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The 36th IUPAC Congress: Frontiers in Chemistry, New Perspectives for the 2000s

The 36th IUPAC congress was organized in Geneva (Switzerland) from August 17.–22. The organizing committee under the Chairman *J. Weber* (University of Geneva) organized the meeting and handled the more than 1200 participants with extraordinary perfection. The Scientific Committee under the Chairman *F. Diederich* from the ETH-Zürich invited nine outstanding plenary lecture speakers who reported as clear leaders in their disciplines about the current status of chemistry. Two plenary lectures addressed the problematic relation between chemistry and the public, which more too often perceives the increase of scientific knowledge as an intolerable risk for life on earth.

In five parallel sessions, modern aspects of organic chemistry, inorganic chemistry, analytical chemistry, physical chemistry, and last but not least chemistry and biology were discussed. 40 invited keynote lectures, another 40 invited lectures, and 20 short lectures formed the basis for the outstanding scientific program. During the week, 832 posters presented in three different poster sessions on Monday, Tuesday, and Thursday enriched the scientific discussion during the late afternoons. In order to allow the participants to preselect posters of their interest, all poster abstracts were published in advance in *CHIMIA*. With more than 200 posters presented by Swiss chemists, Switzerland contributed by far the largest poster contingent and showed impressively the high international standard of the discipline chemistry in this country. The IUPAC clearly proved in the conference week that the IUPAC congress is the world largest international forum for the borderless transfer of chemical knowledge. We are, therefore, sure that the 1252 active participants from 59 different countries left this congress with a clear perception for the problems and the risks of the science chemistry, but with the conviction that chemistry is a lively, rapidly growing and exciting science endeavor in which new ideas and concepts are constantly generated to help increasing the wealth of human society and to enrich human culture.

Opening Session

After the welcoming by *J. Weber* (University of Geneva), Chairman of the Organizing Committee of the Congress, *F. Waldvogel*, Chairman of the Board of the Swiss Federal Institutes of Technology emphasized the importance of chemistry for Switzerland, a country in which this discipline has a long tradition and where the chemical industry is one of the most important employers. *M. Brunschwig Graf*, Minister of Education of the Republic and Canton of Geneva was pleased by the outflow of ideas to be expected from the high concentration of *ca.* 1300 chemists' brains in Geneva during the congress. *A. Fischli*, President of the IUPAC, was proud that 56 countries and 150 companies are now affiliated with the IUPAC. For the first time since 1967, both events – IUPAC Congress and General Assembly – took place together in the same city, and this will also be the case for the 1999 meeting in Berlin. *A. Fischli* stressed the role of science as part of our culture and welfare and, therefore, the need for a good scientific education: 'If you think that education is too expensive, try ignorance' (*Abraham Lincoln*). *A. von Zelewsky* (University of Fribourg), President of the New Swiss Chemical Society, reminded the audience that Geneva had already hosted an IUPAC conference on chemical nomenclature in 1892. He expressed his hope that the meeting would contribute to a good communication not only among chemists but also with non-chemists. The many posters that had been accepted for the conference made *F. Diederich* (ETH-Zürich), Chairman of the Scientific Committee of the Congress, optimistic with regard to the development of chemistry in the future. As to the perspectives in chemistry, he stressed the growing importance of biological and materials sciences at the borderline of the core disciplines organic chemistry, inorganic chemistry, physical chemistry, and analytical chemistry. He stated that an excellent knowledge in the core disciplines will ensure efficient research at the interfaces.

Chemistry and Society

Atmospheric Chemistry and Ozone

Although all plenary lectures were well attended, it seemed that nobody wanted to miss *Nobel* laureate *P. J. Crutzen* (Max Planck Institute for Chemistry, Mainz) talking about human activities and the chemistry taking place in the gas layer surrounding our terrestrial globe. Two major atmospheric phenomena have been the object of hot debate: the greenhouse effect and the ozone depletion. Whereas many molecules (whether anthropogenic emissions or naturally produced) have a greenhouse effect by themselves, ozone depletion is more closely related to the chemical reactions occurring in the atmosphere. We are currently facing a loss of stratospheric ozone. The concentration of this gas at low altitudes, however, has increased, mainly in North America, Europe, and China since industrialization took place. Ozone as a key component of the troposphere as well as of the stratosphere where it does not only affect the atmospheric penetration of UV radiation, but has also an important influence on temperature regulation. *P.J. Crutzen* point-

J. Weber, *Chairman of the Organizing Committee of the congress*

F. Diederich, *Chairman of the Scientific Committee of the congress*

From left to right: A. von Zelewsky, A. Fischli, *and* M. Brunschwig Graf, *during the opening ceremony*

C. Weissmann, *answering the question how prion proteins cross the blood-brain barrier, during a lively discussion led by* F. Diederich

Photos by K. Hedinger, Geneva

ed out that our knowledge on atmospheric chemistry has made an enormous progress during the last decades: whereas only a few reactions were known some 30 years ago, their number has increased to *ca.* 400 at present. The same accounts for the modeling of atmospheric phenomena which nowadays benefits from a much larger body of available data.

Chemistry and Its Future Challenges

An educational background in agronomy and microbiology, professional experience in industry, and his current position as the president of the ETH-Zürich put *J. Nüesch* into an ideal position to talk about ethics and sustainability in science, and in chemistry in particular. The starting point of his reflections was that our society is being subjected to major transformations, a situation which by itself is not new, as illustrated by the dramatic changes triggered, *e.g.*, by the invention of the printing by *Gutenberg*, the new ideas of reformers like *Calvin* or *Luther*, the French revolution, or the invention of the steam engine. As opposed to these historical examples, however, nowaday's changes, in which science and technology play a key role, are not restricted to western society and they may be best described by the buzzwords *globalization* and *knowledge society*. On the other hand, *J. Nüesch* notices an increasing gap between two different cultures, that of natural sciences and that of the humanities. Both are often characterized by a mutual ignorance: whereas science does not provide an answer as to its own role, the humanities do not understand science. Thus, there is an urgent need to conciliate these two cultures in an anthropocentric world. This should not only be a moral duty, but also rewarding with regard to the individual's autonomy. *J. Nüesch* pointed out that we should adopt a more holistic view of problems, not forgetting to make the link to the humanities if we want to further increase the quality of life in the future.

Chemistry in the Light of the European Union

G.G.A. Balavoine (CNRS Toulouse) noted an increasing gap between science and culture at the end of this century, which is characterized more than any one before by the transformation of society through the advancement of science and technology. Although people are avidly using the products of science and engineering, they are skeptical with regard to the answers science provides, and in many cases, public debates are characterized by scientific ignorance. In this context, *G.G.A. Balavoine* raised the question of what is being done in Europe for the reconciliation of science and culture and for the promotion of chemistry. In his lecture, he strongly encouraged young scientists to efficiently use the resources made available through the commission of the European Union. Among the efforts for increasing the competitivity of industry and promoting basic research, he emphasized COST (European Cooperation in the field of Scientific and Technical research), a program for international collaborations including many sections of chemistry, which was launched in 1991 and is still being further expanded.

Prions, Prions, Prions ...

A final highlight was the talk by *C. Weissmann* (University of Zürich), a very clear survey on the molecular biology of prion diseases, of which bovine spongiform encephalopathy (BSE) continues being a topic of hot debate not only in the scientific community, but also in politics and in large parts of our society. Spongiform encephalopathies consist in a degeneration of brain tissue characterized among others by vacuoles in brain tissue giving it a spongy appearance, and by an amyloid deposit containing the PrP (Prion Protein). *C. Weissmann* explained the current understanding of the nature and mechanism of action of the infectious agent. In the second part of his talk, he reported about experiments carried out by his group after the gene, encoding PrP^C protein, had been discovered. It was found that chimeric mice devoid of the PrP^C encoding gene have a normal development, which is a surprising fact since this protein, is occurring in all vertebrates. Furthermore, injection of PrP^{Sc} to knockout mice does not make them sick; there is no replication of the infectious agent. After reintroduction of the PrP gene and subsequent injection of PrP^{Sc}, however, the transgenic animals come down with the disease even faster than wild-type mice. An important point in the transmission of prion diseases is the question of whether species barriers can be transgressed. *C. Weissmann* and his coworkers found that mice can be infected by the agent from hamster and *vice versa*, but the incubation time in such cases is much longer compared to intraspecies infection. The origin of the species barrier are differences in the amino-acid sequence of the PrP. Finally, it was observed that transgenic mice carrying the hamster PrP gene come down very rapidly after infection with the hamster agent. In a similar experiment, *Prusiner* was able to show that a transfer of the *Gastmann-Sträussler* disease gene to knockout mice made them sensitive to contracting the disease.

Bioorganic Chemistry

Bioorganic Chemistry at the Top!

Bioorganic chemistry was one of the key themes at the 36th IUPAC congress, represented by world leaders. Directly following the opening ceremony, *P.G. Schultz* (University of California, Berkeley) gave a complete overview about his current scientific program. His group is exploiting the principle idea of combinatorial chemistry/biology to create vast amounts of compounds, and they use the powerful methods of selection and amplification to extract biomolecules, small synthetic organic molecules, and new inorganic phases with desired properties. *P.G. Schultz* started to discuss the ability to create catalytically competent antibodies by immunizing mice with synthetic transition-state analogs. Since nature is only able to create antibodies with the 20 natural amino acids, the *P.G. Schultz* group has developed an *in vitro* method, which allows to incorporate unnatural amino acids into proteins using molecular biology tools. The method, powerful as it is, however, allows so far only to obtain minute amounts of the modified protein. This is the driving force for the *P.G. Schultz* group to develop even more powerful *in vivo* techniques. To this end, artificial 'RNAs and aminoacyl transferases are developed, which might help in the future to generate proteins which contain artificial amino acids at crucial positions.

Methane Metabolism

S.J. Lippard (Massachusetts Institute of Technology) continued the bioorganic chemistry morning, discussing the synthesis of carboxylate-bridges diiron compounds which mimic the active center in dioxygen-activating metalloproteins. *S.J. Lippard* discussed the mechanism of the hydroxylase enzyme of the soluble methane monooxygenase, an enzyme that plays a key role in the metabolism of CH_4 by methanotrophs. He explained that the hydroxylase is an $a_2b_2g_2$ dimer, which contains in each subunit a dinuclear iron active site which participates in the hydroxylation of methane to methanol. A major breakthrough in the research area is the X-ray crystal structure of the hydroxylase enzyme. Intensive X-ray structure work, using xenon as an X-ray visible substrate, allowed the *S.J. Lippard* group to discover that a leucine residue is acting in the enzyme as a gate between the substrate channel and the active site.

Mechanisms of Metalloproteins and the Evolutionary Optimization of Catalytic Antibodies

The ability to elucidate the mechanism of metalloproteins with carefully designed model complexes was further elucidated by *J. Chin* (McGill University, Montreal) who presented a number of marvelous multinuclear cobalt complexes, which are able to simulate the cleavage of phosphodiesters. In nature, this reaction is catalyzed by an array of metalloproteins, which use a so far not well-understood mechanism requiring two metal ions. *J. Chin* could show that the acceleration of the diester bond cleavage critically requires the second metal. He discussed that the first metal is required to activate H_2O. The second metal accelerates the cleavage reaction possibly through a stabilization of the leaving group.

The first afternoon session was opened by *D. Hilvert* (The Scripps Research Institute, La Jolla; now at ETH-Zürich) who reported about the generation of an antibody, which mimics the enzyme chorismate mutase. *D. Hilvert* presented a detailed X-ray structural comparison between the antibody and, *e.g.*, the chorismate mutases from *E. coli*. He explained possible reasons for the observed differences in catalytic efficiencies and discussed the interactions between the antibody and the substrate, which are of crucial importance for the catalytic process. Using evolutionary selection approaches, the group achieved the preparation of a truncated, but still catalytically competent version of the original antibody.

DNA Alkylation, DNA Wires, and DNA Repair

The bioorganic monday session was closed by the presentation of *H. Sugiyama* (Tokyo Medical University) who reported about the fascinating effect that the addition of minor-groove DNA binders like distamycin modulates the site of DNA alkylation by the DNA-alkylating natural product duocarmycin A. The cooperative binding of both natural products causes highly efficient alkylation of guanine residues. In combination with the new highly sequence-specific distamycin analogs, currently developed by *P. Dervan* and coworkers, this finding opens new ways for the design of highly sequence-specific DNA alkylating agents.

The bioorganic session of the second day was opened by *J.K. Barton* (California Institute of Technology, Pasadena) who reported about the electron transfer properties of double helical DNA. *J.K. Barton* reported about a strong fluorescence quenching of an intercalated electron donor in the presence of an additional intercalated electron acceptor. The fluorescence quenching is so strong that the *J.K. Barton* group concluded fast photoinduced electron transfer along the DNA π-stack. Further experiments with electron donors and acceptors, tethered to both ends of a long DNA double helix supported this result. *J.K. Barton* achieved the repair of a cyclobutane thymine dimer DNA lesion through long-range electron transfer. Such processes were named: *Chemistry at a distance*.

T. Carell (ETH-Zürich) discussed in the second morning talk the synthesis of model compounds, which allow to study the flavin- and deazaflavin-dependent repair of cyclobutane thymine dimers by the DNA repair enzyme DNA photolyases. With the help of these models detailed mechanistic information about the electron-transfer-initiated repair could be obtained. In the second part of his talk, he reported about the synthesis of DNA-lesion isosteres, enzymatic DNA repair studies, and about the preparation of cofactor amino acids. These can be incorporated into DNA-binding oligopeptides, which then show a primitive DNA repair function.

G.L. Verdine (Harvard University, Cambridge) reported about his chemical approaches to elucidate the repair of DNA alkylation damages. He described the synthesis of novel inhibitors for DNA glycosylases. These compounds also allow to investigate the mechanisms of these enzymes, which play a major role in DNA repair. He also reported about the fascinating X-ray structure of a methyl transferase enzyme, which shows the alkylated cytosine in a flipped-out conformation. This flip-out motif is currently thought to be a general recognition pattern used by repair enzymes to locate the damaged site within the complex genome.

Chaperonin Assists Protein Folding and DNA Recognition Analyzed by NMR

A. Horowitz (Weizmann Institute of Science, Rehovot) reported about the chaperonin GroEL which is allosterically regulated by adenine nucleotides. The protein consists of two stacked seven-membered rings with 14 ATP binding sites and an ATPase activity which is cooperatively regulated by ATP binding. Each ring exists in two states, a low-affinity state and a high-affinity state. In order to learn about the molecular events which accompany the change of the state, the group performed a number of protein engineering investigations, which showed that an intrasubunit salt bridge becomes significantly weakened during ATP binding.

D.E. Wemmer (University of California, Berkeley) reported about detailed NMR investigations of complexes between the minor-groove binders distamycin and their AT-rich DNA targets. The group found that two of these natural products bind antiparallel and allosterically into the minor groove in a 2:1 manner. The results provided insights into how these natural product interact with bases in the minor groove and allowed to design artificial distamycin analogs, which are now able to recognize GC pairs in a very sequence-specific manner.

Pharmaceutical Chemistry in the Next Millennium and New Insights into the Action of Anti-Herpes-Simplex Pharmaceuticals

On Wednesday morning, *K. Müller* (*F. Hoffmann-La Roche*, Basel) reported in a powerful double projection lecture about the ongoing efforts in the chemical industry to speed up the drug discovery process. All areas, from the finding of new lead structures, the development of the most potent leads into promising drug candidates, the efficient testing of as many compounds as possible, and all procedures in clinical phases are currently under restructuring. New techniques like combinatorial chemistry, high throughput screening, and genome sequencing together with new tools for the evaluation of the pharmacological properties of compounds are currently being implemented. They will form, combined with more traditional techniques, the drug discovery process of tomorrow.

G. Folkers (ETH-Zürich) reported about the X-ray crystal structure of the herpes-simplex tyrosine kinase, which was solved in collaboration with the *G. Schulz* group in Freiburg. This fascinating protein structure allowed the *G. Folkers* group, in combination with cutting-edge *Car-Parinello* density functional methods to obtain a detailed understanding of how the therapeutics acyclovir and gancyclovir interact with the tyrosine kinase. This enzyme is of immense importance in the life cycle of the virus, and the more detailed understanding of the drug-protein interactions is now thought to provide the critical data which are required for the design of more effective and selective inhibitors.

P.G. Crutzen *in discussion with* A. von Zelewsky *shortly after his plenary lecture about the effects of ozone in the troposphere*

New Combinatorial Approaches

The bioorganic session of the fourth day was opened by a lecture from *C. Khosla* (Stanford University). His group is currently exploring the modular enzyme units which are organized to the multifunctional polyketide synthases. By using powerful molecular biology methods, this group is exploring new combinations of these modular enzyme units within cells. These new combinations are indeed yielding novel polyketides, which are isolated by the group. Novel selection procedures might allow the *C. Khosla* group in the future to select organisms which generate a novel and specific natural product which is able to interfere with critical enzymes or important receptors.

I. Huc from the *J.-M. Lehn* group (University Louis Pasteur, Strasbourg) reported about a new approach in combinatorial chemistry. This group generates a virtual library by mixing compounds that are able to form reversible bonds. Upon addition of a biomolecule, the group hopes to template the formation of those molecules, which are able to fit into the active site, thereby shifting the equilibrium towards the desired compounds.

Signal Transduction: A Key Biochemical Mechanism in Life

The bioorganic session of the last day of the 36th IUPAC Congress was opened by an excellent lecture of *H. Waldmann* (University of Karlsruhe). He reported about new synthetic strategies which allow to synthesize lipoproteins. The key element of the synthesis are special enzyme-labile protection groups which can be removed under mild, neutral aqueous conditions. The group is now preparing a variety of lipopeptides, which are used as tools for the investigation of the signal transduction cascade. Membrane insertion and microinjection techniques allowed the *H. Waldmann* group to gain deep insight into the molecular details of the signal transduction cascade.

Organic Chemistry

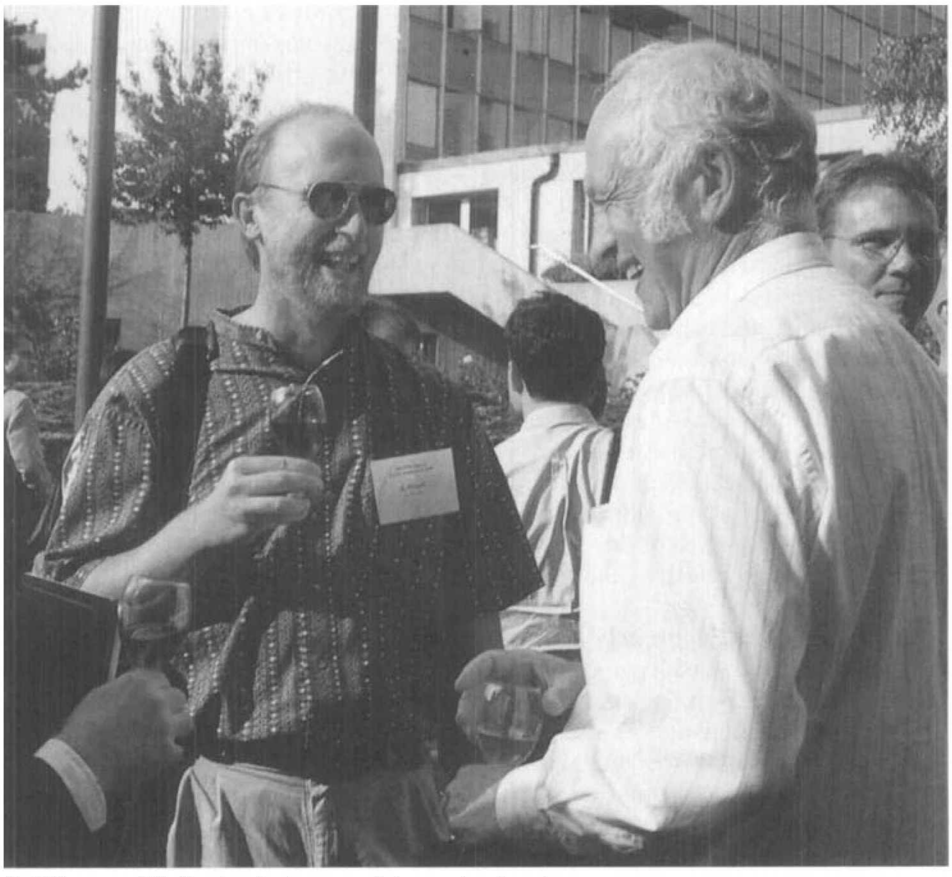
Self-Assembly and Microfabrication

The group of *G.M. Whitesides* (Harvard University, Cambridge) has developed a number of techniques for the fabrication of micro- and nanostructures, grouped under the term of soft lithography. The adjective soft refers to the elastomeric stamps or molds often used in the manufacturing process as well as to the properties of the organic materials on which this type of lithography is based. One of the presented techniques is the so-called microcontact printing (mCP) in which a microstructured silicone-elastomer stamp is 'inked' with a solution of molecules capable of forming self-assembled monolayers (SAMs) and after evaporation of the solvent, is applied to a surface. This leads to a transfer of 'ink' molecules which form a pattern of self-assembled monolayers protecting well-defined parts of the surface in a subsequent selective chemical etching process. By this technique, it was possible to generate microstructures with an edge sharpness of *ca.* 50 nm.

Designer Lewis *Acids*

The first keynote lecture in the organic chemistry session entitled 'Designer *Lewis* Acids for Selective Organic Synthesis' was given by *H. Yamamoto* (University of Nagoya). He discussed the effect of bulky *Lewis* acids such as aluminum tris(2,6-diphenylphenoxide) (ATPH) on a variety of reactions. 1,6-Addition of simple organolithium and -magnesium compounds to aromatic aldehydes, regioselective alkylation of unsymmetrical ketones, and crossed aldol condensation reactions can all be performed in the presence of ATPH. In addition, applications of chiral *Lewis* acids in enantioselective *Diels-Alder*, aldol, and allylation reactions were presented.

The second lecture was given by *I. Marek* (University P. and M. Curie, Paris) He reported highly enantioselective carbolithiations of cinnamyl-alcohol derivatives using sparteine as a chiral inductor. The chiral benzylic organolithium compounds formed in the carbolithiation can either react with external electrophiles to form chiral alcohols or intramolecularly to provide chiral disubstituted cyclopropanes with high enantiomeric excess. A new stereoselective pyrrolidine synthesis *via* intramolecular carbometalation of a zinc enolate as a key step was also presented.



D. Hilvert *and* C. Ganter *during one of the session breaks*

Supramolecular Chemistry: From Molecules to 'Nanomolecules'

After two lectures focusing on synthetic organic methodology, we then moved to supramolecular chemistry. *R.J.M. Nolte* (University of Nijmegen), in his keynote lecture 'From Molecules to Supramolecules to Nanomolecules', showed that palladium-bridged porphyrin dimers can aggregate to form porphyrin 'wheels' on a micrometer scale. These 'wheels' were then analyzed by near-field scanning optical microscopy (NSOM) and by atomic force microscopy (AFM). He then went on to describe electron transfer from a porphyrin to a covalently linked quinone.

L. De Cola (University of Bologna) talked about photoswitchable systems. According to *L. De Cola* a photoswitchable system should fulfil several criteria, namely, fast response, high quantum yield, chemical stability, and reversibility. The reversible photodimerization of anthracene and the *cis-trans* photoisomerization of azobenzene were chosen as 'switchers' in her investigations. *L. De Cola* reported about the synthesis of dendrimers containing azobenzene units in the periphery. She showed that all of the azobenzenes in the dendrimer can be isomerized. The (*E/Z*)-isomerization may lead to a conformational change of the entire molecule.

A Synthetic Odyssee to Vancomycin Antibiotics

In the Tuesday afternoon keynote lecture, *D.A. Evans* (Harvard University, Cambridge) described the highlights of a 12-year odyssee toward the total synthesis of the vancomycin class of antibiotics. The synthesis of unnatural α-aryl amino acids using the well-known *Evans* auxiliary methodology was presented initially. The second part of the lecture was devoted to the key reactions required in the assemblage of the vancomycin skeleton, namely bisaryl-ether formation and aryl-aryl cross-coupling reactions. Strategies for the control of the atropisomers occuring in the vancomycins were also presented.

Another lecture focusing on natural product synthesis was given by *M. Mikolajczyk* (Center of Molecular and Macromolecular Studies in Lódz). He presented a new method for the preparation of 3-phosphorylmethyl-cycloalkenones. The cycloalkenones, prepared by intramolecular *Wittig-Horner* olefination of bis-β-ketophosphonates were shown to be suitable starting materials for the preparation of prostaglandins.

As a contribution to transition-metal chemistry, *M. Murakami* (Department of Synthetic Chemistry and Biological Chemistry, Kyoto) closed the session on Tuesday with an interesting lecture entitled 'Rhodium-Catalyzed Breaking of C–C Bonds for Synthetic Purposes'. Cyclobutanones can be transformed to cyclopropanes by a formal CO extrusion reaction using *Wilkinson*'s catalyst. He also showed that the intermediate acylmetalacycle formed after rhodium insertion into the cyclobutanone can be reduced to the corresponding alcohol derivative.

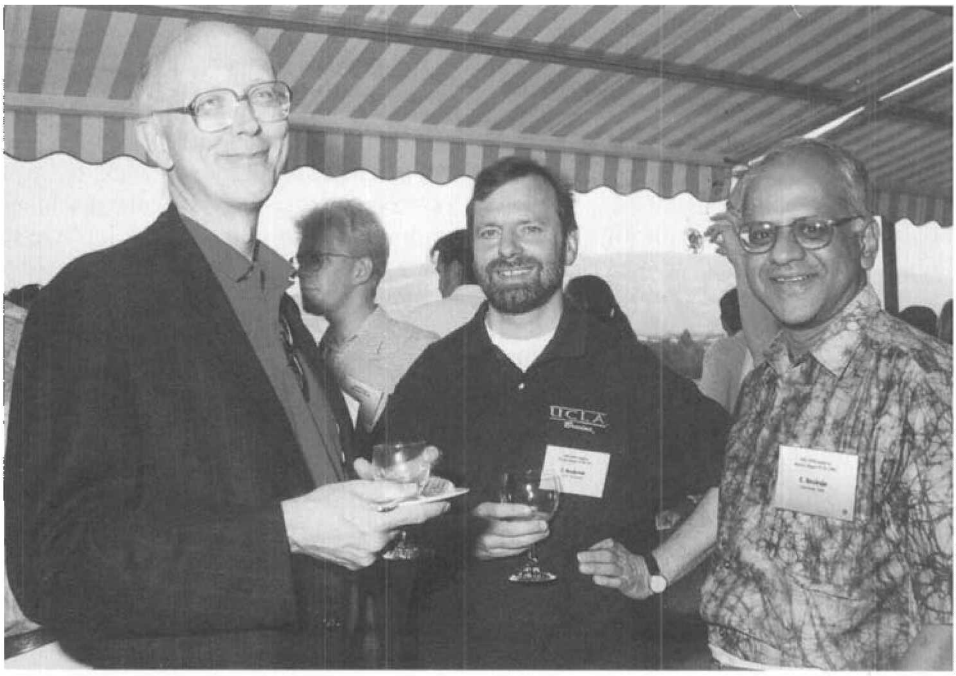
From Synthetic Methodology to the Interface with Biology

In the Wednesday plenary lecture, *D. Seebach* (ETH-Zürich) gave an impressive lecture in which he combined four of his current research topics into a common theme. He first showed the application of various Ti-TADDOLates as chiral catalysts in different reactions. He also showed that TADDOLs can be immobilized into polymers and also into dendrimers without losing efficiency as chiral ligands in asymmetric synthesis. Different chiral dendrimers were presented, some of which were built from (*R*)-3-hydroxybutanoic acid (3-HB). Oligomers of 3-HB with different chain lengths were synthesized and used for the construction of ion channels and for structural studies. By replacing the ester funtionality of the HB oligomers with amide functionalities, he finally ended up in the world of β-peptides. *D. Seebach* showed that β-peptides, easily prepared from the corresponding β-amino acids using conventional peptide chemistry, form stable helical structures in solution and also in crystal form.

News from Endiins

M. Hirama (Tohoku University, Sendai) discussed the synthesis of the strained carbocyclic core structure of kedarcidin. Kedarcidin is a cyclic nine-membered enediyne chromophore. He showed that the enediyne is in equilibrium with its *p*-benzyne form at ambient temperature. *M. Hirama* subsequently related how in the biological system, the biradical is stabilized kinetically by the apoproteins. ESR Spectra of the kedarcidin-derived biradical and of benzannulated biradicals were also discussed. It was shown that in endiynes leading to benzannulated biradicals, hydrogen transfer to the biradical is the rate-determing step in the aromatization process.

I. Stary (Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Prague) talked about a novel strategy for the synthesis of molecules with helical chirality. A cobalt-catalyzed [2+2+2] cycloisomerization of triynes was shown to afford a new class of molecules with helical chirality.



G. Whitesides, F. Diederich, *and* G.R. Desiraju *at the reception*

The closing lecture of the Wednesday session was given by *D. Tanner* (Lyngby, Denmark). Covalently bridged chiral aziridines can be used as *N,N*-bidentate ligands in different transition-metal-catalyzed reactions as pointed out by *D. Tanner*. Pd-catalyzed allylations, Cu-catalyzed cyclopropanations were performed highly enantioselectively by using these novel ligands. Different chiral *N,O*-bidentate ligands (where the nitrogen atom is part of an aziridine) were shown to be good catalysts for the enantioselective Et_2Zn addition to aldehydes.

About Catenanes and Olympiadones

J.F. Stoddart (University of California, Los Angeles) discussed the nature of the mechanical bond. In a fascinating presentation, he explained the kinetically controlled self-assembly of branched [5]olympiadone and [7]catenanes. A redox-controlled switchable [2]catenane with either a tetrathiafulvalene or a naphthalene unit in the cavity was also presented. Finally, the properties of a [2]rotaxane with two different binding sites in the dumbbell-shaped component were discussed. The two binding sites, a secondary dialkylammonium center and a bipyridinium unit, show very different affinities towards the ring component. Depending on the pH, either the dialkylammonium group (if protonated) or the bipyridinium unit interacts with the ring.

P. Renaud (University Fribourg) showed that phenylselanyl-substituted glycolic-acid derivatives are excellent substrates for radical group transfer reactions. A chiral cyclic glycolic-acid derivative (a dioxanone) was chosen to compare the diastereoselectivities of radical reactions (group transfer, bromination, and allylation) with the selectivities obtained for the corresponding ionic reactions. α-Propargylated dioxanones bearing an additional α-phenylsulfanyl group were shown to undergo radical annulation reactions with α,β-unsaturated esters.

Crystal Engineering and Combinatorial Chemistry

On Friday, *G.R. Desiraju* (University of Hyderabad, India) defined in his keynote lecture 'Crystal Engineering' as the understanding of intermolecular interactions in the context of crystal packing and the utilization of such understanding in the design of new solids with desired physical and chemical properties. He extended *Corey*'s 'synthon' terminology to supramolecular chemistry and defined 'supramolecular synthons' as structural units within supermolecules which can be formed and/or assembled by known or conceivable synthetic operations involving intermolecular interactions. Some supramolecular synthons and their application in crystal engineering were discussed.

Inorganic Chemistry

The inorganic chemistry section presented many of the leading topics of the conference. Thus, nearly half of the lectures were focused on supramolecular chemistry, together with its immediate extension to material chemistry, ranging from extended networks, reported by *R. Robson* (University of Melbourne), to the exploitation of symmetry restraints for the formation of *coordination clusters* with predefined structure described by *K. Raymond* (University of California, Berkeley). The synthetic pathways to catenanes and molecular knots was reviewed by *J.-P. Sauvage* (University Louis Pasteur, Strasbourg), who also presented his latest results on the resolution of racemic trefoil knots and the development of [2]catenanes incorporating polypyridyl ligands. The copper complexes of the latter act as bistable molecular switches: the change in the coordination number of the metal upon electrochemical triggering induces the swinging of the [2]catenane.

En route to material chemistry, *J.A. Gladysz* (University of Utah) described the synthetic strategies for polymeric carbon allotropes connecting two rhenium centers, or 'C_n wires' – with *n* up to 20! The electrochemical and magnetic properties of these compounds indicate that the two metal centers communicate with each other even through the C_{20} wire. On the topic of molecular recognition, *D. Astruc* (University of Bordeaux) reported the synthesis of ferrocenyl-based dendrimers and their application in the recognition of anions by means of cyclic voltammetry and ^{1}H-NMR.

Magnets, Magnets, Magnets ...

In the section on supramolecular chemistry devoted to magnetic properties, *O. Kahn* (ICMC Bordeaux), reviewed the evolution of molecular magnets based on the arrangement of 'magnetic bricks', such as bimetallic Cu/Mn complexes, into three-dimensional arrays. Thus, the design of the bricks can be such that they assemble into polymeric chains or three-dimensional lattices with specific magnetic properties and mutual interactions. The latest development is a three-dimensional array of bimetallic Co/Cu complexes showing bulk ferrimagnetic behavior below 45 K and bistability with a wide hysteresis effect. Also, the low-spin/high-spin switching of polymeric 1,2,4-triazole complexes of iron(II) (with the related color change) was found to display a wide memory effect (cT/T hysteresis) about room temperature, which makes them potentially useful as memory devices. Finally, *D. Gatteschi* (University of Firenze) illustrated a strategy for building nanoscale molecular magnets based on Mn_{12} clusters formed by Mn^{IV}/Mn^{III} units. These compounds display superparamagnetic response and hysteresis already on the molecular scale, albeit at very low temperature.

The vast amount of information offered by the conference on supramolecular chemistry convinced the participants that this topic has left its infancy: we now look forward to seeing molecular machines working hard in some application! Up to now, 'molecules at work' were mostly dealt with in the lectures on homogeneous (and heterogenized) catalysis. It is interesting to note that, on this topic, an acknowledgement of the potential of inorganic chemistry was clearly stated in a plenary lecture by a scientist unmistakably committed to organic chemistry, *D. Seebach* (ETH-Zürich) who said that, in his opinion, the most significant new organic transformations are likely to come from the organometallic chemistry of the transition metals.

Enantioselective Synthesis

The topic of enantioselective catalysis was presented by *A. Togni* (ETH-Zürich), who described the last results obtained with his 'Lego'-type system of chiral ferrocenyl P,P and P,N ligands. The flexibility of the ligand system ranges from the systematic variation of electronic and steric properties to the synthesis of chiral dendritic ligands. The large amount of valuable information thus collected allows one to move from empiricism to an understanding of the factors which affect asymmetric induction, and to develop catalytic processes featuring activity and selectivity up to the requirements of large-scale production, such as exemplified by the herbicide Metolachlor by *Novartis*. The final part of the talk was devoted to the asymmetric hydroamination of norbornene, a new type of enantioselective catalytic reaction. *J. Thivolle-Cazat* (CNRS, Villeurbanne) described another exciting new catalytic transformation developed by the group of *J.-M. Basset* (CNRS Villeurbanne): silica-supported tantalum monohydrides catalyze alkane metathesis at moderate temperatures. Thus, ethane disproportionates to methane and propane at 1 atm and 150° with a mechanism which probably involves σ-bond metathesis.

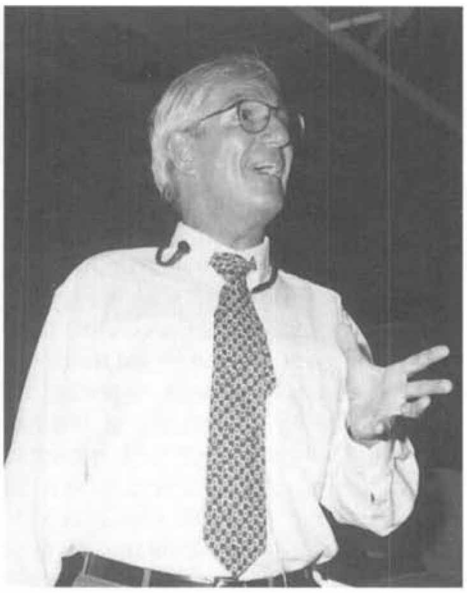
At the Heart of Polymer Chemistry

H.H. Brintzinger (University Konstanz) reviewed the results achieved in the field of α-olefin polymerization catalyzed by Ti and Zr metallocenes since the early days and included fundamental contributions of his own, such as the use of chiral *ansa*-metallocenes. Starting from the role of the α-agostic bond on the stereocontrol of polymer growth, first recognized by *Green* and *Brookhart*, he discussed his recent results showing how alkyl isomerization is responsible for the introduction of stereoerrors. Finally, he presented his latest, elegant studies on how ion pairing in the [TiCp$_2$R][anion] system affects activity of the catalytic system, showing that the olefin insertion occurs *via* an associative pull-in mechanism featuring more than one olefin molecule in the transition state. This cooperative effect allows long sequences of uninterrupted olefin insertions by preventing re-association of the anion.

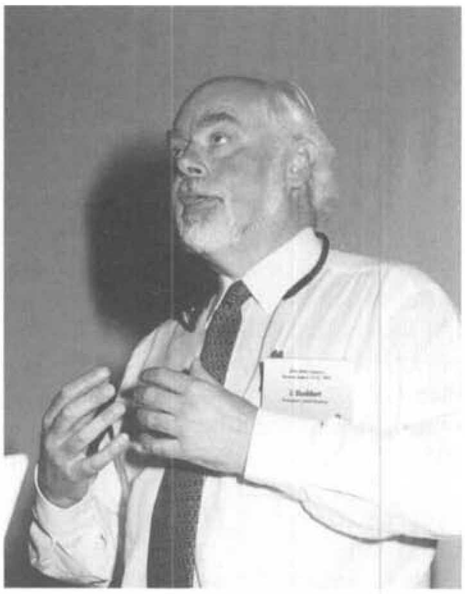
Carbene chemistry also found resonance at the conference: *C. Floriani* (University of Lausanne) illustrated the use of early transition metals in connection with calix[4]arenes and calix[4]pyrroles to mimic fundamental reactions occurring at oxo-metal surfaces, such as alkylidyne-carbene conversion and dinitrogen activation. *R.H. Grubbs* (California Institute of Technology) reviewed the use of ruthenium-carbene complexes as catalysts for ring-opening metathesis, pointing out the advantages of ruthenium in terms of functional-group tolerance and low sensitivity toward impurities and water. Related applications such as ring-closing and relay metathesis were described, indicating that [RuCl$_2$(C(H)R)(PCy$_3$)$_2$] is the active species in ROMP catalysis. *A. Hafner* (*Ciba Specialty Chemicals*) showed how this 'mature' technology finds straightforward application in the chemical industry for the large-scale production of new materials: [RuCl$_2$(h^6-*p*-cymene)(PR$_3$)] thermally initiates the solvent-free polymerization of dicyclopentadiene with a wide tolerance to functional groups and even water. The resulting polymers appear to be the forerunner of a new class of highly valuable materials.

On the topic of 'Dihydrogen Complexes', *B. Chaudret* (CNRS Tolouse) presented his latest results on the use of [RuH$_2$(h^2-H$_2$)$_2$(PCy$_3$)$_2$] as catalyst precursor in Si–H bond activation and the insertion of olefins in aromatic C–H bonds. The question as to whether dihydrogen complexes are actually involved as intermediates in these reactions was, however, not addressed. On a related topic, an interesting poster contribution was presented by *G. Trabesinger* from *P.S. Pregosin*'s group (ETH-Zürich), who detected an unprecedented interaction in a h^5-dienyl ruthenium complex containing the atropisomeric diphosphine MeO-BIPHEP. Solution NMR and X-ray studies established that the diphosphine functions as a six-electron donor to Ru^{II} *via* coordination of one

H. Yamamoto *talking about 'Designer* Lewis *Acids'*



D. Seebach *during his plenary lecture 'Organic Synthesis – As Central as Ever*



J. F. Stoddart *during his lecture, explaining catenanes and olympiadones*

of the biaryl double bonds. The ability of atropisomeric diphosphine ligands to stabilize formally unsaturated species by means of such a weak interaction is expected to have far-reaching consequences in homogeneous catalysis.

Finally, one of the most stimulating talks was delivered by *M. Poliakoff* (University of Nottingham) on nanosecond time-resolved IR-spectroscopic studies of $[W(CO)_6]$ and $[ReCp(CO)_3]$ in supercritical fluids. Under the cover of an (apparently!) old-fashioned chemistry and large amounts of British understatement, he disclosed to the audience a fascinating world, in which the coordinatively unsaturated fragments $[W(CO)_5]$ and $[ReCp(CO)_2]$ interact with supercritical Xe and Kr as solvents to give elusive, but observable adducts. After the preparation of perxenate, should now one expect a coordination chemistry of xenon?

Physical Chemistry

Understandig Heterogeneous Catalysis

Much progress has been made towards a better understanding of catalytic processes, as was demonstrated by *G. Ertl*'s (Fritz Haber Institute, Berlin) plenary lecture. The classic *Haber-Bosch*-catalytic synthesis of ammonia served as an example for a description by macroscopic kinetics. The heterogeneous iron-oxide catalyst also contains K, Al, and Ca admixtures that are essential as atomic promoters. *Via* the adsorption and dissociation of nitrogen, which may then further react with hydrogen, the catalyst offers an alternative reaction path with lower activation energy. On an atomic level of description, the catalytic oxidation of CO was investigated. Fascinating videos by a scanning tunneling microscope showed O-atoms in *Brown*ian motion on the Pt surface, which may condense into ordered phases. In certain critical regions of partial pressures, the surface concentrations exhibit oscillating or chaotic behavior described by nonlinear dynamics. On a mesoscopic scale, these oscillating concentration profiles are observed by photoemission electron microscopy revealing standing wave patterns, solitary or spiral waves, reminding the audience of work of art, or on a cosmic scale, on spiral arms of galaxies.

Several of the lectures in the parallel sessions of physical and technical chemistry gave evidence of the importance of catalysis. *H. Blaser* (*Novartis*, Basel) reported the development of an industrial catalyst for the selective hydrogenation of nitroarenes. By much 'trial and error', finally a very successful and viable heterogeneous catalyst was found. The importance of the choice of active phase, support, reaction media, and modifiers for a catalyst was stressed. *T. Mallat* (ETH-Zürich) also finds a dramatic increase of performance using heavy metals (Pb or Bi) or organic (phosphines) modifiers to a Pt catalyst for the aerobic oxidation of alcohols and polyols. The operation of the modified Pt catalyst was demonstrated for the oxidation of L-sorbose, an important step in the vitamin C synthesis. Studying bond activation by isolated transition-metal cations in the gas phase, *H. Schwarz* (Technical University, Berlin) concentrated on intrinsic properties. As examples, he presented the catalytic oxidation of CH_4 by Pt^+, the coupling of CH_4 to CO by Ta^+ as catalyst, and the selective C–F bond activation by Pr^+. Important aspects in the reaction mechanisms are relativistic effects governing the potential-energy surfaces. *N. Kruse* (University Libre, Brussels) emphasized structural factors in catalysis. The reaction of CO on Ni to $Ni(CO)_4$ is enhanced by a rough surface. By field ionization microscopy, a morphological change of a Pt tip was observed with surface explosions, chemical waves, and rate oscillations during the catalytic reduction of nitric oxides. Progress on instrumentation was reported by *M. Maciejewski* (ETH-Zürich) who presented pulse thermal analysis as a novel tool for the *in situ* study of 'real' catalytic systems. According to *V.N. Parmon* (Boreskov Institute of Catalysis, Novosibirsk), modern *in situ* studies show that the catalyst and reaction medium constitute a system far from thermodynamic equilibrium, either in a stable or unstable steady state as evidenced by rate oscillations and chemical waves. He introduced a theoretical approach for describing catalytic reactions where the chemical potential is combined with kinetic equations. *E. Molinari* (University of Rome) emphasized the role of vibrational nonequilibrium at catalytic surfaces. The power of the *Car-Parrinello* method to simulate complex chemical processes by molecular dynamics with *ab initio* interaction potentials was illustrated by *M. Parrinello* (Max Planck Institute, Stuttgart). As example, he introduced the catalytic formation of polyethene and polypropene on a Ti catalyst with $MgCl_2$ support. Polymer formation is initiated by CH_3 on a Ti bond, and the stereoselectivity in the polypropene formation arises from a sterical effect along the grooves of the $MgCl_2$ surface. The *ab initio* modelling of catalysts has also made much progress, as shown by *J. Sauer* (Humboldt University, Berlin). He studied the interplay of active site and framework shape in zeolite activity, the preferred sites of the acidic OH group and how its acidity varies. Different measures of acidity, heat of NH_3 adsorption or heat of deprotonation, were discussed.

Progress Reports in Theoretical Chemistry

H.F. Schaefer's (University of Georgia, Athens, USA) talk focussed on molecular anions presenting a wealth of important, yet uncharacterized systems. Comparing with 'theory, the right way', *i.e.*, high-level 'converged' quantum chemical *ab initio* methods, he finds the less expensive density-functional methods also quite successful despite some formal objections against their use. The calculations complement the relatively few reliable experimental electron affinities. *R.F. Nalewajski* (Jagiellonian University, Cracow) introduced charge-sensitivity analysis as a novel tool for exploring chemical reactivity. In this approach, the charge flow from high to low chemical potential is described by a linear response treatment, and new reactivity concepts are derived. *C.W. Kern* (Northwestern University, Evanston) calculated binding and ionization energies of clusters with up to 135 Be-atoms, and compared the values with bulk properties. *W.F. van Gunsteren* (ETH-Zürich) referred to experimental work of the *D. Seebach* group in his study of the reversible folding of hepta-β-peptides in methanol by molecular dynamics with temporal, spatial and energetic resolution, not obtainable in experiment. In the computer simulations, no correlation of folding with energy, radius of gyration, solvent-accessible area, and hydrogen bonds was found ruling out the use of simpler models to predict reversible folding of peptides at present. *W.F. van Gunsteren* identified entropy as the driving force for folding in his simulations. *G. Wipff* (Institute of Chemistry, Strasbourg) made molecular dynamics computer simulations of ionophores at the water-chloroform interface. *J. Troe* (University of Göttingen) demonstrated the complexity of interaction potentials even for seemingly simple unimolecular reactions. The dynamics of bond formation can be studied employing the statistical adiabatic channel model combined with classical trajectories. Comparing these accurate calculations with the simpler phase space theory, rigidity factors are derived for some typical capture mechanisms. *J. Troe* stressed also the competition between bond formation, dissociation, and collisional energy transfer.

Progress Reports in Experimental Physical Chemistry

H. Müller et al. (ETH-Zürich) studied hydrogen-bond dynamics in $(HF)_2$ and its isotopomers by high-resolution spectroscopy, and discussed tunneling splittings and predissociation lifetimes. In molecular beam-scattering experiments of orbitally aligned atoms with rare gases, *V. Aquilanti* (University of Perugia) investigated the transition from *van der Waals* forces to the simplest chemical bonds, especially the influence of charge transfer to bond stabilization. From the enormous amount of experimental data, he was able to derive useful semiempirical correlation rules. *D. Cavagnat* (Laboratory of Spectroscopy, Talence) reported experimental results of her work with *L. Lespade* revealing the effect of anharmonic interactions on vibrational energy redistribution in nitromethane, especially invoking internal rotation. Selective multiple laser spectroscopy of highly excited molecules was presented by *T.R. Rizzo* (EPF Lausanne). The overtone-induced dissociation of HOCl was studied yielding state-resolved dissociation rates and the dissociation energy for this molecule. He further demonstrated Si isotope enrichment by selective multistep laser dissociation of SiH_4. He predicted a renaissance for laser isotope separation. *B.M. Baysal* (TUBITAK-Marmara Research Center, Gebze) reported on the preparation and characterization of macroinitiators containing various functional groups. *G.R. Fleming* (now at the University of California, Berkeley) studied photosynthetic light harvesting of plants or bacteria, where photons are collected by antenna molecules funneling the energy to the reaction center. He also devised multidimensional ultrafast laser experiments with phase-locked and time-gated laser pulses and echoes, replacing the 'whack-and-watch' approach of conventional pump-probe laser experiments. *V.S. Letokhov* (Russian Academy of Sciences, Troitsk) has exciting perspectives for the direct visualization of the structure of single molecules. Towards this goal, he demonstrated laser resonance photoelectron microscopy and laser *Förster* resonance energy-transfer microscopy (comparable to field ionization and near-field optical microscopy, respectively) with the potential of sub-nm-spatial resolution.

Poster Sessions in Physical Chemistry

In three poster sessions, about 170 posters were presented with subjects ranging from pure to applied chemistry. We mention as examples supersonic jet spectroscopy of AuKr (*F. Wallimann et al.*, University of Bern), the first report of vibrational preionization after infrared multiphoton excitation of a neutral molecule, C_{60} (*M. Hippler et al.*, ETH-Zürich), the treatment of pulp from recycled waste

J.A. Gladysz *on the way to the banquette* paper (*J.C. Norman*, Green Bay), the photocatalytic degradation of aromatic compounds in TiO_2 suspensions (*Z. Çinar*, Istanbul), or chemical reactions in flames (*R.C. Sausa*, Aberdeen, USA).

The regular poster sessions were also complemented by special poster sessions such as the presentation on 'High-Performance Instruments for Innovation' in a CSCS/NEC collaboration. This included quantum mechanical modelling of organometalics and zeolites (*J. Weber* and coworkers, University of Geneva), an *ab initio* study of heme (*R. Car* and coworkers, IRRMA, Lausanne), a study of the pseudorotation of cyclic water pentamer (*S. Graf, W. Mohr*, and *S. Leutwyler*, University of Bern), and a new theoretical approach towards calculating the parity-violating energy differences between enantiomers of chiral molecules (*A. Bakassov, T.-K. Ha*, and *M. Quack*, ETH-Zürich).

The organizers succeeded in selecting a rich and interesting program, which stimulated all participants, as evidenced, *e.g.*, by the lively discussions. The lectures and posters documented in a kind of snapshot the state of the art in physical and technical chemistry and provided an outlook to the chemistry of the next century.

Analytical Chemistry and Nanosciences

'There is Plenty of Room at the Bottom'

The series of lectures in the research field 'Analytical Chemistry and Nanosciences' could be summarized by quoting the famous physicist *R.P. Feynman*: 'There is plenty of room at the bottom'. Analytical chemistry does not only determine macroscopic quantities: single molecules can be manipulated and their chemical behavior can be observed. There is a range where the sizes of large molecules and of small natural or man-made materials meet. Tools are required to study what really happens at this level without losing information due to averaging during large-scale measurements. Several researchers displayed new and exciting results. The atmosphere during the lectures was stimulating and the discussions were very lively!

Solution Nanochemistry

The plenary lecture held by *R.N. Zare* (Stanford University) was dedicated to the late *H.M. Widmer*, chairman of the Section of Analytical Chemistry of the New Swiss Chemical Society. *R.N. Zare* started by explaining how discrete fluorescence events of a single molecule in solution can be detected using confocal fluorescence microscopy. A second result of this study was that the measurements were biased by the observation, because a dipole is induced in the molecule in the presence of the electric field generated by the excitation laser; he took advantage of this phenomenon to create molecular 'tweezers' in solution at the focus, so that he was able to show a video where a single piece of supercoiled DNA can be moved around in solution at will. *R.N. Zare* then gave his definition of 'femtochemistry' as the chemistry in very small volumes; he uses lipid vesicles suspended in water as 'test tubes' with a diameter of *ca.* 1 mm, that is with a volume around 0.5 fl. The fusion of vesicles can be nicely observed; because the content of the vesicles remains intact after the fusion, new conditions seem to be available for reaction chemistry. Finally, *R.N. Zare* managed to combine all of the displayed techniques for the analysis of single vesicles by capillary electrophoresis after inserting them into the capillary using the laser tweezers.

Advances in Near-Field Techniques

At the interface between physics and chemistry, several near-field techniques offer new possibilities for the manipulation and the study of a single or few molecules. *J.K. Gimzewski* (*IBM* Research Division, Switzerland) showed how single molecules such as spider-like porphyrine derivatives or C_{60} can be moved on surfaces by pushing them with a tip; he then demonstrated the use of scanning tunneling microscopy (STM) for their molecular recognition and their conformational identification. *H.E. Gaub* (University of München) held a remarkable talk on single-molecule force spectroscopy by atomic force microscopy (AFM). One of his most amazing results was the reversible forced unfolding of individual titin Ig-domains by pulling single molecules of this rigid protein present in muscle tissue between a surface and a functionalized AFM tip. Finally, *R. Zenobi* (ETH-Zürich) exposed the point of view of a chemist who is not satisfied with only topographical and physical data, but is looking for chemical information as well; he displayed among others surface-enhanced *Raman* spectra (SERS) of 300 molecules of anthracene spread on a silver island surface, with a spatial resolution below 200 nm. Quite a few posters were dealing with related subjects; the one of *N. Nurdin* (University of Geneva) describing the use of scanning force microscopy (SFM) to evidence surface phase-separated films of polymer blends was particularly interesting.

O. Kahn *during his enthusiastic lecture about molecular magnets*

Miniaturization of Conventional Analytical Methods

More conventional analytical methods can now be miniaturized. The driving force for these developments is the increasing demand in industry for rapid, low-cost, and efficient analytical methods, as emphasized by several speakers working in this area. Electrophoresis on a chip is already known; *F. Regnier* (Purdue University, Lafayette) showed in an outstanding talk how he managed to perform the more polyvalent liquid chromatography in parallel columns etched on a silica chip. Since it is extremely difficult to pack silica particles into a very small column, he instead microfabricated the stationary phase and the column together; he used the technology developed for computer engineering to etch 5 mm cubes separated by 1.5 mm channels on silica chips. His first results are not only encouraging, but also show that the new columns have several advantages and may well compete with conventional ones in the near future.

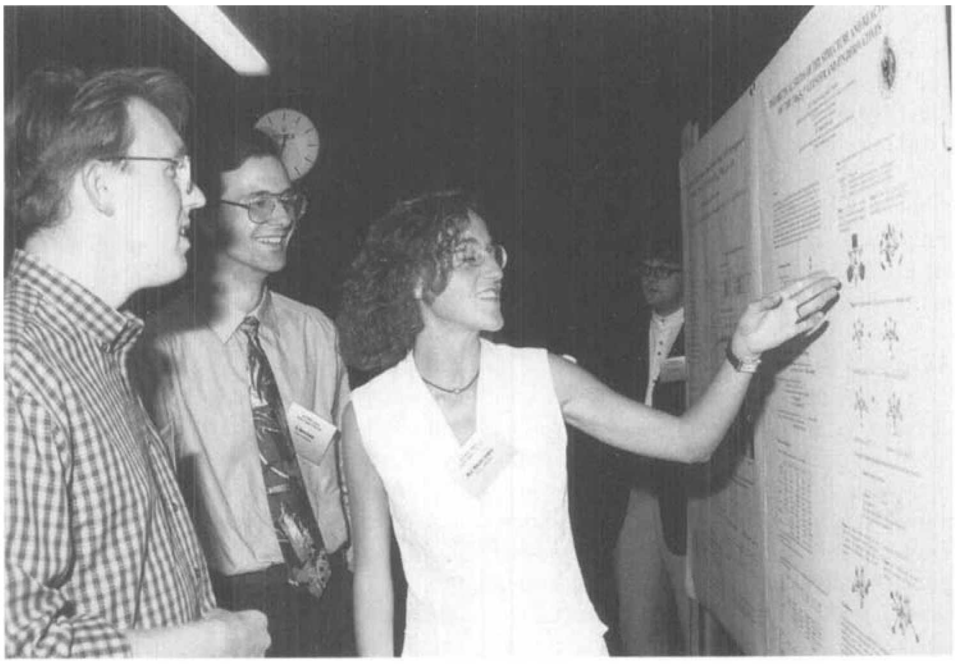
Chemistry of Small Materials

A few lectures were dealing with the chemistry of small materials; these talks were only indirectly related to the topic of the session but showed one of the target applications of modern analytical chemistry. *S. Mann* (University of Bath) discussed the biomimetic synthesis of complex inorganic materials; one of several examples was the use of surfactant micelles with cylindrical microstructures for the template-directed synthesis and patterning of mesoporous silica. *L. Addadi* (Weizmann Institute of Science) reported about antibody recognition of organized surfaces; antibodies that geometrically and chemically recognize a single face of cholesterol crystals while having no affinity for an isolated molecule were presented.

Other Remarkable Advances

Finally, three additional lectures were subjectively selected by the author. *H.W. Gäggeler* (University of Bern and PSI Villigen) described the preparation of few atoms of the new element 106 (seaborgium) by bombardment of a ^{248}Cm target with ^{22}Ne. He and his collaborators then proved that the atoms occupied the proper place in the periodic table by using the on-line gas chemistry apparatus (OLGA): as expected, oxychloride complexes were observed to elute at positions similar to those of molybdenum and tungsten. *W.E. Smela* (Linköping Institute of Technology) developed micro-actuators that use a conducting doped polypyrrole film as the volume-changing element. Gold/polypyrrole bilayers were produced that reversibly bend when a voltage is applied; various applications are expected for these micro-actuators after further development. *B.H. Meier* (University of Nijmegen) showed how higher fields, faster magic angle spinning, and novel pulse sequences allow to measure high-resolution NMR powder spectra that contain more information as previously.

In conclusion, we can definitely say that analytical chemistry is a rapidly developing interdisciplinary research field that is now at a turnover point. Already existing methods are being improved towards miniaturization, and new techniques are becoming available for observation at an extremely small scale.



Participants in an intense discussion during one of the poster sessions

R.N. Zare *in discussion with the next generation of chemists*

Closing Ceremony

F. Diederich was delighted by the excellent quality of the talks and posters presented throughout the meeting, and this made him envisage a bright future for chemisty. It became clear during the congress that the walls that separated chemistry from borderline disciplines are coming down and, as a result, emerges the field of molecular sciences with chemistry at its center. Meetings like the IUPAC Congresses constitute an ideal forum for bringing together different disciplines at the interface of chemistry, thus leading to a mutual cross-fertilization, an effect which has not been enough appreciated in the past. Another important conclusion from this week of scientific exchange was that a merger of the top-down and the bottom-up approaches in materials and medicinal chemistry begins to materialize and is expected to lead to major advances in these areas. *F. Diederich* encouraged all the participants to take the messages from this congress to the broad public and to encourage young people to study chemistry.

J. Weber finally thanked all the people who contributed to this outstanding meeting which had all the ingredients necessary for success: high quality of oral and poster presentations, good facilities and accomodation, sunshine outside and air condition inside the International Congress Center, young people, and – as a contrast to the 'intellectual food' served during five days – parties or 'nourriture terrestre' as *A. Gide* called it. The ceremony was closed by the announcement of the 37th IUPAC Congress to be held in Berlin from August 14–19, 1999, in parallel to the 27th General Meeting of the German Chemical Society.

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