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Progress in Colloid & Polymer Science

Structure, Dynamics and Properties of Disperse Colloidal Systems

Editors:
F. Kremer (Leipzig)
G. Lagaly (Kiel)

Guest Editors:
H. Rehage and
G. Peschel (Essen)

The 38th General Meeting of the German Colloid Society was held at the University of Essen, Germany, from September 29th to October 2nd, 1997. The selection of papers presented in this volume covers a broad range of fundamental aspects as well as recent developments.
It focuses the following sections

- Technical applications
- Advanced experimental techniques
- Thin films and interfaces
- Suspensions and microcapsules
- Emulsions, microemulsions and foams
- Macromolecules
- Association colloids
- Colloidal systems in environmental science.

STEINKOPFF
DARMSTADT

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PREFACE

This special issue contains of a selection of papers and posters which were presented at the 38th General Meeting of the German Colloid Society. This conference was held at the University of Essen, Germany, from September 29th to October 2nd, 1997. The main topic of this congress was focused on "Structure, Dynamics, and Properties of Disperse Colloidal Systems". The lectures and posters covered a broad range of colloidal particles, such as emulsions, microemulsions, foams, dispersions, membranes, vesicles, microcapsules, nanoparticles, surfactants, polymers and liquid crystalline phases. On October 2nd, an additional symposium was organized on the application of colloidal systems in environmental science. Special topics of this session were focused on new processes of soil and ground water remediation.

The conference was attended by over 360 participants coming from 12 different countries. It is interesting to note that about 40 % of the participants work in industry. The scientific program was composed of 132 contributions, covering theoretical, experimental, and technical aspects. Lively discussions took place during the lectures and around the posters.

The first session was opened by the President of the German Colloid Society, Prof. Dr. M. J. Schwuger. Two well-known and famous scientists received awards from the German Colloid Society. In honor of his excellent and outstanding work on surfactants, emulsions, and microemulsions, Prof. Dr. Stig Friberg, Potsdam, New York, received the Wolfgang Ostwald Prize.

The Thomas Graham Medal was conferred to Prof. Dr. Armin. Weiß, Munich, for his detailed investigations of clay minerals and for his exceptional merits in colloid science. The Richard Zsigmondy Scholarship for successful young colloid scientists was awarded to Dr. Andreas Pohlmeier, Forschungszentrum Jülich.

In addition to these distinctions two students were honored for their excellent poster presentations. These prizes were awarded to: M. Dreja, B. Tieke (Köln): Polymerization of styrene in ternary microemulsions using cationic gemini surfactants, and H. Lippold, K. Quitsch (Leipzig): Micellar incorporation without solubilizing effect: Experimental studies of the surfactant system water/phenol/MEGA-10.

Review lectures on main topics of the conference were presented by S. E. Friberg (Clarkson University), P. G. de Gennes (Paris), D. Horn (BASF AG), G. Rossmy (Th. Goldschmidt AG), W. Umbach (Henkel KGaA), and A. Weiß (Univ. München). These plenary lectures were focused on emulsions, liquid films, advanced experimental techniques, amphiphilic solid particles, the importance of colloid chemistry in industrial practice, and the stability of suspensions. In addition to these contributions, 18 invited lectures, 48 contributed lectures, and 60 posters were presented. These activities provided a platform to review recent developments and to exchange new results and ideas. They also served to improve our current understanding of microscopic structures and macroscopic properties. The different contributions can be divided into the following sessions, which appear roughly in the order as they were presented in the meeting:

- Technical Applications
- Advanced Experimental Techniques
- Thin Films and Interfaces
- Suspensions and Microcapsules
- Emulsions, Microemulsions, and Foams
- Macromolecules
- Association Colloids
- Colloidal Systems in Environmental Science

The conference covered both fundamental aspects as well as technological applications. The scientific program was established under the guidance of an efficient program committee comprising P. Belouschek, G. Peschel, H. Rehage, W. v. Rybinski, and M. J. Schwuger. Our thanks go to all who contributed to the cordial scientific atmosphere of the meeting. Generous donations, which helped to finance the meeting, were made by BASF AG, Bayer AG, Clariant GmbH, Henkel KGaA, Industrie und Handelskammer Essen, Th. Goldschmidt AG, and RWE AG. We also gratefully acknowledge financial support from the University of Essen which kindly allowed us to use the facilities, where the conference took place. On behalf of the organizing comittee, we would like to thank all the participants and lecturers for their brilliant contributions and stimulating discussions. Finally, it is also a great pleasure to thank the authors of this volume for their excellent presentations. We sincerely do hope that the conference will stimulate new activities for future research in the whole area of colloid and polymer science.

Heinz Rehage
Gerhard Peschel

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M.J. Schwuger

Opening address at the 38th General Conference of the German Colloid Society in Essen

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Ladies and Gentlemen,

Today I would first like to discuss the situation of chemistry and especially that of colloid chemistry in Germany. These two disciplines differ considerably. You are all aware that in the industrial sector chemistry is flourishing, companies are achieving high returns; nevertheless the employment situation for chemistry graduates is not very encouraging. In comparison, the situation for good colloid and interfacial chemists is distinctly better. This is due to the fact that interfacial and colloid chemistry is a discipline of great significance in industrial processes, a fact which is becoming increasingly apparent to companies. The same is also true for the environmental research field. Processes in the terrestrial environment, in soil, water and also in the gas phase, are largely of a colloid and interfacial chemical nature. These processes are today involved in the assessment of the environmental compatibility of new substances and their transport behavior. Some new environmental technologies are also based on such processes. To this extent, the significance of colloid chemistry in the environmental field has also increased in the past few decades. This naturally has a positive effect on the employment situation in our branch of science.

In the late 1960s and early 1970s, the image of colloid chemistry in Germany was very unfavorable. A large number of professorships ceased to exist and scientists went over to other so-called modern disciplines of physical chemistry. This meant that the industry had great difficulty in obtaining trained staff, and in some cases personnel had to be trained in the individual companies. This was recognized and we have a much more satisfactory situation in Germany today. A number of new research institutions have been established, both at universities and at national research centers. Special mention should be made of the new institutes of the Max Planck Society in Berlin and the Helmholtz Association in Jülich. In this respect, large research institutions are also now devoting themselves to colloid chemistry as an important research field. Such a significant discipline also needs a strong association and representation. We have, therefore, attempted in the course of the past four years to invigorate the Kolloid-Gesellschaft and provide it with new impetus.

Until four years ago, we essentially held only the general meetings of the Kolloid-Gesellschaft every other year. There was an optional possibility of holding other events under the umbrella of the Kolloid-Gesellschaft, but this was not sufficiently exploited. We have made a radical change here.

First of all, the structure of the general meetings was revamped. At the beginning of each conference, leading personalities from politics, industry, and science are to be invited to deal with topics of overlapping significance in general lectures. Furthermore, we want to enhance the attractiveness of the events by holding a special symposium within the framework of the general meetings. We organized such a symposium for the first time in Essen concerning the significance of colloid chemistry for innovative environmental technologies. In this respect, we are trying to make the events as interesting as possible in order to attract colleagues from industry, public authorities, and universities to the Kolloid-Gesellschaft. We shall see how this new conception for the general meetings is received. However, it can already be said that a record was achieved with about 350 delegates in Essen since previous events all had fewer attendees.

As a further innovation we instituted the Wolfgang Ostwald Colloquia to be held once or twice a year: once in the year of the general meeting and twice in the years between the general meetings. In one or two day workshops special, as a rule closely defined, topics are to be addressed and brought to the attention of a broad group of interested persons by invited speakers. Five such colloquia have been held to date. They were all a success. The number of participants ranged between 90 and 140, which represents an optimum size for events of this type.

We have recently also opened up another field intended to appeal to young researchers. Meetings for young scientists in colloid and interfacial research have been introduced. Being specially tailored to students, taking their final examinations, PhD students, and those working on their *Habilitation*, these meetings are aimed at giving young people the opportunity to present their work to a wider public for the first time. We are still at the beginning here and hope that this idea will gain acceptance in the future.

Finally, we also intend to hold international conferences on an occasional basis in the gaps between the general meetings taking place every other year, either alone or together with other societies. This means that we have introduced different types of events, or are planning to do so, and hope that we can, thus, increase interest in the Kolloid-Gesellschaft and colloid chemistry in Germany.

Four conferences are planned for 1998. In order to avoid an overload this year, the young scientists' meetings will be organized separately but held at the same venue in Jülich together with the 6th Wolfgang Ostwald Colloquium so that both events can profit from each other. We shall also organize a 1st International Conference in Dresden on "Self-Assembly of Amphiphilic Systems" and hold the 7th Wolfgang Ostwald Colloquium in Berlin.

As far as cooperation with other societies is concerned, we have already had a joint Wolfgang Ostwald Colloquium in Dresden with the Society of German Chemists (GDCh) and a joint Wolfgang Ostwald Colloquium is planned for 1999 with Swiss colleagues. In the year 2000 an international conference is to be held with our Hungarian colleagues in Hungary.

Our Society's prizes are also an opportunity for promotion. As of now we have four prizes which are awarded as the occasion arises: the Wolfgang Ostwald Prize for lifework, the Thomas Graham Prize for lifework and commitment to colloid chemistry in an international and national framework, the Steinkopff Prize for applying colloid chemistry to environment and technology, and the Zsigmondy Scholarship for young scientists. We find that one instrument is still lacking in this context we shall institute a new prize for scientists in the medium age range between 40 and 55. In American societies there are prizes especially for this group, and we would also like to introduce one at the Kolloid-Gesellschaft. As chairman, I do not wish to merely fulfill a representative function so I have decided to donate this prize from my own private funds. After lengthy discussion, we agreed to name this prize after Raphael Eduard Liesegang. Perhaps some of the younger generation are not immediately familiar with Raphael Eduard Liesegang. He was born in Wuppertal-Elberfeld in 1869 and became professor at the University of Frankfurt am Main in 1908. He died at a ripe old age in 1947. Liesegang's particular achievements were in "classical" colloid chemistry. Reactions in gelatinous systems, i.e., in gels and sols, the Liesegang rings, are also familiar to all young chemists. The reason why he appears particularly important is that he was one of the first to recognize the significance of colloids in technology. His books "Colloids in Technology", "Colloid Chemical Technology" as well as "Biological Technology" were ground-breaking for what we today regard – undoubtedly from a different standpoint – as particularly significant for our discipline. I believe that this will be a worthy namesake for our new prize.

The Society's activities and active recruitment have led to membership having almost doubled in the past few years. Nevertheless, the potential for colloid chemistry in German-speaking countries is much greater than expressed by this level of membership. We are therefore recruiting new members, but at the same time we regret to announce the death of respected colleagues who have accompanied us throughout the years. In the past two years, the death occurred of Professor Hans Sonntag, who was awarded the last Ostwald Prize in Dresden, Professor Erika Cremer from Innsbruck, and Dr. Moll from Walsrode.

I hope this conference will be a great success.

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E. Matijević

Wolfgang-Ostwald-Prize 1997: Awarded to Stig Friberg

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Professor Stig E. Friberg, Potsdam, NY, USA, received the Wolfgang Ostwald Prize of the Kolloid-Gesellschaft for his investigations on the applications of amphiphilic association structres in dispersions ranging from colloidal to macrosize systems, with special emphasis on liquid dispersions.

His research has led to a large number of scientific firsts in the area of amphiphilic association structures, such as the formation of non-aqueous lyotropic liquid crystals, microemulsions, and stable foams from low-surface free-energy liquids. He also developed new stabilization mechanisms for emulsions, as well as catalytic activity by inverse micelles and by the surfaces in lyotropic liquid crystals.

Curriculum vitae

Stig E. Friberg was born in the small village of Rimforsa in the heavily wooded, hilly southern part of Östergötland in Sweden. His unusual intellectual capacity was already realized in the little country school, where he received his first education. Later, a combination of part-time employment and scholarships allowed him to study physical chemistry at the University of Stockholm with the extremely gifted (and temperamental) Arne Ölander as his "hands off" mentor.

One year after obtaining his PhD he was appointed successor to Per Ekwall as director of the Laboratory for Surface Chemistry in Stockholm, a research institute, which under his leadership developed into an internationally known establishment with some sixty scientists supported by the Swedish government and industries from Sweden, Norway, and Denmark.

For his contributions to colloid science and the technical development in Sweden, Stig Friberg was elected as a member of the Swedish National Academy for Engineering Science in 1974, at the time the youngest person to be so honored.

Managing the institute limited his research activities, and although several scientific firsts were published from Stockholm, it was obvious that Stig Friberg wanted to devote more time for research. Thus, in 1976 he accepted the position as Chairman and Professor in the Chemistry Department, University of Missouri at Rolla, Missouri, USA. His research efforts became appreciated internationally, as shown by the Award for Excellence in Research by the Japanese Colloid Division in 1978 and nationally with several awards from

the American Cosmetic Chemists Society, the American Chemical Society Award in Colloid and Surface Science, and the University of Missouri at Rolla Faculty Medal for the Curators Distinguished Professorship.

In 1987, Stig Friberg moved to Clarkson University, Potsdam, NY, USA as Chairman of the Chemistry Department, and a member of the University's Center for Advanced Materials Processing. During his tenure at Clarkson, he has received honorary doctorates from Lund University, Sweden, Yokohama National University, Japan, and Åbo Academy University, Finland. His recent interest in the fundamentals of skin care was rewarded with the highest honor from the American Society of Cosmetic Chemists, the Maison G. DeNavarre Medal Award.

He is an outstanding lecturer both in the classroom and in professional forums. His activity in continuing education led to the American Chemical Society's Award for Exceptional Achievement in this area.

Research activities

Microemulsions and emulsions

Stig Friberg realized very early the fundamental difference between emulsions and microemulsions and introduced phase diagrams as a tool for the formulation of the latter, an approach that is overwhelmingly used for these systems today.

He discovered multilayer emulsion stabilization, a wide spread phenomenon in pharmaceutical, food, and personal care systems. His analysis of the multilayer stabilization mechanism yielded a surprising fundamental result: the van der Waals forces showed a strong discontinuity in the transition from flocculation to coalescence. This discontinuity results in more than 90% reduction of the force, a significant contribution to the enhanced stabilization by the multilayer adsorption.

The problems with the aerosol package formulations for foams led Friberg to investigate potential mechanisms for the stability of foams from hydrocarbons. The problem is fundamentally simple: hydrocarbon based surfactants do not reduce their surface free energy. Hence, there is no adsorption at the air/hydrocarbon interface and no foam stabilization may be obtained.

Stig Friberg could show that the phase change from an inverse micellar solution to a lamellar liquid crystal led to a reduction of surface free energy due to a restricted conformation of the surfactant in the latter phase. The surface of the lamellar liquid crystal contains predominantly methyl groups instead of a mixture of methyl and methylene groups in the disordered liquid. The difference in the surface free energy is at the level of 6–10 nM/m, which is sufficient to give a preferred organization hydrocarbon/liquid crystal/air instead of liquid crystal/oil/air in a three-phase system. Hence, the foam bubbles are covered with a macroscopic layer of a liquid crystal, providing excellent stabilization.

Ever since the Winsor analysis in the 1950s, it was generally accepted that water was a necessary solvent in order to form micelles or lyotropic liquid crystals. Stig Friberg demonstrated this conclusion to be premature by discovering the first example of a waterless lamellar liquid crystal in 1979, which led to a series of publications, clarifying the structure of such liquid crystals. His contributions led several European laboratories to engage in this area of research.

Sol–gel process

The sol–gel process uses alcohol solutions to hydrolyze and subsequently condense alkoxymetal compound combinations to form glasses of extreme purity and of molecularly controlled homogeneous composition. Stig Friberg recognized the potential for using water-in-oil microemulsions as solvents, thereby opening the field for formulating glasses with a high content of inorganic electrolytes. Transparent glasses containing inorganic salts, or even concentrated sulfuric acid in excess of 50%, were prepared and tested for application in laser technology.

Vapor pressure variation in colloidal systems

Recently Stig Friberg has become interested in the variation of vapor pressures in colloidal systems for applications in personal care products, coatings, and high-speed printing inks. The new results have demonstrated that the association structures have a decisive influence on the vapor pressure of solubilized volatile compounds in microemulsions, liquid crystals, and emulsions.

Some personal observations

The writer of this laudation met Professor Stig Friberg nearly 30 years ago and countless times both in Sweden and in the USA even before he joined Clarkson's faculty. These contacts made it possible to add some personal notes to the more formal description of his vitae and accomplishments. In summary, Stig is a true scholar as an academic person need be. His interests transgress the area of research, which he certainly enjoys doing, because he is equally able to discuss and argue topics in philosophy, civilization, politics, religion, art – and extra curricular activities.

Friberg can also readily adapt to a new environment or different situations. When I first met Stig in his

native country, he always wore a dark suit and followed a rigid working schedule. A few years later I found him in Rolla, Missouri attired with cowboy boots, a shoelace tie, and a five gallon hat! But there was a reason for it. In Sweden his outdoor activities included sailing; indeed, he is an expert seaman who sailed the waters of the Baltic Sea and the Atlantic Ocean. Well, there is little chance to sail in Missouri, so Stig turned his interest to horses. Within a short time he knew more about these animals than most people who owned stables for a long time. He still rides daily in his "corral" in Potsdam.

Stig's ability to adapt pays off professionally. He is one of the academic people who has the ability to translate a research problem (or project) into useful application. For this reason, he has been a valued consultant to many corporations in the USA and abroad.

Stig enjoys life. He likes fine foods and good wines, especially in the company of friends, who are conducive to interesting conversations.

Finally, Stig Friberg never denies his Swedish roots. However, he has accepted the USA as his home to which he is most loyal. One of his proud moments was when he became a citizen of this country. With his move to the United States we have gained much, but the "Old World" has not suffered a loss, because Stig is scientifically a – World Citizen.

Egon Matijević
Distinguished University Professor
Clarkson University, Potsdam, NY, USA

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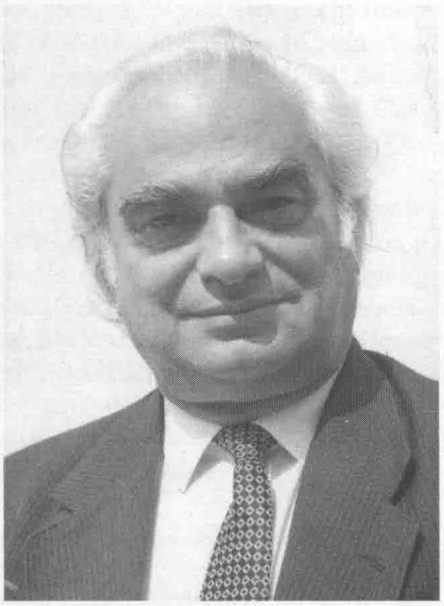
K. Beneke
G. Lagaly
G. Schön

Thomas Graham Prize 1997 awarded to Armin Weiss



The Kolloid–Gesellschaft awards the Thomas Graham Prize for exceptional merits in colloid science, for encouragement of international cooperation in colloid science and advancements in interdisciplinary research. Armin Weiss is deserving of this prize because of his activities during the last 30 years.

In 1966, Armin Weiss became the editor of Kolloid Z. Z. Polymere. During this time, the journal (founded 1906 by Wolfgang Ostwald) was already an international journal. Nevertheless, the transformation of it into Colloid Polymer Science in 1974 was indicative of the strong international orientation of Armin Weiss. In the 20 years in this position, he made strong efforts to publish outstanding contributions in almost every area of colloid and interface science.

During this period Armin Weiss was also President of Kolloid–Gesellschaft. He held this position for over 20 years (1967–1987), almost as long as Wolfgang Ostwald (1922–1943). At the beginning of this period the destiny of the Kolloid–Gesellschaft was oscillating between a quietly running German group and a vivid association with an international reputation. Armin Weiss was responsible for gaining the international reputation of this society. In the 1960s, this was not as easy as one imagines today. The charming, fascinating personality of Armin Weiss and his high scientific reputation outside Germany promoted this metamorphosis of the society into one with an international standing. He also created many contacts between the Kolloid–Gesellschaft and industrial research and application groups; he always stressed the importance of diffusion through the interface between the society and the industrial sector.

Armin Weiss' activity for the Kolloid–Gesellschaft was recognised world wide: 1979–1983 he was appointed Vicepresident of the International Association of Colloid and Surface Scientists. In this period, 1978–1982, he also served as Vicepresident of the Association International pour l'Étude des Argiles.

The success of Armin Weiss as editor of Colloid Polymer Science and as President of the Kolloid–Gesellschaft was certainly not based on red-type behavior (he always stays in an atmosphere of "ordered chaos") but solely on his exceptional ability to persuade people of his ideas and on his outstanding scientific reputation.

The oeuvre of Armin Weiss is of greatest importance. In his doctoral thesis (1953, Technical University Darmstadt, Professor Ulrich Hofmann) he described reactions in the interlayer space of layered crystals.

K. Beneke · Prof. Dr. Dr. h. c. G. Lagaly (✉)
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After two years (!) he passed the Habilitation with a contribution about cyanides of transition elements. In the 1950s he published studies on the structure and properties of various chalcogenides, silicides, germanides, cyanides, mercury compounds, thiosalts, etc. (many papers together with his brother, Alarich Weiss, G. Nagorsen, and H. Schäfer). An highlight was the preparation and crystal structure determination of a new modification of silicium dioxide which consists of infinite chains of SiO_4 tetrahedra sharing opposite edges.

The first publication (1951) was "Batavit", a vermiculite-like 2:1 clay mineral. As a student in the group of Ulrich Hofmann (Diploma examination in Munich, 1951) he acquired a long lasting interest focused on the study of clay minerals. He described fibrous vermiculite, wolchonskoite and saponite, but his main interest lay in the study of ion exchange properties and the intracrystalline reactivity of the clay minerals, in particular towards organic compounds. Thus, numerous intercalation compounds were first described by Armin Weiss and coworkers. In this field of research he also contributed to our knowledge of mechanisms of petroleum formation, and, for some time, he was engaged in the discussions about the role of clay minerals in the origin of life. We have enjoyed and preserved a vivid memory to endless discussions on this topic in Munich. Unfortunately, these brilliant ideas were never published in the convincing original framework.

A significant impact on colloid science resulted from studies on the thixotropy of clay mineral dispersion. The current understanding of ceramic processes is based on the principles of colloid chemistry of clay minerals worked out by Ulrich Hofmann and Armin Weiss.

More recently, Armin Weiss and coworkers studied alteration of clay minerals by phosphate and formation of taranakite and other alumophosphates, an important aspect to be considered when clay minerals are used in barriers.

A milestone (1961) was the observation of the intercalation capability of kaolinite, when kaolinite was reacted with urea. The idea behind these experiments was that the hydrogen bonds between the kaolinite layers may be opened by molecules such as urea, which are known to break hydrogen bonds.

This discovery not only resulted in practical applications but provided an explanation of the secret of Chinese procelain. Everyone who was lucky to attend one of his lectures on this topic was deeply impressed by his fascinating bridging between old eastern cultural heritage, empirical knowledge and modern science.

A few years later, Armin Weiss observed the intercalation of organic molecules into titanium disulfide and initiated a new field of research. Since then, the number of new intercalation compounds had increased rapidly.

In parallel with the studies of 2:1 clay minerals he investigated intracrystalline reactions of various layer compounds such as titanates, phosphates, vanadates, uranium micas (often together with K. Hartl and E. Michel), graphite oxide and, more recently, iron oxychloride and earth alkali quadrates (together with C. Robl). He also described, for the first time, the two-dimensional swelling of many chain-like compounds: polyphosphates, polyvanadates, mercury amidosulfonates, alginic acid, pectic acid and deoxyribonucleic acid.

A fascinating aspect of his research was the study of silicosis. In 1958 he analyzed solid materials enriched in human lungs and isolated a swelling, toxical iron phosphate silicate, which grows within the air cells and finally destroys them.

Besides these studies Armin Weiss was also interested in complex chemistry and published several papers on silicon complexes with octahedral coordination. More recently, he (together with S. Dick) modified the clay mineral surface with binuclear iron complexes to prepare enzyme models.

Armin Weiss continuously covered new fields of interest. He initiated solid state chemistry at high temperature (with K. Hartl) and high pressure (with K. J. Range). Dielectric measurements on layer compounds (with G. Schön) laid the foundations for dielectric spectroscopy and modern impedance spectroscopy in material research. Detection of kink-type conformational changes of the alkyl chains in bimolecular interlayer films (with G. Lagaly) bordered on polymer chemistry and biomembrane science. He also studied the nerve myelin structure and excitation of nerve cells.

In 1974 he initiated (together with H.-P. Boehm and G. Lagaly) an advanced course "stability of dispersions and emulsions". This training of scientists from industry and practice became one of the most effective courses of Fortbildungskurse der Gesellschaft Deutscher Chemiker. From 1967 to 1969 he performed 27 telecourses on general and inorganic chemistry.

Armin Weiss was always open to discussions of environmental problems. An increasing activity in this field was not unexpected as Armin Weiss always engaged himself fully in all areas he touched. From 1986 to 1990 he acted as a member of the Bayerischer Landtag (parliament of Bavaria). Many of his colleagues could not understand his consequent morale since this was connected with many troubles and hostilities.

As annex we report biographical data:

1927 born in Stefling (a small village near Regensburg), 1943–1945 Luftwaffenhelfer in the second world war. 1945 Vorexamen in pharmacy, 1947–1951 study of chemistry in Regensburg, Würzburg and München. 1951 diploma examination in Munich,

1953 thesis (Technical University, Darmstadt, Prof. Dr. Ulrich Hofmann), 1955 Habilitation (Technical University Darmstadt). 1961–1965 Professor (Extraordinarius) of Inorganic Chemistry, University Heidelberg, 1965–1996 Professor (Ordinarius), University Munich.

Several of his coworkers hold or held positions as professor of inorganic chemistry: G. Lagaly (Univ. Kiel), K.-J. Range (Univ. Regensburg), C. Robl (Univ. Jena), H. Schäfer (Univ. Darmstadt, ✠ 1986), R. Schöllhorn (Techn. Univ. Berlin), G. Schön (Univ. Essen).

Armin Weiss was honoured with several awards:

1963, Medal d'Hommage, Université Libre Bruxelles;

1979, Member of New York Academy of Sciences;

1981, Liebig-Preis der Gesellschaft Deutscher Chemiker;

1984, Preis für Verfahrenstechnik der Textilveredelung;

1985, Dr. rer. nat. h. c., Lorand-Eötvös-University Budapest;

1987, Distinguished member of Sociedad Española de Arcillas.

He was visiting professor at Université Libre, Bruxelles (1963), Unileyer Visiting Professor, University Bristol (1974), and guest at Institute Laue-Langevin in Grenoble (1980).

A few basic papers concerning clay mineral and colloid chemistry are listed:

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