history of the isolation of pure active ergot ingredients there is serious confusion due partly to the fact that this drug contains several pharmacologically active compounds that are difficult to separate from one another.

Stoll was the first to isolate the pure alkaloid C_{33}H_{35}N_{5}O_{5}, called ergotamine, which is the main carrier of reliable uterine activity; it is stable either as base or as tartrate. The tartrate is readily soluble and, under the name Gynergen, has proved an important drug in gynaecology. Ergotamine also has other medical applications owing to its sympatholytic action.

Five further alkaloids, most of them to Stoll’s credit, could be isolated from ergot. On hydrolysis they all afford lysergic acid, whose structure had already been almost completely cleared up by W. A. Jacobs, although the last detail was supplied by Stoll’s group, namely, the demonstration that certain isomers were due, not to variation in the position of the alicyclic 9,10-double bond, but to stereoisomerism at C-8 (see formula 4).
It proved considerably harder to determine the structures of the ergot alkaloids themselves. Complete formulation for the ergotamine series was achieved only after Stoll's group had elucidated the structure of the tripeptide moiety of these alkaloids. It was found that the formula of ergotamine is best presented as an equilibrium mixture of 5 and 6, where \( R' = \text{H} \), \( R'' = \text{C}_6\text{H}_5\text{CH}_2 \) and \( R \) is the lysergic acid residue. Important early contributions were due to W. A. Jacobs and G. Barger, especially in connexion with the 9-membered ring of 6, which according to Stoll et al. easily forms the cyclol 5.

The annexed scheme illustrates hydrolysis of the tautomeric formulae 5 and 6 representing ergotamine: 7 is lysergic acid, 8 and the neighbouring \( \text{NH}_3 \) are derived from alanine, 9 is phenylalanine and 10 is proline.

Chemical and pharmacological work in the ergot field has not quite ceased even yet and it still proves a useful source of new drugs; in this connexion the important psychopharmaceuticals may be mentioned in passing.

**Cardioactive glycosides**

Stoll also made important contributions in the field of the cardioactive glycosides which constitute a well-known, very extensive area that has been subjected to much scientific study. In particular, by excluding enzymic
hydrolyses, he was able to isolate new, unchanged, genuine glycosides and so to introduce into cardiac therapy novel preparations of constant activity and complementary action. Scillaren A was isolated from white squill (*Scilla maritima*), lanatosides A, B and C and purpurea glycosides A and B from *Digitalis* species (*D. lanata* and *D. purpurea*, respectively), and k-strophanthoside from *Strophanthus kombe*. In all these plants various groups of steroid glycosides of similar structure occur as active ingredients possessing physiological properties that are similar but can be differentiated pharmacologically. When after 1932 the formulae of cholesterol and the cholic acids had been finally elucidated, the chemical structures of the cardioactive glycosides could be completely determined. Many other laboratories were active in this field; Stoll naturally concerned himself mainly with chemical investigations of the new glycosides discovered in his laboratories.

**Squill**

From white squill, Stoll’s group isolated nine glycosides, of which we shall discuss the two shown in the groups of formulae on p. 574, namely the triglycoside glycoscillaren A (**11**) and the diglycoside scillaren A (**12**). Here for the first time the doubly unsaturated 6-membered lactone ring was observed in a cardioactive glycoside—a structural feature later found by H. Wieland and R. Tschesche in toad venoms.

Determining the structures of the squill glycosides proved unexpectedly difficult. Two D-glucose residues were removed successively from the glycosides 11 and 12 by the known enzymes β-glucosidase and scillarenase, thus yielding the rhamnoside proscillaridin (**13**), but no known natural enzyme would remove the L-rhamnose from 13. This hydrolysis was then first attempted by acid, which, however, led to simultaneous removal of water and formation of a conjugated double bond in 15. By a more energetic action of acid on 15 the tertiary hydroxyl was eliminated; subsequent catalytic hydrogenation saturated the five double bonds and opened the lactone ring by hydrogenolysis, the final product being the known allocholic acid (5α-cholanoic acid) (**16**).

To prevent removal of the hydroxyl group from ring A of 12, the double bond next to the hydroxyl group had to be saturated before the sugar was split off. Catalytic hydrogenation of 12 reduced the three double bonds and opened the lactone ring, giving 17. Subsequent treatment of 17 with acid led to hydrolytic loss of both sugars with preservation of the secondary hydroxyl group and removal of water involving the tertiary hydroxyl group. Catalytic hydrogenation of the resulting compound 18 yielded the known 3β-hydroxy-5α-cholanoic acid 19.

Enzymic removal of rhamnose, without removal of water from ring A, was first achieved by means of an artificially prepared enzyme: a *Penicillium* species was grown in a nutrient solution containing L-rhamnose as sole source of carbon, and the aglycone scillarenin (**14**) was obtained by use of this adapted enzyme. The α,β-position of the double bond with respect to
the 3-hydroxyl group in 14 could be demonstrated with certainty, by chromic acid oxidation of 14 to scillarenone (20), spectroscopic proof of the α,β-unsaturated keto grouping in that product, and finally reduction of the keto group of 20, which regenerated 14.

The isolation and structural elucidation of the two most important squill glycosides 11 and 12 was one of the most outstanding achievements of Stoll's group, for which reason it has been described here in some detail.

**Digitalis lanata and purpurea**

Earlier investigators isolated only three toxins (digitoxin, gitoxin and digoxin) from the leaves of *Digitalis lanata* and only the first two from *D. purpurea*. By excluding the enzyme digitoxigenase or digipurpuridase, Stoll was able to isolate the genuine lanatosides A, B and C; the C glycoside does not occur in *D. purpurea*.

To amplify the above scheme the formulae of lanatoside A and its hydrolysis products are annexed. The aglycone of lanatoside B is gitoxigenin (16-hydroxydigitoxigenin), and that of lanatoside C is digoxigenin (12-hydroxydigitoxigenin). Stoll did not take part in work on the chemistry of the toxins.
Strophanthus kombé

The seed of this plant also contains an important cardioactive glycoside. Crystalline k-strophanthin-\(\beta\) (25) had already been isolated by W. A. Jacobs and its structure had been elucidated by processes requiring enzymic removal of \(\beta\)-glucose to cymarin (26); this was effected by strophanthobiase which occurs in seeds of *Strophanthus kombé*.

Using his general methods Stoll prepared the genuine crystalline glycoside k-strophanthoside (24), which was cleaved by the glycosidase from brewers' yeast to D-glucose and k-strophanthin-\(\beta\) (25). Acid hydrolysis converted the genuine glycoside to strophanthidin (27) and the complete sugar component, namely the trisaccharide strophanthotriose. Such a smooth separation of trisaccharide from its aglycone, without simultaneous loss of water as, e.g. in the case of scillaren A (12), requires that a 2-deoxy sugar (e.g. cymarose) be bound directly to the aglycone.
Senna leaves

Stoll studied the constituents of this drug because of its laxative properties. He was able to isolate sennosides A and B, for which formula 28 was proved. Two equivalent asymmetric carbon atoms at the junction positions of the two anthracene rings make possible the existence of an optically active and meso-stereoisomer. Removing the glucose gave sennidins A and B (29) as aglycones.

\[
\begin{align*}
28 \quad R &= \text{glucose} \\
29 \quad R &= \text{H}
\end{align*}
\]

The known compound rhein (30) was obtained on oxidation of 29. The position of the glucose was determined by synthesis of the methoxy methyl ester (31) prepared from sennosides as shown in the formulae. The sennosides yield by reduction the compound 32, which can be reconverted into the starting material by suitable oxidants.

Garlic

Garlic (\textit{Allium sativum} L.) has been valued since antiquity in the orient and sometimes in the occident, not only as a food, but also as a cure for digestive disturbances and more generally as a preventive against infections. Sceptical Europeans used to laugh at this; but it induced Stoll to undertake a detailed examination. Using precise conditions, in particular keeping the temperature as low as possible, he isolated from garlic a compound of formula C_{6}H_{11}N\textsubscript{2}O\textsubscript{3}S, the genuine ingredient of garlic; it is odourless and has no antibacterial activity. This compound termed alliin, is converted by the enzyme alliinase, isolable from garlic, into the previously known allicin C_{6}H_{10}OS_{2} which has the typical garlic odour and shows well developed antibacterial properties even in high dilution. Stoll proved that allicin (34) is the \(S\)-allyl ester of 2-propenethiosulphinic acid; it could be synthesized by the action of hydrogen peroxide on diallyl disulphide—and indeed diallyl disulphide had long been known as the main constituent in the steam distillate from garlic. The structure of alliin (33) was deduced from the course of its decomposition by alliinase; in the annexed scheme the
intermediates that probably arise in this decomposition and react further are placed in parentheses; alliin is accordingly S-allylcysteine S-oxide (33). This formula was proved by an unambiguous synthesis. Pyruvic acid (35) and ammonia, as well as allicin (34), are isolated products of enzymic fission of alliin. Alliinase cleaves only those aliphatic sulphoxides that are derived from natural L-cysteine, as was shown by a study of several synthetic compounds.

\[
\begin{align*}
\text{CH}_4\text{CH}-\text{CH}_2-\text{S}-\text{CH}_2-\text{CH}-\text{COOH} & \quad 33 \\
\text{CH}_2=\text{CH}-\text{CH}_2-\text{SH} & + \quad \text{CH}_2=\text{C}-\text{COOH} \\
2 \text{Mol} \downarrow \text{H}_2\text{O} & \quad \text{CH}_3\text{COOCOOH} + \text{NH}_3
\end{align*}
\]

**Other natural compounds**

Stoll et al. carried out numerous interesting studies on compounds from some plants of the *Podophyllum* group and from various *Veratrum* and *Rauwolfa* species having potential medicinal value. They also investigated other plants and lower fungi containing antibacterial ingredients.

**Injectable calcium**

To the chemically less interesting compounds, that find wide application in medicine belong the calcium salts of sugar acids: calcium gluconate and calcium lactobionate which were introduced by Stoll et al. into the physician's daily practice.

I have refrained so far from mentioning Stoll's collaborators, but would like now to name at least the most important: E. Becker, A. Brack, E. Burckhardt, A. Helfenstein, A. Hofmann, E. Jucker, W. Kreis, W. Kussmaul, T. Petrzilka, J. Renz, A. Rüegger, J. Rutschmann, W. Schlientz, E. Seebeck, T. Troxler, A. von Wartburg and E. Wiedemann. Naturally the investigations of the above and many other areas of organic pharmaceutical chemistry necessitated the co-operation of pharmacologists. Particular tribute should be paid to the valuable and often decisive collaboration of the excellent pharmacologist E. Rothlin, who has set out his observations in numerous publications.

We have here surveyed in rapid glances a scientific lifework of exceptional extent. The recognition that followed automatically from that work was
widely extended to him. He received sixteen honorary doctorates, of which the pharmaceutical (eight) and the medical (three) leave no doubt of his standing in these circles; in addition, thirty honorary memberships, ordinary and corresponding memberships of scientific Societies and Academies were conferred upon him; and finally there were seven scientific medals and two Orders, as well as the Marcel Benoist prize. In 1958 he was elected Foreign Member of the Royal Society.

That Stoll also received the recognition where his activity could be most clearly seen and most closely followed is evident from his rapid rise in the hierarchy of the Sandoz Company: he was appointed Director as early as then in 1933 Member and Delegate and in 1935 Vice-President of the 1923, Board of Directors; in 1949 he became President of the Company, and in 1964 President of the Board of Directors.

But all this did not complete Stoll’s daily stint. He was by nature a helpful person in many directions; and as this characteristic gradually became known to widening circles, and as the conviction grew and spread that he was not merely a competent chemist but moreover a man who could do other things also, so there descended on his head, from his homeland and from far abroad, requests to use his great capabilities and his good offices in chemical and other scientific organizations. In Switzerland he was active as president or member of numerous foundations and committees. In the international world he was first one of the Vice-Presidents and then for four years President of the International Union of Pure and Applied Chemistry, and also a Member and then Vice-President of the International Council of Scientific Unions.

‘Ultra posse nemo obligatur’ was never Stoll’s motto. Stoll’s activities, over so many years and in so varied fields, in furthering scientific research and scientific growth are, I like to think, one of the reasons for, and the inspiration behind, the special Festschrift (1957) that was handed to him on his 70th birthday and in which colleagues from all over the world paid their tribute by scientific papers in, especially, the field of natural products. Numerous persons and scientific organizations completed the Festschrift by Addresses. At the head of the Addresses are statements by two of his important non-chemical friends, the ‘doctor from the primeval forest’ Albert Schweitzer and the poet Hermann Hesse. I shall cite two sentences from Hesse: ‘That you, dear Jubilar, during your great lifework in the field of chemistry have not neglected music, painting, or poetry, but rather have devoted your love to them, may mean little to an only-a-chemist. To us artists it means much’. And a few sentences from Albert Schweitzer: ‘I have the honour, Professor Arthur Stoll, to greet and congratulate you from Lambarene. I do this two-fold, as doctor and as friend. . . . The hours that we were able to pass together were indeed not many; but we both experienced them as something costly that had been presented to us for our lives’. Stoll’s attitude to certain questions of public life appears clearly in the ideals of this friend.
Hermann Hesse’s congratulations made mention of painting; so we should note that, mainly during the last 35 years, Stoll had built up with much love and understanding a collection of some 800 paintings and sculptures, for which a beautiful catalogue was published a few years ago. They are mostly works of the 19th and 20th century. In addition to works by foreign and many Swiss masters, the collection centres round magnificent works by Hodler from each of his active periods. Stoll, however, did not merely collect, he actively helped many living artists by his collecting. He was also an active member of a Zurich and two Basle Art Commissions and a member of the Federal Art Commission.

This very busy man had thought in good season of founding a family. Here too fate was kind to him. In 1913 he was able to lead Martha Amsler, a friend of his youth, to his home. From this happy union sprang five children and many grandchildren.

We began with Willstätter and will close with him. As recounted earlier, Stoll stood in close contact with his teacher and thus was able to help alleviate the tragic suffering that was handed out to him a few years before his death. Willstätter was a good, indeed an enthusiastic, German. But he was a Jew. After he had been forced to ‘renounce’ his entire fortune and his house, ‘of his own free will’, he was able on Stoll’s intervention to leave Germany and, from 1939, to pass his few remaining years in the homely Villa Eremitaggio in Locarno-Muralto in peace. We must all be grateful to Stoll for what he did for one of our great men.

I am indebted to Dr R. S. Cahn for the English translation of a slightly modified German original of this Biographical Memoir (Ruzicka 1971).

Dr Christian Stoll kindly supplied the photograph of his father (by Peter Heman, Basle) and the last part (from No. 284) of the bibliography in addition to the bibliography published in the Festschrift (1957).

L. Ruzicka.

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