

## Polish chemistry in the century of the discovery of polonium and radium by Maria Skłodowska-Curie and Pierre Curie

This is another in a continuing series of articles on chemistry in IUPAC National Adhering Organizations

### Historical

The beginnings of modern chemistry in Poland are connected with a great educational reform that was introduced by the Royal Commission of Education. That institution, which was founded in 1773, was in fact the first ministry of education in Europe. Under its auspices, the chairs of chemistry and natural history were established in 1782 at what was then known as Cracow University (now called Jagiellonian University). Jan Jaskiewicz (1749–1809), who was the first Professor of this chair, and his successor Franciszek Scheidt (1759–1807), introduced into their lectures the theories of Antoine Lavoisier. Jędrzej Sniadecki (1768–1838) became Professor of Chemistry at the University of Vilnius after completing his studies in Cracow, Pavia and Edinburgh, and in 1800 published the first Polish textbook of modern chemistry. This eminent scientist exerted a strong influence on the early stages of development of chemistry in Poland. At the present time, the Sniadecki medal is the highest distinction awarded by the Polish Chemical Society.

In 1795, Poland lost its independence for over 100 years, and the development of the experimental sciences was considerably hampered. The best situation in country was in the region that incorporated the Austro-Hungarian Monarchy, where the universities of Lvov and Cracow were able to continue their activities, and which was also where the Technical University at Lvov was organized. In 1883 in Cracow, Karol Olszewski (1846–1915) and Zygmunt Wroblewski (1845–1888) accomplished the first static liquefaction of nitrogen, oxygen and carbon monoxide. Olszewski became one of the founders of modern cryogenics. He also liquefied and solidified argon, and determined its critical properties. In about 1900, Władysław Natanson (1864–1937) Professor of Theoretical Physics in Cracow, published a series of papers on the problems of thermodynamically irreversible processes, becoming a pioneer in the modern thermodynamics of irreversible processes. Marian Smoluchowski (1872–1917) Profes-

sor of Physics at Vienna, Lvov and Cracow universities developed the theory of fluctuations in gases and, independently of Einstein, proposed the theory of Brownian motion. Subsequent experimental confirmation of the Einstein–Smoluchowski equation became one of the final proofs in the kinetic theory of matter.

Great achievements in organic chemistry were made by Alfred Freund (1835–1892, first synthesis of cyclopropane, 1881), Bronisław Radziszewski (1838–1931, Radziszewski's conversion of nitriles to amides with  $H_2O_2$  in alkaline solution, 1890), Stanisław Kostanecki (1860–1910, synthesis of flavonoids, 1899) and Stefan Niementowski (1866–1925, synthesis of 4-oxoquinazolines, 1895). In Cracow, Leon Marchlewski (1869–1946) was one of the founders in the field of chlorophyll chemistry. During the inter-war period (1918–1939), the study of organic chemistry developed at the chemistry departments of universities and technical universities. The particularly active centres were in Warsaw, Cracow and Lvov. From that period, the investigations performed by Tadeusz Milobędzki (1873–1959, organophosphorus chemistry), Wiktor Lampe (1875–1962, curcumin and light-sensitive dyes), Karol Dziewonski (1876–1943, work on synthetic dyes, decacyclene and other polycyclic aromatics), R. Malachowski (1887–1944, carbonyl cyanide) and Edward Sucharda (1891–1947, chemistry of pyridine) deserve to be mentioned.

Among the Polish scientists who were working in Warsaw, two names deserve to be mentioned here: Jakub Natanson (1832–1884), who was the author of one of the earliest syntheses of artificial dyes (fuchsine), and Józef Boguski (1853–1933), a pioneer in the field of chemical kinetics who also proposed the widely known equation which describes the kinetics of the dissolution of solids in liquids.

At the same time, many talented Poles had been working in different laboratories abroad. Marcell Nencki (1847–1901), who worked in Russia and Switzerland, was the author of some important publications in the field of organic chemistry and biochemistry. He greatly contributed to an establishment of the structure of heme, obtained hemine from hemoglobine, and studied the mechanisms of formation of urea in animal organisms. Stanisław Kostanecki, who was also working in Switzerland, was renowned for his work on the structure and synthesis of flavonoids (Kostanecki synthesis). Bohdan Szyszkowski (1873–1931) published important papers on electrochemistry and surface chemistry.

Ignacy Moscicki (1867–1946), an outstanding specialist in chemical technology working in Switzerland, performed a technical synthesis of nitric acid from air.

Maria Skłodowska-Curie (1867–1934) and Kazimierz Fajans (1887–1975) are among the most famous Polish scientists who worked abroad, Mme Curie in France, and Fajans in Germany and then in the USA. There is no need to explain here their role in the development of modern chemistry and physics.

When Poland regained its independence in 1918, only just a few years of research and teaching had been organized at the old and new universities and technical universities. In fact, in the inter-war period, all the main branches of chemistry research had their representatives at Polish universities and laboratories. In inorganic chemistry Wiktor Jakob (1886–1971) and Bogusława Jezowska-Trzebiatowska (1908–1991) had been working on the coordination chemistry of transition metals and the chemistry of rhenium. Włodzimierz Trzebiatowski (1906–1982) began his work on the magnetic properties of alloys and intermetallic compounds. Alfons Krause (1895–1972) carried out studies on the structure and properties of amphoteric hydroxides and oxides, in particular of iron.

Important research was carried out in the field of organic chemistry. Osman Achmatowicz (1899–1988) was an eminent specialist in the chemistry of alkaloids and terpenes. Synthetic dyes were investigated by Waclaw Lesnianski (1886–1956) and natural dyes by Wiktor Lampe. Polycyclic aromatic hydrocarbons and alkaloids were the object of research carried out by Jerzy Suszko (1889–1972). Tadeusz Urbanski (1901–1985) had begun his work on nitrocompounds and explosives.

The field of Physical chemistry was represented by many investigators. Among the most notable were: Wojciech Swietoslawski (1881–1968) an international authority in the field of thermochemistry, ebulliometry and polyazeotropy. Antoni Galecki (1882–1962, chemistry of colloids), Mieczysław Centnerszwer (1874–1944, chemical kinetics, multiphase equilibria electrochemistry of fused salts), Alicja Dorabialska (1897–1975) a specialist in microcalorimetry who studied the heat of radiation of radioisotopes, allotropic transformations and corrosion of metals, Bogdan Kamiński (1897–1973, surface chemistry, flotation of minerals), Wiktor Kemula (1902–1985, electrochemistry, polarography), Antoni Basinski (1905–1990 colloids, polymers and chemical kinetics) and Jan Zawadzki (1866–1928, chemical kinetics). The physicochemical fundamentals of chemical technology were studied by Jozef Zawadzki (1886–1951, technology of sulfuric acid and Portland cement, thermal decomposition of solids). New methods of petroleum technology were developed by Stanislaw Pilat (1881–1941).

Zygmunt A. Klemensiewicz (1886–1963) working in the Fritz Haber laboratory in Karlsruhe, laid the foundations for membrane electrodes in potentiometry. After the First World War, several centres were created which carried out both research and practical applications of classical and technical analytical methods. The names of Tadeusz Milobędzki and Marceł Struszyński (1880–1959) of the Technical University of Warsaw should be mentioned here.

All this highly successful development was suddenly interrupted by the outbreak of the Second World War in 1939, which resulted in great disruption to the whole country. After the war, those scientists who survived contributed to a reconstruction of the system of higher education in Poland. In the years 1945–1955, new centres of research in chemistry had been established. Besides the chemistry departments of the universities (Warsaw, Wrocław, Łódź, Cracow, Gdansk, Poznan, Torun, Lublin, Białystok, Katowice, Opole) and the technical universities (Warsaw, Wrocław, Łódź, Gdansk, Gliwice, Szczecin, Rzeszów, Lublin, Poznan), research institutes of the Polish Academy of Sciences (established 1951) were also created.

## Inorganic chemistry and related fields

Coordination chemistry is one of the best developed fields of inorganic chemistry. Research in this direction is being carried out in Wrocław, Cracow, Poznan and Torun, and also in several smaller scientific centres elsewhere. The synthesis, structure and physicochemical properties of transition metal complexes using different ligands are being studied, including ligands of biological importance such as amino acids and nucleotides, forming models of metal-centred biological systems. Chemical and thermal stability, spectroscopic and magnetic properties, and the chemical and the photochemical reactivities of these complexes are also under investigation. Homogeneous catalysis, closely related to structural coordination chemistry, is represented in Poland in several centres which are specialising in inorganic (Wrocław, Poznan, Cracow), organic (Warsaw) and physical (Warsaw, Cracow) chemistry.

Separation of lanthanides, their coordination and structural chemistry, spectroscopy and chemiluminescence are being studied in Lublin, Wrocław, Łódź and Poznan.

Silicate chemistry is centred on the synthesis of old and new generations of zeolites, pillared clays (Cracow) and structure, as well as the properties of glass (Cracow, Gdansk).

Different aspects of solid state chemistry are under study in Poland. The physicochemical properties of simple and mixed oxides of transition metals are the object of investigations connected with heterogeneous cataly-

sis, the high temperature corrosion of metals, and materials engineering (Cracow). Defect structure and equilibria, diffusion, electrical conductivity, and the magnetic properties of transition metal oxides, as well as the segregation in solid solutions and reactions in solid state also being investigated.

Equilibria and binary and ternary diagrams of transition metal oxides are under study in Szczecin and Cracow, and those of alkaline earth phosphates in Wrocław. Investigations into the synthesis and structure of mixed oxide systems, important from the point of view of high temperature superconductivity, have been undertaken.

Physical and structural chemistry studies on solids are being carried out in Wrocław, where the crystal structure and magnetic properties of uranium compounds, intermetallic compounds, ferroelectrics and other solids are being investigated.

The synthesis and study of physical properties of nitrides, metal hydrides, intercalated chalcogenides and fullerenes are being carried out in several laboratories.

## Physical chemistry and related fields

Theoretical chemistry was founded in Poland at Cracow in the 1950s under the leadership of Kazimierz Guminski (1908–1983), and at the Jagiellonian University, and also in Warsaw under Włodzimierz Kolos (1928–1996). Both centres very quickly gained an international reputation, the Cracow centre for its studies of the electronic structure of  $\pi$ -electron molecules and transition metal complexes, as well as molecular vibrations; the Warsaw group in very accurate calculations of the electronic structure of small molecules (Kolos and his student Lutosław Wolniewicz, Torun). Meanwhile, other centres began research in theoretical chemistry (Torun, Wrocław, Poznań) as well in as smaller places (Lublin, Katowice, Łódź) and other scientific pioneers appeared (who were often the students of the above-mentioned founders). The results of the joint efforts often represented the state of the art in the following areas: the modern theory of intermolecular interactions and molecular properties, the most accurate calculations for small systems, including a determination of the mass of the neutrino, muon-catalysed fusion, electronic correlation in atoms and molecular vibrations, efficient algorithms for protein structure prediction, global optimization algorithms and the development of efficient methods in density function theory, etc.

Studies on the application of correlation analysis in organic chemistry (solvent and substituent effects on physico-chemical properties) should also be noted (Warsaw, Poznań, Cracow). Some contribution to the theory of aromaticity (Warsaw) should also to be mentioned here.

Equilibrium and nonequilibrium thermodynamics, as well as thermochemistry have been developed in Warsaw, Cracow, Łódź, Gdansk and Wrocław. These relate, among others, to diffusion in liquids, the theory of charge transport in metals, diffusion in adsorbed layers, the thermodynamics of associated liquids, and physical chemistry studies of metal hydrides under high pressure. This embraces both the synthesis of various hydrides and determinations of the thermodynamic characteristics of systems under high pressure. The results concerning the thermodynamics of solutions and fused salts which were obtained by means of electrochemical methods (ionic equilibria and acid–base interactions) should also be mentioned here.

The discovery of the hanging mercury drop electrode, stripping voltammetry and chromatopolarography (the first amperometric detectors for liquid chromatography) were made in the school of electrochemical studies founded by Wiktor Kemula in Warsaw. Electrochemical investigations have also been carried out in Łódź, Wrocław, Poznań, Cracow and Gdansk in the field of the structure of electrolyte solutions, including nonaqueous solutions and fused salts, both inorganic and organic, the structure of double layers, the kinetics and mechanism of electrode processes, corrosion, electrochemical sources of energy, modified electrodes (polymeric electrodes in particular), organic electrosynthesis and electroanalysis, as well as in the exploration of fused carbonate fuel cells and a recognition of the kinetics and mechanisms of electrode processes in the electrolysis of aluminium and magnesium. Polish physicochemists have a long and well-established tradition in the study of interfaces. A number of institutes at the universities and in the Polish Academy of Sciences have been founded (in Cracow, Warsaw, Wrocław, Gliwice, Poznań and Łódź). At the same time, five applied chemistry research institutes and four industrial laboratories have been organized (Warsaw, Kędzierzyn-Koźle, Puławy and Cracow). Fundamental and applied research has been developed which led to the industrial application of new catalytic processes. Amongst other subjects, the selective oxidation of hydrocarbons, the synthesis of sulphuric acid, synthesis of ammonia, hydrogenation, processes of refining, chemistry of zeolites catalysts, combustion of pollutants are being studied. Investigations into the applications of quantum chemical methods in catalysis have also been carried out. Novel efficient catalysts were developed for industry.

Research into surface and colloid chemistry is being carried out in Cracow, Lublin, Wrocław, Poznań and Łódź. The main achievements in this area are related to the development of the convective diffusion theory of colloid transport, the formulation of a new localized adsorption model for a description of the kinetics of ad-

sorption of macro molecules, development of a unified theoretical description of adsorption, description of the electrokinetic phenomena in disperse systems and the synthesis of a new class of biodegradable nonionic surfactants (dioxanes).

The rapid development of physicochemical studies in material science (Wrocław, Warsaw, Poznan, Lodz and Gliwice) should also be mentioned here. This relates both to the search for new materials and studies on their physical properties important in practice. One should also mention here the results of investigations into the electrical and optical properties of molecular crystals and composite materials, novel photoactive materials, the recording of optical information, the spectroscopy of highly conducting organic materials and nonlinear optical properties. Results obtained from research on reticular doped polymers and plasmic polymers should also be mentioned here. In Warsaw, novel liquid crystalline materials were elaborated and applied in practice. A rich family of ferroelectric crystals were discovered which were based on halogenoantimonates and bismuthates, and important results were obtained in the field of magnetic materials (Wrocław). This field embraces among other things semiconducting magnetics (Warsaw), permanent magnets based on rare-earth compounds, thin magnetic films (Poznan), and magnetic properties of a variety of uranium compounds which appeared to be interesting from the physical point of view (spectacular ferromagnetic properties of  $\beta$ - $\text{UH}_3$ ; Wrocław). A contribution to the investigations into various types of intermetallic rare-earth compounds (Wrocław, Cracow and Katowice) and magnetic nanomaterials (Warsaw and Poznan) should also be emphasized. Recently, a number of new molecular ferro- and antiferromagnetic materials were synthesized and explored with respect to their physical properties and low temperature magnetism (Wrocław).

In structural studies, a special position is occupied by the hydrogen bond research which is being carried out in Wrocław, Poznan, Warsaw, Cracow, Lodz, Gdansk and Szczecin. This relates to the theory of vibrational spectra, infrared continua, polarized transmission spectra, isotope effects, charge distributions and proton transfer in hydrogen bonded molecules, and numerical band shape analysis and dynamics of hydrogen bonded systems. Special attention is being paid to the strongest quasi-symmetric bridges such as those in protonated proton sponges. Resonance methods, namely NMR (Warsaw, Cracow, Poznan—structural application of nitrogen magnetic resonance, dynamic aspects, both theoretical and experimental) and ESR and NQR (Poznan, Wrocław—application to hydrogen bonded solids in particular) have been developed.

A rapid development of almost all branches of crystallographic studies began in the 1970s. This relates to structural studies on such systems as

intermetallic alloys, metalloorganic and complex compounds, organic and biologically active compounds (including proteins). The results that were obtained in studies of disordered structures, phase transitions, liquid crystals and hydrogen-bonded systems should be mentioned here. These achievements were made possible due to, among others things, the development of modern facilities (e.g. the KUMA automatic four circle diffractometer with CCD detector).

In the field of radiation chemistry which was developed in Lodz, Warsaw, Wrocław and Siedlce, results were obtained concerning the description of excited states and migration processes in irradiated materials, including quantum mechanical electron tunneling, low temperature pulse radiolysis, the radiation chemistry of polymers and free radicals, computer simulations of radiation and modelling of the solvated electron.

During the inter-war period, three important names in the field of photochemistry and photophysics should be mentioned: Wiktor Kemula, and the physicists Stefan Pienkowski (1883–1953) and Aleksander Jablonski (1898–1980). At Warsaw University, Pienkowski set up a well-known school of photoluminescence studies where a number of significant discoveries were made: independence of luminescence spectra of excitation energy, the concept of the fluorescence centre, an exploration of the anisotropy of adsorbed molecules and above all, both the discovery of the metastable excited state and the publication by A. Jablonski of a subsequently well known energetic diagram which described spectra and photoluminescence kinetics.

In Gdansk, a solvatochromic method of dipole moment determination in excited state was elaborated, in Warsaw donor-acceptor (CT) complexes in gas phase and the kinetic rules of photophysics of CT complexes were discovered. The presence of twisted conformations in the excited state (TICT states) was explained for molecules containing electron donor and acceptor fragments. The existence of such states was confirmed in a number of experiments. In other studies, direct excitation to the triplet state in the presence of heavy atoms or paramagnetic compounds was demonstrated. The phenomenon of photoinduced double proton transfer was discovered. In Cracow, the theory of electron transfer and the kinetics of elementary photophysical processes was extended. In Poznan, studies of photochemical reactions for biologically important molecules are being carried out. In Wrocław, B. Jezowska-Trzebiatowska initiated intense studies on the spectroscopy and luminescence of coordination compounds. Among other things, several new laser-active materials based on lanthanide compounds were discovered. The recent contribution of Polish physico-chemists to the spectroscopy of single molecules, arising from close international co-operation, should also be noted.

## Organic chemistry

Early research maintained links to the pre-war studies. Jerzy Suszko (1895–1972, Poznan: quinine alkaloids), Osman Achmatowicz (1899–1988, Lodz, later Warsaw: strychnine, Lycopodium alkaloids), and Zofia Jerzmanowska (Lodz, flavanoids) were all involved in the isolation and structure of natural products, Edwin Plazek (Wroclaw) was involved in the chemistry of pyridine and Tadeusz Urbanski (Warsaw) developed the chemistry of nitrocompounds and explosives. New researchers gradually took the lead: Jan Michalski (Lodz) extensively developed the chemistry of organophosphorus compounds, Henryk Kuczynski (1909–1991, Wroclaw) and Witold Zacharewicz (Torun) led the foundation of terpenoid chemistry and Maciej Wiewiorowski (Poznan) developed the field of lupin alkaloids.

The next generation, currently active, has broadened further the fields of research. This has been connected to the rising interest in scientific investigations in general and with the growing availability of new instrumentation. In addition this has also been connected with an expansion in international cooperation. As a result, new ideas and new subjects have been developed.

### What are the main lines of organic chemistry research in Poland now?

New methods of organic chemistry: nucleophilic substitution in aromatic nitro compounds (Warsaw), two-phase reactions (Warsaw), oxidation of organic compounds (Wroclaw), and new stereoselective syntheses (Warsaw, Lodz and Wroclaw). The chemistry of natural products: isoprenoids (Warsaw, Bialystok), carbohydrates (Warsaw, Gdansk) amino acids, peptides (Wroclaw, Gdansk, Warsaw, and Opole), alkaloids (Warsaw, Poznan), antibiotics (Gdansk), porphyrins (Wroclaw). Nucleic acids (Poznan), nucleotides (Lodz), organo-phosphorus and -sulfur chemistry (Lodz, Wroclaw and Lublin), organoboron chemistry (Torun), organosilicon chemistry (Lodz, Poznan and Gdansk), chemistry of heterocycles (Gliwice, Lodz and Cracow), supramolecular chemistry (Warsaw). High pressure methods are studied in the synthesis of organic compounds (Warsaw).

Two large projects are underway in Warsaw: reactions in catalytic two-phase systems and 'vicarious nucleophilic substitution' have been carried out. The chemistry of the thioacids of phosphorus (thiopyrophosphates, substitution reactions of thiophosphates) was developed in Lodz, where substantial contributions have been made to the chemistry of phosphorus(III) compounds and to optically active sulfur(IV) acids. Organic syntheses based on amino acid-derived aldehydes were expanded upon in War-

saw. New oxidation methods of aromatic compounds have been introduced in Wroclaw. New syntheses of amines based on phosphoamidites were studied in Lodz. The structures and syntheses of the first sulfur atom-containing alkaloids were studied in Warsaw. The structures of several complex polyene macrolide antibiotics (Gdansk) have been disclosed. Several significant results have also been achieved in the synthesis of natural products: new approaches to marine sterols and vitamin D-type compounds (Warsaw), new porphyrins (Wroclaw), two general (*de novo*) approaches to monosaccharides (Warsaw), and  $\beta$ -lactam synthesis (Warsaw). In nucleoside chemistry, the contributions of Łódź (chemistry of nucleoside esters with phosphorus thioacids, synthesis of enantiomeric phosphoric acid containing isotopes of oxygen) and Poznan (Markiewicz's reagent in nucleoside chemistry) should be mentioned.

## Analytical chemistry

The reconstruction of educational institutions and industry after the Second World War promoted the development of modern analytical techniques. Wiktor Kemula (Warsaw), developed different variants of voltammetry, in particular pioneering work on chromatopolarography (1953), and anodic stripping voltammetry (1958). Janina Swietoslawska (Warsaw) introduced mathematical methods into spectrophotometry (1952), long before the importance of chemometry was recognized. Bogdan Kaminski (Cracow), Janina Opienska-Blauth (1895–1987) and Andrzej Waksmundzki (Lublin) created a basis for the further development of chromatography. Jerzy Minczewski (1914–1995) (Warsaw) introduced modern approaches to inorganic trace analysis. Zygmunt Marczenko (Warsaw) developed the application of organic reagents for the separation and spectrophotometric determination of metals and metalloids. All of these scientists have created scientific schools that are still active and are well recognized abroad.

The development of analytical chemistry exerted a considerable influence on research topics in Poland. In chemical techniques, research on organic reagents continues, including derivative spectrophotometry and separation by flotation and multicomponent complexes in spectrophotometry (Warsaw). The original technique of thiomercurometry was developed by M. Wronski (1926–1996) (Lodz). The iodine–azide reaction was applied in many methods which are of theoretical and practical significance (Poznan).

Significant achievements were noted in stripping voltammetry, the application of ultramicroelectrodes, ion-selective electrodes (Warsaw, Poznan and Lublin). New electrochemical instrumentation was developed (Cracow). Biosensors based on electrochemical detec-

tion have been developed (Warsaw).

Thin-layer chromatography, both gradient and pressured techniques, was developed (Lublin, Warsaw and Katowice). In HPLC, various stationary phases were investigated (Lublin). Fundamental theoretical studies on the relationship between retention data and the molecular structure of the chromatographed substances are being carried out (Gdansk, Torun and Lublin). Novel results have been obtained in trace analysis using ion-exchange chromatography with a theoretical approach to resolution, as well as in the modification of anion exchangers with sulphonated organic reagents (Warsaw). Students of Edmund Kozlowski (1932–1995, Gdansk), where head space analysis was studied, have been carrying out extensive investigations on the determination of organic pollutants in the environment, in particular on sampling and sample treatment. Liquid crystals were applied as stationary phases (Warsaw). New types of detectors have been developed (Cracow).

Atomic spectroscopy has been intensively applied to trace analysis (Warsaw). Particular achievements were associated with the study of interference effects and with correcting them by methods of standard addition and subsequent dilution, as well as with the application of chemical modifiers to atomic absorption spectrometry. Research on the use of microwaves in analytical spectrometry is also ongoing (Poznan). Spectroscopic techniques are being also applied to the study of metal speciation (Warsaw and Poznan).

Flow methods, with various detection methods and on line sample pretreatment methods are being developed for speciation, environmental and clinical analysis (Warsaw). Chemical sensors, including potentiometric, amperometric, piezoelectric, ISFETs and semiconductors are being developed for various methods of routine chemical analysis (Warsaw). Numerous chemometric methods have been developed for structural analysis, multicomponent analytical procedures, the optimization of analytical procedures and for data processing (Cracow, Rzeszow). The environmental monitoring of air and water pollution is being developed and carried out (Warsaw, Poznan). Research has been initiated into cooperation with the Environmental Specimen Bank (Warsaw). Several certified reference materials have been developed on the basis of international interlaboratory studies (Warsaw, Cracow).

## Polymer chemistry and technology

Polymer chemistry and polymer technology in Poland have their roots in the early 1930s, when the basic research on polyaromatic compounds (Wojciech Swietoslowski and Dyonizy Smolenski) and applied research on plastic and rubber technology was developed. This area includes the original technology for

synthetic rubber production (KER) which was later transferred to the USA.

After World War II, a number of centres for polymer science emerged. In Lodz, the physical chemistry of synthetic fibres was developed (Antoni Boryniec, Eligia Turska) as well as the chemistry of polyamides and polysiloxanes (Stanislaw Chrzczonowicz, Zygmunt Lasocki). Ion-exchange resins were studied in Wroclaw (Tadeusz Rabek, J. Lindeman), whereas the Warsaw Technical University group (S. Porejko) concentrated on polymer synthesis. In the University of Torun (Antoni Basinski), research in the area of the physical chemistry of polymers and colloids was carried out. In the early 1950s the Institute of Plastics was created (M. Wajnyrb, J. Pochwalski), which later became a part of the Industrial Chemistry Research Institute. In the latter, several new technologies were developed, including an original process for polyacetal polymer production.

Lodz remains the major centre for polymer chemistry and technology in Poland with its Center of Molecular and Macromolecular Studies of the Polish Academy of Science, Institutes in Lodz Technical University and several industrial laboratories. These groups cover a broad range of research fields, including theories of ionic ring-opening polymerization, the electric properties of polymers, and elastomer properties. In the Warsaw Institute of Technology, polymerization with metalloorganic catalysis and solid polymer electrolytes are being studied. The theory of fibre formation has been formulated by a group from the Polish Academy of Science Institute. In Gliwice, Szczecin, Wroclaw and Zabrze, degradable and biomedical polymers are under study, while in Opole, olefin polymerization is being investigated. Applied research in the area of polymer technology is being carried out, not only in the Industrial Chemistry Research Institute in Warsaw, but also in a number of industrial laboratories, namely in Plock, Osiecim, Blachownia and Tarnow.

## Chemical technology

The Polish chemical industry has a long history, dating back to the beginning of the 19th century. Parallel to its formation and growth was the development of chemical technology—a science which studies the processes and the products. Many outstanding Polish scientists have made significant contributions to its progress.

Initially, the chemical industry in this region was based exclusively on local raw materials, such as the rock salt used for fabrication of soda, the sulfur for powder and sulphuric acid productions, pyrite for sulphuric acid production, etc. The beginning of the exploitation of the crude oil resources in the Ciscarpatian region and the development of the fractional distillation technique for the production of kerosene fractions for lighting pur-

poses by Ignacy Lukaszewicz in the middle of the 19th century initiated the oil refinery upgrading processes in this area, which were later developed by Stanislaw Pilat (1881–1941). At the end of the 19th century and early in the 20th century the sugar industry was rapidly developed, in addition to the paper industry, the tanneries for leather production, and fats and oils processing, etc. The growing sulphuric acid production has often been linked to the manufacture of superphosphate. Numerous gas works produced town gas by the coal degassing process. Coal coking, based on the rich coal reserves, developed rapidly.

Between the two world wars, rapid progress was made in manufacturing paints, lacquers and varnishes, cosmetics, pharmaceuticals and synthetic dyes, etc. The separation and utilization of aromatic and heterocyclic components from coal tar was developing, which was also due to research on coal degassing processes, the physicochemical characteristics of the coal tar, etc. that was carried out by Wojciech Swiętoslawski. However, at that time the chemical industry was not very significant. To change this situation, a government programme of modernization and expansion was announced. Particularly important in this was the role of Ignacy Moscicki, known from his earlier innovations and achievements in Switzerland and Poland concerning the formation and properties of the electric arc, the synthesis of nitrogen oxides and the production of nitric acid and hydrogen cyanide. It was that time that the large Chorzow Works was modernized and new products were added to its output (carbide, calcium cyanamide, nitrogen fertilizers, etc.). A large, completely new chemical factory was built near Tarnów (Moscice) to produce ammonia, nitric acid and ammonium nitrate (by the methods of Tadeusz Hobler, 1899–1975), etc. Both factories were headed by Eugeniusz Kwiatkowski (1888–1974) a talented manager. Altogether, almost 1000 chemical factories existed in Poland in the inter-war period. It is worth mentioning that among them was a unit producing synthetic polybutadiene rubber from ethanol ('KER', Dębica), being among the first in the world. During the Second World War this technology was passed to a US producer by the inventor (W. Szukiewicz).

The last 50 years was a period when the chemical industry, which was largely destroyed during the war, was rebuilt and expanded. At present, the industry employs over 230 000 people and has a stable share of nearly 10% in the sales of all of industry. It produces practically all the basic chemicals and almost all modern sorts of plastics, fibres, surfactants, rubber and fertilizers. It includes two large modern refineries (Plock, Gdansk) and several smaller ones, one large petrochemical centre (Plock—olefins, PE, PP, ethylene oxide, aromatics, etc.), several large companies with

diversified, mainly petrochemical, production (Kedzierzyn-Kozle—ammonia, nitric acid, urea, nitrogen fertilizers, oxo alcohols, phthalates, formaldehyde, etc.; Pulawy—nitrogen compounds and fertilizers, cyclohexanone, caprolactam, etc.; Tarnow—nitrogen compounds and fertilizers, chlorine and derivatives, acetylene, hydrogen cyanide, acrylonitrile, cyclohexanone and caprolactam, PVC, polyacetals and other polymers, etc.; Oswiecim—synthetic rubber, polystyrene, PVC and other polymers, acetaldehyde, acetic acid and esters, chlorine and derivatives, etc.; Wloclawek—nitrogen compounds and fertilizers, PVC, etc.; Police—sulphuric acid, extractive phosphoric acid, nitrogen-phosphorus fertilizers, etc.; Bydgoszcz—polyurethanes, epichlorhydrine, other chlorocompounds, dyes, etc.; Torun, Gorzow and Lodz—respectively, polyester, polyamide and polyacrylonitrile chemical fibers) and many other companies. Some installations are of the highest world standard (licensed oxoalcohols, hydrocracking and many others, as well as own caprolactam, low-energy consuming large ammonia unit based on autothermic catalytic reforming and partial oxidation of natural gas, etc.).

The process of modernization, restructuring, privatisation and development of the chemical industry is now in progress, supported by technological research in about 20 research institutes and centres (among them the oldest institute in Warsaw, created in 1922 by Ignacy Moscicki, presently called the Industrial Chemistry Research Institute), numerous faculties of chemistry at the universities and technical universities (polytechnics), and the scientific institutes of the Polish Academy of Sciences. As a result of their previous R&TD activity, this industry has developed a number of original technologies, some of which are now on the international market (sulfur granulation, sulfuric acid and oleum, cyclohexanone, caprolactam, bisphenol A, trioxane, dioxolane and polyoxymethylene, epichlorhydrine, nonylphenol, and some others). A process developed in Poland for making cyclohexanone from benzene via cyclohexane, known under the trade mark 'CYCLOPOL', has been licensed to many countries and is the basis for a substantial proportion of global cyclohexanone production.

The development of individual technologies was possible, due, amongst other factors, to the progress in theory and research concerning unit operations and processes. Fundamental and applied chemical engineering research initiated in Poland by Tadeusz Hobler were developed successfully by Janusz Ciborowski (1918–1986), Stanislaw Bretsznajder (1907–1967) and others, at several technical universities and at the institute of the Polish Academy of Sciences.

The carefully selected and now gradually introduced model of the ecology-oriented strategy of sustainable

development of the chemical industry is based in this country, similarly as in other countries, on programmes such as Clean Technologies, Responsible Care philosophy and obligations, Product Stewardship practice, 'cradle-to-grave' policy, etc. As the chemical industry is a particularly science-dependent and technology-based kind of industry, it has become clear, that chemical technology is a fundamental tool for the realization of an environmentally-friendly strategy. Bearing this in mind, The Chemical Technology Congress held in Wroclaw in 1997 named the main priorities in technological research areas concerning Process and Product Research and Technological Development. Among them are: all possible routes to increase selectivity (catalysts, optimization of parameters, recycling of by-products, etc.), to limit energy consumption (heat-exchange and utilization of heat, exothermic processes replacing endothermic, integration of the processes and operations, such as combinations of reactions via separation or heat transfer, a gradual replacement of distillation and cryogenic techniques in the separation of mixtures by adsorption and membranes, etc.), to limit, utilize and neutralize wastes, emissions and discharges (zero-waste and low-waste technologies, closed cycles, recycling and re-utilization, safe waste processing and disposal, etc.), to limit feedstock consumption and materials consumption in auxiliary operations (water treatment, steam production, etc.), to develop processes based on alternative hydrocarbon and non-hydrocarbon raw materials, some refinery processes (hydrotreatment of every kind,  $C_5$ - $C_6$  isomerization, alkylation on solid acids, etc.), some petrochemical processes (olefins production, chemistry and technology of  $C_1$ , methods of direct transformation of low alkanes, selective oxidation, hydrogenation and isomerization, polymerization on single-site catalysts, etc.), zeolite chemistry, biotechnology, the enrichment of poor mineral raw materials, among others. Priorities in more fundamental studies include kinetics, macrokinetics, mechanisms of reactions and of processes, dynamics of the system reagent-catalyst-reactor, multifunctional reactors, organization of processes, nonstationary conditions, new methods in modelling and process design, etc. The accepted priority programme also contains the main fields of research to develop advanced products and materials of various molecular and supramolecular structure and functionality (superengineering polymers, thermostable, nonflammable, biocompatible, biodegradable, composites, superabsorbents, materials for optoelectronics, adhesives, carriers for drugs, medicines or fertilizers, chemical fibres, special ceramics, catalysts, carriers, adsorbents, indicators, sensors and many others).

In all research areas, the ultimate aim is to improve existing or to develop new more advanced technolo-

gies, operations, equipment and products, environment-friendly, with low energy and feedstock consumption.

Various research centres are carrying out multidirectional investigations on chemical methods, catalysts, technology and engineering for environmental protection, on water treatment and waste processing, recycling and reutilization of by-products, waste and post-consumer products, on various syntheses of fine chemicals (specialities) and intermediates, biologically active compounds, on industrial analytical methods, on integrated computer-assisted control systems, and many other subjects.

## Organization of chemistry research and education in Poland

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There are 22 chemistry departments at 11 universities and 11 technical universities. Chemistry research is often present at Higher Schools of Agriculture, Medicine and Economy (altogether 24 chairs or institutes). There are eight institutes of the Polish Academy of Sciences which are involved in research in various aspects of chemistry. Apart from these institutions, there are 12 institutes working for industry which carry out research in chemistry—mostly applied chemistry.

Within the Polish Academy of Sciences there are two committees which collect members of the chemical community—Committee of Chemistry with the chairman Prof. Bogdan Marciniak, and Committee of Analytical Chemistry with the chairman Prof. Adam Hulanicki.

The Polish Chemical Society (founded in 1919) has more than 3000 members and every year it organises annual congresses with over 1000 participants presenting the results of research from all branches of chemistry and also many specialized symposia.

Funding for research is arranged via a Government Institution—the Committee of Scientific Research (Komitet Badan Naukowych) which evaluates grants and distributes financial support for research in higher schools and scientific institutions.

## Acknowledgement

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# The Phuket Declaration

International Conference on Biodiversity and Bioresources—Conservation and Utilization, Phuket, Thailand, 23–27 November 1997

## Preface

The Phuket Declaration, which is concerned with the conservation and sustainable utilization of biological diversity, was developed at the IUPAC International Conference on Biodiversity and Bioresources—Conservation and Utilization, held in Phuket, Thailand during 23–27 November 1997. The Declaration recognizes the sovereign rights of states over their natural resources and their authority to determine access, in compliance with the Convention on Biological Diversity. Under the Convention it seeks to accomplish the following important objectives:

- biological diversity must be protected, minimizing anthropogenic influences;
- the principle of sustainable utilization of genetic resources must be adopted; appropriate research activity should be carried out, if possible, within the source country and in close contact with local scientists;
- there should be a fair and equitable sharing of commercial benefits arising from this research.

Regional concerns over the over exploitation of biological resources led to the Manila Declaration in 1992, which was endorsed by the Bukittinggi Declaration in 1992, and followed by the Melaka Accord in 1994. These three documents outlined a regional standpoint to ensure the conservation and sustainable utilization of biological resources. The Guidelines to facilitate access to biological resources and the equitable sharing of benefits in the South-east Asian Region were prepared at the Workshop in Kuala Lumpur in April 1996 to ensure a fair and equitable sharing of benefits.

IUPAC recommendations on the Preservation and Utilization of Natural Biodiversity in the Context of the Search for Economically Valuable Medicinal Biota have been published in *Pure and Applied Chemistry* 1996, Vol. 68, pp. 2325–2332, taking into account IUPAC's global, strictly scientific and non-governmental mandate for chemistry.

At the Phuket IUPAC International Conference on Biodiversity, held during 23–27 November 1997, all scientists agreed that the principles outlined above, in compliance with the Convention on Biological Diversity should be implemented and the Phuket Declaration was adopted.

## The Phuket Declaration concerning the conservation and sustainable utilization of biological diversity

Adopted at the IUPAC International Conference on Biodiversity and Bioresources Conservation and Utilization, held during 23–27 November 1997, in Phuket, Thailand. We the participants of the Conference outlined and agreed on the following principles:

- Recognition of the sovereign rights of the source countries over their biological resources, and of their rights to utilize such resources in accordance with their own environmental policies.
- Development of legislative measures by the source nations for conserving and sustainably utilizing their biological resources.
- Provision of incentives to promote the transfer of technology through collaborative research and training under '*fair and most favorable terms to the parties concerned*'.
- Ensuring the fair and equitable sharing of benefits arising from the utilization of biological resources.

It is recommended that the countries endowed with rich biological resources should:

- 1 Develop legislative measures to facilitate effective conservation and responsible access to biological resources and its molecular diversity.
- 2 Discuss the establishment of an effective coordinating/administrative body to ensure that the provisions of the legislative measures are properly implemented.
- 3 Adopt national systems of licenses for foreigners and nationals who plan to have access to biological resources; develop cooperative research and development programs that ensure a mutually agreed level of science and technology transfer.
- 4 Provide an efficient process for granting a license with efficient mechanisms to obtain Prior Informed Consent from the source country and the local communities concerned.
- 5 Provide mechanisms for the protection of rights of local communities and indigenous people with a fair and equitable sharing of benefits.
- 6 Encourage collaborative research and training to be carried out preferably within the source country in order to enhance scientific and technological capabilities and ensure appropriate recognition of the contribution of host country collaborators.
- 7 Facilitate the exchanging of relevant information regarding scientific, technical, legislative and administrative protocols among collaborating countries.

## **ICSU Press Workshop on Electronic Publishing in Science, Keble College, Oxford, UK, 30 March—2 April 1998—some observations**

This three-day conference, officially titled 'Economics, Real Costs and Benefits of Electronic Publishing in Science—A Technical Study,' was planned to follow up on the Joint ICSU Press/UNESCO Conference on Electronic Publishing in Science that was held in Paris, France, during February 1996 (*Chemistry International* 1996, Vol. 18, pp. 165–169). The Oxford workshop attracted around 50 participants, about half of whom had been present at the Paris conference. Moreover, essentially all the organizations represented in Paris were again represented in Oxford. This useful continuity, together with the smaller size of the Oxford Workshop (50 vs. 150 in Paris) made for an unusually stimulating and interactive three days in the comfortable modern facilities at Keble College's ARCO Building.

Sir Roger Elliott (Chairman of ICSU Press and a former chief executive of Oxford University Press) set the stage for the meeting by challenging the attendees to describe an electronic publishing system for science that would have a number of desirable characteristics: (1) Gives authors' works visibility, with adequate quality control; (2) Can be accessed easily; (3) Preferably costs less than the current system; and (4) Provides adequate incentive and financial return to those (such as publishers) who 'add value.'

Fred Spilhaus, Executive Director of the American Geophysical Union, predicted that the present scientific publishing system was nonlinear, and that substantial, unpredictable changes would inevitably take place. He observed that the boundaries between 'chit-chat' and formal publication were becoming distinctly blurred in the electronic arena and that electronic enhancements will become both more complex and more costly. Anent Parekh, Professor of Physiology at Oxford University, expressed the enthusiastic view of many young academics, that electronic publishing offers users many advantages and relatively few disadvantages. Among the features Parekh found most helpful were currency, ease of access (including access from one's home computer) and the ability to look at and download additional data not usually printed in the paper journal. Donald King (King Research, Ann Arbor, Michigan), Terry Scott (until recently with the American Institute of Physics), and Owen Hanson and Robert O'Shea (Lindsay Ross International, Abingdon, UK), all pointed out that a comparison between the costs of conventional (paper) pub-

lishing and costs of electronic publishing must be conducted with great care. King stressed the need for a careful definition of terms, while the others emphasized that many costs (for example, those for peer review) do not disappear in the electronic publishing system and that there is no reason to believe, as some have suggested, that electronic publication is inherently less costly than paper publishing. Indeed, many enhancements in the electronic system—for example hot-linking and graphics display improvements—actually increase cost, they stressed. William Mischo (University of Illinois, Champaign-Urbana) described some of the technical difficulties inherent in archiving electronic journals, including the still substantial cost of archival storage, despite large decreases in storage device costs in recent years. He also raised the disturbing issue of the questionable readability in future years of outmoded storage vehicles such as 5¼-inch floppy disks and current-technology CD-ROMs. Bernard Donovan (Association of Learned and Professional Society Publishers, UK) had surveyed a number of publishers and concluded that substantial costs were incurred by scientific publishers in their conduct of peer review. He estimated such costs as typically between 100–300 GBP per accepted paper. Fytton Rowland (University of Loughborough, UK) challenged the assertion that users would find electronic publications so accessible and easy to use as to render librarians redundant. Indeed, he contended that the librarian and information intermediary functions will continue to be needed as never before, to cope with the variety and rather chaotic arrangement of materials on the Internet. Gary VandenBos and Susan Knapp (American Psychological Association) described a new all-electronic journal published by the APA; this journal has 2500 individual users, currently accessing it for no charge. However, there had been, and continued to be some resistance from potential authors and more resistance than expected from reviewers. Knapp also described an innovative pricing arrangement (still experimental) under which APA members with a print subscription to at least one APA journal could purchase in addition, at a very attractive price, access to a full-text database of all APA journals and/or to the Psychological Abstracts database. Knud Thomsen, a participant in a working group of scientists at fusion energy facilities scattered over many parts of the world, described the characteristics and problems of their system for mutual communication over the Internet. Many of these problems—for example, use of incompatible software versions and different e-mail systems—are extremely

germane to electronic publishing on 'the Net.' Abel Packer (Pan American Health Organization, Sao Paulo, Brazil) and Virginia Cano (Queen Margaret College, Edinburgh, UK) explained why scientists in developing countries are attracted to the possibilities of publishing electronically. Fundamentally, this attraction is related to the relatively low barriers inherent in operating a web site, provided that the web host possesses the ability to offer material in English, now the scientific 'lingua franca' of choice world-wide. Visibility can quickly be obtained electronically, but progress is still too often hampered in many countries by poor infrastructure (telephone system) and by a lack of computer availability or literacy. The same points were made by Attlio Bustos and Graciela Munoz (Catholic University of Valparaiso, Chile), who have developed the *Electronic Journal of Biotechnology* in Chile. Vitaly Nechitailenko (National Geophysical Committee, Russian Academy of Sciences) described some of the special problems posed by offering on-line a journal having extensive mathematics, where HTML representation is in some respects deficient.

Summarizing the status of a fast-moving and technologically sophisticated field such as electronic publishing is no mean feat, but workshop attendees attempted it with the assistance of David Pullinger of Macmillan Publishing and of the chairs of three break-out groups to which all attendees had been assigned during the last sessions of the workshop.

The following principal conclusions were among those generally agreed to by participants:

- 1 Electronic journals will become dominant (over conventional paper publishing) in the next 5–15 years.
- 2 Peer review and methods to 'brand' (indicate the quality of) electronic papers will be indispensable to successful electronic publishing.
- 3 Despite widespread expectations that electronic publishing will be less expensive than paper publishing, every evidence to date indicates that it may be just as expensive or even more expensive, de-

pending on the sophistication and cost of electronic enhancements such as live graphics and hot links.

- 4 Publishers generally have done a poor job in the past explaining to authors and librarians how they have added value to authors' work. (This explains in good part why there exists the wrong expectation described in Conclusion no. 3, above.)
- 5 The ability to gather detailed information on the searching habits of scientists when they access electronic publications will pose ethical questions for publishers. Users should be informed about any information gathering practices used by electronic publishers.
- 6 The infrastructure—telephone systems, networks, etc.—that is in place in advanced countries will continue to need maintenance; in developing countries, and even in some developed countries, large capital investments are essential if the citizens in those countries are to share in the benefits of electronic publishing and other services made available via the Internet. Inevitably, government agencies will be looked at as the source of these investments.
- 7 Everyone agreed that there is an urgent need to maintain archives of electronic publications. But who should be the keepers of the archives? Conferees had little confidence in the willingness or ability of national governments or of commercial publishers to undertake this vital task. Not-for-profit scientific societies—presumably having an obligation to assure access to the record of their various disciplines—were seen as the most logical candidates for this Herculean task.
- 8 Electronic publishing has reached an exciting stage. There are now a sufficient number of 'products' in the marketplace that the next few years will bring a great deal of practical knowledge about how technical users react to these products, how they use them and—the \$64 000 question—how much they are prepared to pay.

Michael Bowen, 4 August 1998

## ICSTI General Assembly

Loch Lomond, Scotland, 21–25 May 1998

### Attendees

Present were 43 people from 38 ICSTI member organizations, 3 observers, 5 speakers and 3 people from the Secretariat. There were representatives of various international organizations and attendees from UK, USA, Netherlands, Canada, South Africa, Japan, France, Russia, Taiwan, and Sweden.

### Electronic libraries—relationships between suppliers and customers

#### The primary publishers' viewpoint

Ian Bannerman, *Blackwell Science*

Blackwell Science are unusual in that often they are publishing under license for learned societies, so they

### Free access

Pros	Cons
Can provide critical mass of users	Can swamp the service
No administration of payments or security problems	Stores up problems
Promotes titles/organization	Tests the technologies not the product
Users should be tolerant of problems	Undermines the value of copyright
	Does not encourage internal discipline
	No money!

So, you need to be clear why you are giving it away free.

### Online linked to print (i.e. online is bundled with print).

Pros	Cons
Preserves revenue in short-term	Not necessarily what customer wants
Print as back-up and archive for all customers	Does not resolve format question
Offers added value	Does not allow savings
	Acts as a straight jacket

do not hold the copyright. The creation of digital content should be integral with print systems. They use PDF full text, and HTML for headers. They chose not to have an Elsevier Science Direct or Springer LINK type of service, instead they use intermediaries such as BIDS to deliver the content.

Blackwell Science studied pricing policy. The market expected electronic journals to be cheaper than print but online publishing creates additional costs. At first the pricing policy was online price 90%, print 100%, online plus print, 130%. We are all caught in an inflation-

### Online only

Pros	Cons
Provides customer choice	Archival problem needs to be addressed
Potential for cost savings	Requires faith in the quality of the service

### Product bundles ('For 10% more you get access to all our materials')

Pros	Cons
Easy to sell to accountants	Undermines collection development role
Increases penetration of all titles	Short-term insulation from market forces
Mops up finite funds in the short term	May not be scaleable or sustainable
Once negotiated, easy to administer	Assumes all titles are valuable
	Difficult to negotiate

### Consortia (Libraries club together.)

Pros	Cons
Avoids duplicated negotiation	Consortia differ in size, infrastructure, budget and cohesion
Good PR (public relations)	May be no sense of local ownership
Provides critical mass of users	Can be high risk—all your eggs are in one basket

## Transactional pricing

Pros	Cons
Already part of the economy but currently yields little revenue	May be difficult to budget
Statistical data	May undermine subscription revenue (especially to high price titles)
Provides a richer product mix	May undermine nonsubscription revenue from industry, e.g. offprints to pharmaceutical industry

ary spiral (journal subscription cancellations lead to reduced profitability lead to publisher price increases lead to reduced spend on journals) but the tendency is for publishers to increase prices, since cancellations do not cause as much loss as price increases cause profit. Electronic publishing may break us out of the spiral.

'There are no stable or half-way solutions for launching the learned periodical literature onto the post-Gutenberg galaxy' (Steven Harnard). Pricing options include 'free' access, online linked to print, online only, product bundles, consortia and transactional pricing (document delivery). Bannerman considered the advantages and disadvantages of the various options in the Tables below.

When Blackwell Science chose to charge 130% of the print price for print plus online, customers focused on the 30% surcharge, not on the actual price. The focus is on the add-on, not on the real problem or benefits. The real problem was how much the *print* costs in the first place. Bannerman cited some figures from the University of Georgia figures, comparing various publishers. There is a big difference between Publisher A adding 10% to its average journal price of \$1400, and Blackwell Science adding 30% to its average of \$473.

Blackwell Science was involved in the UK National Pilot Site License. The old model was that Higher Education Funding Councils (HEFCs) paid HE institutions

who used subscription agents, while the publishers supplied the journals to the HE institutions. The new model links HEFCs directly with publishers who supply journals (with a site license) to the institutions, although institutions still use agents to order from the publishers.

The experiment is coming to the end. One problem for Blackwell Science is that universities might use the cost savings not to cancel subscriptions to Blackwell Science's competitors. A new project is NESLI, the National Electronic Site License Initiative. In this model, HEFCs will pay a managing agent (Swets and the University of Manchester) and electronic delivery is separated from print delivery. This new model is not yet commercially acceptable to Blackwell Science.

He concluded that we are faced with instability for the foreseeable future. There are *no* stable pricing and licensing models for online journals. There are no 'sacred cows': universities cannot always have interlibrary loan (ILL), free archival access and annual subscriptions. A single solution is not universally applicable.

There was some discussion about the delivery of single articles instead of full journals. Bundling is not done by subject area but this could make sense in the future. Herman Spruijt of Elsevier said that we must accept that the next generation may want the 'article' rather than the journal. We have to look at the 'container'.

Finally, Bannerman produced the following table:

	Examples	Payment	Usage Data	Price Control
Publisher run	Journals online	Full, intermediate	Full; article and customer	Complete
Commercial docdel	Uncover; ISI	Full, frequent	Partial	Control of copyright component
RROs	CCC, CLA	Unpredictable	Inadequate	Disconnected
Other	Fair (or unfair) use; ILL; BLDSC; library privilege	None	None	None

## The primary publishers' viewpoint

*Brian Thackray, Aslib*

Aslib has only 10 journals, but some are of high impact in information science. Five of them are online in some form. It is *making money* that is the Holy Grail: the content is already on the Web. We are about to see the 'reinvention' of the journal. Publishers tend to be traditional; the academic community also tends to the conservative. So, reinventing the journal is tricky. Aslib is involved in BOPCAS, the catalogue for British Official Publications Current Awareness Service, at the University of Southampton. This is a free online bibliographic database of British publications, funded by the Joint Information Systems Committee (JISC) in the UK. Aslib have an award from the Department of Trade and Industry to continue this work.

Aslib has looked at the concept of advertising revenue. Advertising usually costs GBP 0.02–0.08 per page view, but this is dependent on the specific nature of the online content, and on the advertisement. Thackray reckons that users will pay to keep advertising off the site because they do not want access slowed by graphics, but how much are they willing to pay? Aslib still wants to offer a 'free' service, so it is looking into different pricing bands for the added value services.

Aslib, with money from the EC, have been working on a new model. The 'container' will change by means of refined electronic feeds with value-added to the articles in the journals. The 'information refinery' approach will involve discussion group formats. The focus groups are willing to pay (in pricing bands) for various added value services: content-based bundles of information, delivery for use on customers' intranets, etc. The transition to electronic publishing will not be easy.

## The secondary publishers' viewpoint

*Jim Lohr, CAS*

Jim began by giving statistics for the huge amount of information available, and the size of CAS databases. Life was simpler when a library was a library. The digital electronic age enables the formation of a nontraditional library, which we may call an 'aggregation'. All the traditional suppliers in the old information supply chain want to evolve and survive in the digital age. All are trying to fill the library function with some sort of aggregation or access scheme.

The CAS perspective on chemical information libraries focuses on a broad set of end-users. It aims to simplify access, provide effective searching, be as comprehensive as possible and offer multiple delivery options. The linking model uses the Internet to provide a broad economic access to a broad user base. The model responds to current business practice realities:

many publishers are not willing to load their materials on others' sites; many publishers are establishing their own sites and want to do things their own way. The CAS model unites search and access capabilities.

The service is called ChemPort (<http://www.chemport.org>). It uses Internet access. Searching is via CAS databases. There are direct links to publishers for retrievals. Subscription services are available via the publishers. Document delivery is available offered from the publisher and/or CAS. There is reference linking. As of last December, eight publishers were involved. This is just one idea for the electronic library. It will evolve with time. It is not the only answer.

After the talk, someone asked whether there will be no need for secondary publishers in future. Jim said that a search engine may be OK for the *New York Times* but chemical information is different because of the nature of chemical structures and the bizarre terminology of chemistry. Thackray suggested that secondary publishers should do subject area 'Yahoos'. Kurt Mulholm says that *all* languages are arcane and full text search engines will never cope with them all.

*Dick Kaser, National Federation of Abstracting and Information Services (NFAIS)*

Kaser reported on a session entitled 'The economics of scholarly publishing: primary publishing models and user response' held at the 1998 NFAIS Annual Conference. There are four options: the publisher licenses the entire journal collection in electronic form to library consortia, the user buys the journal and gets the electronic text, the user buys by subscription or one article at a time, and to print or not to print at all.

He went on to summarize his conclusions from three NFAIS conferences. Publishers and users seem to be speaking different languages. Today's customers may well be the library consortium and the corporate intranet but the end-user is driving the process. A new model seems to be emerging but it is actually an old one.

The linear distribution model (author to primary publisher to secondary publisher to subscription agent to online vendor to library to user) is dead. The old model had collections of journals, buyer collectives, collection pricing and unlimited access; the emerging model also has collections of journals, buyer collectives, collection pricing and unlimited access.

It is the publishers' and distributors' perception of reality that is dying. The users' perception of reality is enduring and is driving the rest of us to change. Our top-down model is being pressured from the bottom up. The 'new' paradigm is actually an old one: the subscription model with end-users the beneficiaries. The envelope is bigger and so are the buyers. The users remain the same but we are getting closer to them than we have

been in a long time.

The user perceives that information is a public good, is above ownership, is beyond government control and is of great value but little cost. It is there when you need it, accessible, findable, copyable, cut and pasteable, transferable and not restricted. The user believes that information itself has no monetary value (the corollary is that the bulk of information is worthless). Once a gem is found a copy should be kept (the corollary being that users will take what they can get free but they will pay for items they want to possess).

In the new paradigm, lots of users use lots of networks and access indexes, catalogues and search engines. Today's questions are as follows. How big should we let groups be? How should print and electronic prices interrelate? Can pay-per-use coexist with subscriptions? Should rights to current content extend forever? How might copyright law override licenses? What do purchasers want?

Kaser drew attention again to Fisher's statement 'Our focus is now on learning how end-users use the journal and use our content with other content'. Axioms that arose from the NFAIS meeting are as follows. Pricing should not inhibit usage. Keep the end-user in mind. User-friendly systems can dramatically increase the use of materials. 'A lot of researchers are happy with inferior aggregations' or 'What I really want is access to quality'.

Kaser had these words of advice. Become a user of electronic information. Distinguish between customers and users. Negotiate with customers but think like a user. Know that each barrier you erect has a price (to you). Don't dwell on the past. Think of the potential. In e-Utopia, full text will be set loose, links and citations encouraged, browsing permitted, spontaneous purchases supported and re-use endorsed. The challenge is to maintain the revenue stream so that we can continue 'publishing', to manage in an orderly fashion the movement from print to electronic and to expand readership of the journal. We are in the habit of thinking that scholarly publishing is propped up and therefore we must erect barriers to protect ourselves. Scholarly publishing may no longer need to be an artificial economy, if we can just restore the relationship we once had with our real users.

### **The intermediaries' viewpoint**

#### *S. Wilson-Higgins, Blackwell's Information Services*

Blackwell's Information Services products are the online bookshop, Electronic Journal Navigator, which concentrates on delivery of journal articles, ESP which is a CD-ROM database in a Web environment, and Collection Manager focused on book materials. Blackwell Science is carrying out the Higher Education Resources

Online project which is studying on-demand printing.

Libraries need training and support to use electronic journals. There is a multiplicity of requirements and libraries continue to seek value for money. They will buy collectively to increase access and cap price increases. Their customer service requirements are greater and they do not want primary-publisher-centric access.

Primary publishers' launches are late and diversity is the rule. Primary publishers want contact with the users of their e-journals, and they want to defend their revenue streams. Licensing to consortia is increasing, license management is an issue and prices and packages vary.

For secondary publishers, database aggregators and document delivery services, license driven models prevail. There are more links to primary publishers and agents. Migrating to the Web can slow down access. Pay-per-view is increasingly available.

Blackwell Science believes that listening to customers and suppliers pays off. Monitoring usage across 'many to many' is a valid proposition. Customers need Blackwell Science's assistance to access and try new information services from publishers. Archiving and refreshing data is vital for the future. Good and consistent service remains a competitive differentiator. All new electronic services are 'works in progress'. New competitors will continue to emerge and challenge traditional competitors (Northern Lights, Profound, etc.)

Wilson-Higgins then presented a view of 're-intermediated agent services'. In this model, agents supply an electronic service, electronic budgetary control, advice and support for electronic publications, assistance with electronic access, electronic marketing and usage information and arbitration and documenting of agreed terms. (Administration of electronic acquisitions is a nightmare at the moment.) The agent in this new role will validate multipublisher electronic access, handle high volume transactions, handle electronic billing, facilitate multiple format access, handle electronic license administration, and monitor electronic usage statistics.

The right grouping to handle licensing might be a virtual community organizer such as OhioLink, GlaxoWellcome or the Royal Society. It makes it easier if the community has a common or single source of funding, a common interest and a common legal jurisdiction. Archiving electronic publications is very important. Current technology for electronic fair use and loans is not adequate: in future a trusted system is possible.

Purchasers want more certainty in the purchasing framework, to reduce the 'cost of purchase' (e.g. password administration), and, ideally, more for less (a good deal with tangible benefits and value for money).

The first topic in the discussion session was archiving. The British Library has no funding to do this but it is

reporting to the UK government on deposit of electronic documents. Since last year, the American Institute of Physics (AIP) seems to have diluted its promise of access in perpetuity. Terry Scott (now retired from AIP) also reported that there are significant data protection issues in monitoring usage. AIP destroys its records once they have been processed.

*Ian Best, Faxon (part of Dawsons)*

The library marketplace is moving to consortia for buying electronic products. End-users want desktop delivery for selected disciplines and they want linkage to the primary information. Usage is shifting to the end-user. End-users demand more features and the product must be Web-enabled. Access must be independent of geography. Clients still want an agent to process their orders. Best was astonished by the primary publishers' comments about getting closer to the client.

Post-Web re-intermediation brings new rules and roles for all parties. Value-added services will be created to cut through information overload. The information's usefulness will be increased. Information will be integrated into internal processes and will facilitate strategic decision making. Publishers are struggling with the evolving business model, maintaining brand identity, technical challenges, and resource allocation and restructuring. Few publish enough titles to make the right bundles. Librarians worry about archiving, budgets, technical challenges and resource allocation and restructuring. Users care about peer review, the tenure system and the imperative to publish, and finding information quickly and integrating it into their own work. Aggregators have to define the product and the market and remain flexible about business models and file formats. There is a lack of standards and infrastructure. Content providers are conservative and each publisher is different. Integrating all the information into the same chain is a problem.

### **The purchasers' viewpoint**

*Michael Breaks, Heriot-Watt University, Edinburgh*

Heriot-Watt spends 10% of its budget on electronic items but 90% of staff time is spent on managing electronic resources. Library budgets are stable but clients have increasing expectations. There are more students and mature students are less familiar with libraries. Budgeting is decentralized in some universities, i.e. faculties may be making library decisions. Libraries are going through a transition phase and are agents of change on campus. Distance learning and off-campus access are also issues.

Students think of the Internet as a virtual library. Elaborate log-on procedures (authentication and authorization) are a problem, although JISC is nearly at

the point of standardizing this. Some universities are merging their library and IT services. The IT infrastructure (desktop/campus/national/international) has to be considered: JANET has been 'free' (actually paid for by 'top-slicing' from grants) in the past but now some network access may be charged.

Teaching, learning and research make conflicting demands. The library users are students but most of the library budget goes on journals for researchers. The Research Assessment Exercise (RAE) rankings are used for funding while TQA assesses the quality of teaching and of the library. There are tensions between RAE and TQA. As regards collection development, every institution has a different mission.

Breaks listed the following obstacles to the use of electronic information services: skills training and awareness, lack of exemplars, lack of national and local vision, lack in key areas, pricing and licensing, too much variety in access methods, and IT infrastructure.

What do libraries and users want? They want to go from a reference to an article. Access and holdings are not two different things: preservation of electronic materials is essential if access is to be guaranteed and the user is to accept loss of the print holding. They want sustainable price models: they cannot afford 'print plus'. They are used to a 'free at point of use' model: transaction pricing gives them no control. The publisher/subject/aggregation question is like comparing a supermarket with a boutique: you actually need both of them.

Libraries need a standard interface for access. They need measures of effectiveness to determine if they are getting value for money. They want to get figures for usage from publishers. They want consortia purchasing. 'Fair use' ('fair dealing') is well established in the print environment: it is wanted in the electronic environment too. There must be electronic-only options. Standard license terms are needed: negotiating with individual vendors is a problem. Libraries do not like noncancellation clauses. Integrated access (compare channel hopping in a TV environment), 'walk-in' access (for people outside the university) and institution-wide access are needed. Libraries want a critical mass (in breadth and depth) and value-added features such as rotating chemical structures within a journal.

Finally, Breaks mentioned the Distributed National Electronic Resources. There is a JISC group working on content and a collections policy is being formulated. National Data Centers (e.g. BIDS and MIDAS) have been established. Charging models may differ between small and large institutions. The 'hybrid library' programme is carrying forward lessons from the electronic library programme. There is also a 'New Library' concept of bringing in the public libraries as well.

In the discussion session, Eamon Fennessy, the



Copyright Group, USA, asked what constitutes fair use in an electronic environment. The answer seems to be that libraries do not want to make multiple copies. Copying is not displacing a sale because they would not buy the material. Herman Spruijt asked whether there was still a place for print. Apparently there is, but the house of cards built on print may collapse as the Internet, etc. takes over.

*Tom Graham, University of Newcastle*

The stakeholders in hybrid libraries are customers, publishers and authors. In an electronic environment there are different relationships, different production models, different cost models and different price models. Cost and pricing are *separate* issues. There is a variety of journals, and parallel publishing has increased the awareness and use of electronic journals. Can electronic production be cheaper? The jury is out on this. The 'first copy' argument is less than convincing. The publishing industry has not had to learn about efficiency.

Why is there a 'licensing' pricing mechanism? There has been a shift from ownership to providing access. Electronic publishing is governed by contract law: you do not 'own' something as you do with a print copy. Site license pricing has the advantage that the price is predictable and 'free at point of use' but you end up paying for material you do not want. With transaction pricing you pay per use of material from a publisher or aggregator and you only pay for what you want. It is easy to establish usage figures, but the cost is not predictable.

A problem with national licensing is the variety of terms: the administrative cost of doing it is high for all parties. The Pilot Site License Initiative (PSLI), the objectives of which were to test and evaluate several models, ends at the end of 1998. The National Electronic Site License Initiative (NESLI) is now starting. JISC will run it and Swets/MIDAS will manage it. The benefits will be a single interface to a single access point of journals, access by subject, search mechanisms, usage statistics, and a single deal with lots of publishers. Publishers will be able to negotiate with a single HE source and they will see a reduction in marketing costs. There will be a single point for ordering and billing, and pay-per-use revenues.

It is not yet known how print and electronic products will be unbundled. The cultural aspects of the project are very important. The devil is in the detail: not all the details have been thought out yet. Aspects of use to be considered are fair use (or fair dealing), dial-up use (e.g. from home), the definition of users (including perhaps the National Health Service), document delivery, walk-in use, course packs and the library's responsibilities. Access cannot be restricted to 'this library' or 'this site':

it is the user who matters and the user requires continued access over a number of years. Authentication and archiving are also issues.

New pricing models are needed, with different levels as well as different mechanisms. The funding reality is that library budgets will *not* increase. Bundling and 'online plus print' may not be the best options. Development costs must to be shared among more players. Differential pricing options are also needed.

In the discussion session, Dan Wilde, NERAC Inc., USA, could not see why libraries think it is cheaper to produce electronic journals in terms of the totality of a system. A librarian agreed that librarians do not necessarily believe it is cheaper but some users certainly do. Ian Best said that some people think that the paper product is a by-product of the electronic one because they see the electronic version 6–8 weeks earlier.

## Restructuring and rationalization in the information industry

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Koji Tamura of Japan Science and Technology Corporation (JST) outlined how JST was tackling the problems of reduced usage of information services since 1992. The stagnation appears to have arisen from saturation in the use of information services that happened during the economic boom, collapse of the bubble economy, and a rise in the number information services competing with each other.

Ruggero Giliarevsky of VINITI told us how VINITI is still producing 1 million abstracts in Russian a year, with its staff cut from 2500 to 1040 people and with a budget of just \$160 000 per month. Quality is inevitably a problem. Only 40% of VINITI's money comes from the government. The rest comes from sales of journals and databases. Unfortunately Russian scientists cannot afford to buy: export needs to be stimulated. There is no document delivery service although the St. Petersburg library can distribute hard copies.

Carel Jonckheere of EPO talked about the Distributed Internet Patent Service which is not aimed at patent information professionals but at end-users. In the first phase, the most recent 24 months of information from 19 European patent offices, and from WO patents is being made available with limited text searching. In Phase 2, online delivery of full facsimile documents is planned. There will be 29 million patents available.

Kurt Mulhulm of the Defense Technical Information Center talked about CENDI: a name derived from government departments of Commerce, Education/Energy, NASA/NLM, Defense (DTIC and NAIC) and Interior (USGS BRD). CENDI is a group of information managers who share knowledge resources. Mulhulm gave examples of the great variety of information these departments have on their Web sites. Free MEDLINE

usage has increased tenfold since the introduction of PubMed and 30% of the usage is by the general public. Critical success factors were acquiring world-wide information of interest to the customers, developing highly automated processes, assuring customers of information integrity, offering a single look and feel, providing analysis tools and establishing a world-wide infrastructure.

## The Digital Object Identifier System

Norman Paskin, Director of the International DOI Foundation, gave an update about DOI. It is a unique identifier of a piece of digital content and it is a system to get to that content. It has been called 'the ISBN for the 21st century'. It was launched in October 1997. DOIs are an application of the Handle System of the Corporation for National Research Initiatives. The Handle System is a distributed computer system for naming digital objects and storing the names and information that is needed to locate and access these items via the Internet. The DOI system is in use now but it is not yet fully scaled up to a commercial system. It has international support.

The DOI System guarantees persistence and prevents the '404 not found' problem. It is being made available as an open standard and is not a proprietary company effort. It supports browsers. Handles resolve to data types and offer potential for resolving URNs and multiple URLs. New data type definitions will also be supported. From the users' point of view a Handle will link a name to a location, i.e. an Internet address. At the location there could be an object (such as a document, an image or an order form) or there could be an entry point such as an option list (a catalogue or a rights list).

The DOI system has three components: the Identifier, or DOI, which is the name for a piece of content, the Resolver, which takes the name and finds a location, and a Database which takes the name and gives information about the content. The DOI (e.g. 10.1016/(PII)S1384107697000225) can use any existing name or identifier (e.g. 10.1016/SICI00062510(19950506)107:18<94:BIMAJF>2.0.TX;2F) and the existing names do not have to be standard.

The DOI System is the mechanism, and the DOI Foundation is the governing body which sets the rules of the System and carries out further development. It is not necessary to join the Foundation in order to use the System. The International DOI Foundation is a nonprofit foundation run by a Board elected by and from its members. Membership income (\$10 000 or \$30 000 per member, depending on the type of company) funds development. STM, AAP and IPA are Charter members. Paskin, appointed in March, is the first full time staff member. DOI does not provide a standard numbering system where none exists, or provide copyright protec-

tion, but it does provide the basis to build these. DOI is not fully developed. It is intended to be useful in the protection of intellectual property but DOI assignment does not imply rights other than assignment. The Foundation is now recruiting members. About 20 organizations have committed already (including Blackwell Science). For further information, see <<http://www.doi.org>>.

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## Subcommittee on transport properties of commission I.2: Thermodynamics summary minutes of the June 1998, Amsterdam meeting

Nine scientific presentations were made on specific topics related to the ongoing projects of the Subcommittee.

### Standard reference data for the transport properties of fluids

New recommendations for the:

- viscosity of toluene at atmospheric pressure,
- viscosity of propane,
- viscosity of *n*-butane, and
- thermal conductivity of propane

were concluded. The resulting papers, reviewed by two members of the Subcommittee, will be published under the auspices of the Subcommittee.

Work that will continue refers to propositions for recommendations for the: (a) viscosity of toluene under pressure, (b) viscosity and thermal conductivity of methane + ethane, (c) thermal conductivity of *n*-butane, (d) viscosity of iso-butane, (e) viscosity of liquid water, (f) viscosity of *n*-pentane, (g) viscosity of alkali chlorides.

### Standard reference value for the viscosity of water

The new proposition from ISO for a new value for the viscosity of water that incorporated the previous comments of the Subcommittee was considered and agreed.

### Midas databank of transport property data

It is hoped that the work carried out by Prof K. Stephan and Mr R. Krauss in compiling all recent and unpublished results on transport property measurements will be continued normally.

# Air quality in Croatia

This is one of a series of reports by Commission VI.2 on air quality in the member countries of IUPAC.

Air quality in settlements has been improving in the last 10 years. The reasons for this improvement could be found in the introduction of natural gas, introduction of heating facilities operated from heating plants, substitution of coal with other fuel types and gradual reconstruction of the Croatian economy towards environmentally cleaner technologies. In 1995 the air protection law came into force, and the problem of air pollution has been put under more systematic control.

Emissions inventories for eight pollutants ( $\text{SO}_2$ ,  $\text{NO}_x$ , NMVOC,  $\text{CH}_4$ , CO,  $\text{CO}_2$ ,  $\text{NH}_3$  and  $\text{N}_2\text{O}$ ) have been established for Croatia in accordance to the European programme for such emissions inventories. Emissions have been determined for the time period 1990–95. In addition, for the years 1990 and 1995 emissions of Hg, Cd and Pb have been determined as well as emissions of stable organic compound for 1990 (Fig. 1).

Due to the war in Croatia, the standard of living and economic activity were reduced, resulting in a reduced emission of pollutants (Table 1).

The emission of sulfur dioxide has been reduced by 65% mainly due to the reduction of the sulfur content in petrol fuels, and the closing of some large industrial

sources of  $\text{SO}_2$ .  $\text{NO}_x$  emissions come from road traffic (41%), other traffic (28%), combustion power plants (12.8%). Non-methane volatile organic compounds (NMVOC), very important compounds for photooxidant production and global warming, are mainly emitted from natural sources (49.2%), usage of solvents (15.1%), road traffic (20.3%) and nonenergetic industrial processes (5.9%)<sup>1</sup>.

Surface ozone measurements in Zagreb, the capital of Croatia, were performed as early as the end of the 19th century, but the first ozone measurements using automatic monitoring equipment took place in the centre of Zagreb in the spring and summer of 1975.

Continuous measurements of photochemical air pollution in the atmospheric boundary layer above Zagreb (8 years mean ozone value 25 p.p.b., but with very pronounced diurnal variation due to local effects) and the nearby elevated Puntijarka site (980 m a.s.l.) (8 years mean ozone value 40 p.p.b.)<sup>2</sup> were supplemented by summer season measurement campaigns along the Adriatic coast<sup>3,4</sup>, which has greater insolation and Mediterranean flora with many different sources of NMVOC.

Locations along the Adriatic coast were chosen so as to be representative of tourist resorts at different distances from larger pollution sources. Starting from the north, one site was on Krk island in Malinska, relatively

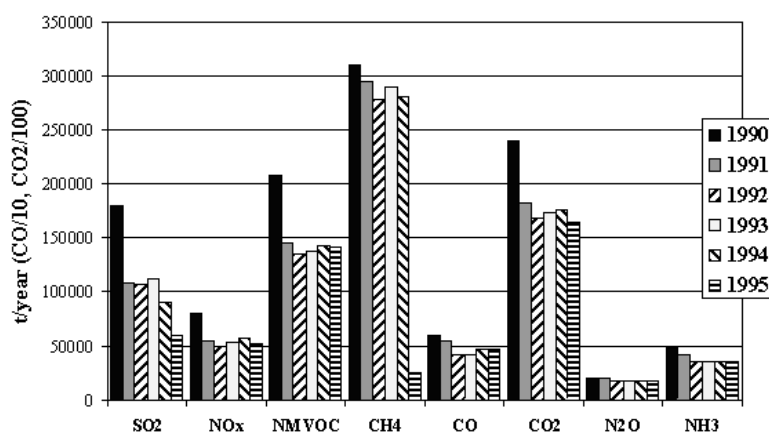


Fig. 1. Emissions of pollutants for the period 1990–1995 in Croatia.

Table 1. Reduction of emission in 1995 in relation to 1990

Pollutant	SO <sub>2</sub>	NO <sub>x</sub>	NMVOC	CH <sub>4</sub>	CO	CO <sub>2</sub>	N <sub>2</sub> O	NH <sub>3</sub>
Reduction (%)	65	34	32	21	26	35	18	27

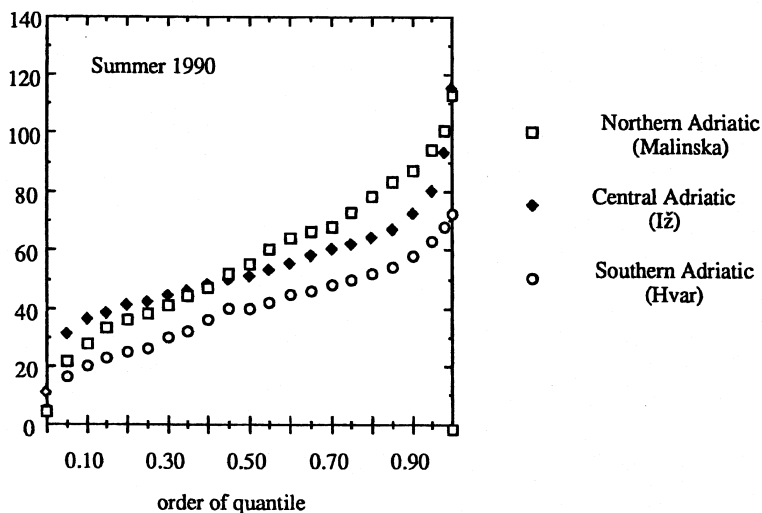


Fig. 2 Distribution of hourly average ozone volume fractions obtained at different sites along the adriatic coast in Croatia

close (25 km SSE) to the city of Rijeka. The second monitoring site was on the island of Iž in the central Adriatic, which can be considered to be isolated from larger pollution sources. The third site was in the southern Adriatic in Hvar on the island of Hvar, an important tourist resort (Fig. 2).

To characterize a measurement site, an index defined as the average ratio between the maximum and minimum daily hourly average ozone volume fraction was introduced<sup>3,4</sup>. Zero values for hourly averages were assigned the value 0.4 p.p.b. in order to avoid division by zero. For urban sites with strong photochemical pollution, this index has a value of over 10, in the upper

Table 2. Index of photochemical pollution for five different sites in Croatia

Location	Time period	Index
RBI (Zagreb)	Apr–Sep 1991	16.0
Puntijarka	Apr–Sep 1991	1.6
Rovinj (northern Adriatic)	Jun–Aug 1991	4.8
Iž (central Adriatic)	Jun–Jul 1991	1.9
Hvar (southern Adriatic)	Jul–Aug 1990	2.7

boundary layer and above, where there are no sources of precursor molecules which act also as sinks during night-time, it is less than 2. In less polluted urban and suburban sites as well as in some rural locations, where some photochemistry takes place, it will be of the order of 2 to 5 reflecting formation around noon and destruction during the night<sup>4</sup>. The corresponding values for five measurement sites in Croatia are compared in Table 2.

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## New from AOAC

*FDA Bacteriological Analytical Manual (BAM)*, 8th Edition, Revision A, 1998.

For use in regulator, academic, or industry laboratories, this recently updated manual contains the methodology currently in use in US Food and Drug Administration (FDA) laboratories for the detection of micro-organisms and certain of their metabolic products

in foods, beverages, and cosmetics.

The 1998 version of the 8th edition contains over 300 pages of revised material. Revision A includes updates to selected BAM chapters and other new information. It also incorporates editorial corrections to the 8th edition published in 1995.

*New information includes:*

- The chapter on *Campylobacter* includes a new enrichment broth, simplified sample processing procedures with product-specific flowcharts, and an improved, blood-free isolation agar.
- Procedures with enhanced sensitivity have been added to the chapter on Staphylococcal enterotoxins.
- The chapter on *Yeast and Molds* now utilizes media that retard growth of bacteria and permit more accurate enumeration of yeasts and moulds.
- The *Parasitic Animals in Foods* chapter has been expanded to include the FDA's protocol for PCR identification and microscopic detection of *Cyclospora cayatenensis*, an emerging protozoan pathogen that has been involved in several recent food-borne outbreaks.
- Appendix 1 is a compilation of selected commercially available methods kits, which has been updated.
- Appendix 2, on Most Probable Number enumeration of bacteria has been revised to accommodate new statistical assumptions and to clarify this statistical treatment for analysts without extensive background in statistics.

*Highlights of the contents*

- Food Sampling and Preparation of Sample Homogenate;
- Microscopic Examination of Foods;

- Care and Use of the Microscope;
- Aerobic Plate Count;
- *Escherichia coli* and the Coliform Bacteria: *Salmonella*, *Shigella*, *Campylobacter*, *Yersinia*, *Vibrio*, *Listeria*, *Staphylococcus*, *Bacillus*, and *Clostridium* species;
- Diarrheagenic Enterotoxin;
- Yeast, Molds and Mycotoxins;
- Parasitic Animals in Foods;
- Analysis of Milk;
- Examination of Canned Foods;
- Examination of Containers for Integrity;
- Microbiological Methods for Cosmetics;
- Identification of Food-borne Bacterial Pathogens by Gene Probes;
- Investigation of Food Implicated in Illness;
- Detection and Quantification of Hepatitis A Virus in Shellfish;
- Residual Phosphatase in Cheese;
- Appendixes: Rapid Methods for Detecting Foodborne Pathogens; most Probable Number Determination from Serial Dilutions; Media and Reagents.

614 pp. 8th Edition, Revision A. 1998. Illustrations. Looseleaf with Binder. ISBN 0 935584 59 5. \$129. Add \$10 for shipping to US/Canada, \$45 to other countries, Stock no. 1800. For more information write to AOAC International-D8IBP, 481 North Frederick Ave., Suite 500, Gaithersburg, MD 20877-2417, USA.

## Federation of European Chemical Societies

### Millennium Project: Celebration of the 100 most distinguished European Chemists from the Chemical Revolution to the 21st Century

The Federation of European Chemical Societies (FECS) is initiating, as a Millennium Project, the celebration of Distinguished European Chemists spanning a period of over 200 years.

Member societies of FECS are invited to submit their nominations of distinguished European chemists from, say, the end of the 18th century until the present day. In addition to Nobel Prize winners, there will be nominations of many others from Europe who have, over more than two centuries, transformed the science and influenced others across the world.

It is suggested that FECS member societies may wish

to arrange for their Boards to establish a working group to develop their list of nominations. Individuals will also be given the opportunity to submit nominations via the FECS web site.

The process of evaluating the nominations will be considered by the FECS Executive Committee when it meets in September 1998.

Publicity for the outcome of the first part of the project will be considered during the next 6 months and will be aimed at the year 2000. Member societies are encouraged to let the FECS Secretariat know if they have any suggestions for publicity.

The closing date for nominations is 26 February 1999.

**E. K. McEwan, FECS Secretariat,  
July 1998**

## *Guidelines for Poison Control*

This book provides authoritative guidelines for the establishment or improvement of national programmes for poison control. Addressed to policymakers and the administrators of specialized facilities, the book responds to the need for comprehensive advice on the most rationale and effective ways to manage the greatly increased number of poisoned patients seen throughout the world. Strategies for the prevention of poisoning are also described.

The guidelines draw on the practical experiences of numerous well-established poison centres in different parts of the world. Although recommended lines of action have universal relevance, the book gives particular attention to the situation in developing countries, where a basic infrastructure for the care of poisoned patients is often absent and special problems arise from the lack of adequate communications, transportation, drugs and support services. Throughout, emphasis is placed on the role and functions of a poison information centre as a crucial component of any national programme for poison control.

The book has nine chapters presented in two parts. Part one provides an overview of the policy issues surrounding decisions to introduce measures, including specialized facilities, for the prevention and management of poisoning. Arguing that a poison information centre should be available in every country, part one also describes the benefits of such centres, outlines their principal functions, and suggests various options for their logical and cost-effective operation.

Against this background, part two provides detailed technical advice on how to organize and operate the various facilities and services that make up a comprehensive system for poison control. Separate chapters describe the functions and requirements of information services, clinical services, and analytical toxicological and other laboratory services, and discuss the importance of toxico-vigilance as a strategy for prevention. Subsequent chapters explain how to deal with major emergencies involving toxic chemicals, and outline solutions to the problem, encountered in most developing countries, of obtaining essential antidotes. Part two concludes with advice on the design and content of forms for collecting, storing, and reporting data, followed by a detailed list of the main literature required in a poisons information centre.

Additional practical information is provided in a series of annexes, which describe a computer software system for the management of poisons data, reproduce

several model record and reporting forms, and classify a large number of antidotes and related agents according to their proven effectiveness and urgency of availability.

WHO, Distribution and Sales, 1211 Geneva 27, Switzerland.

*Guidelines for Poison Control*, 1997, xii + 112 pp. (available in English; French and Spanish in preparation) ISBN 92 4 154487 2, CHF35.-/USD31.50, In developing countries: CHF24.50. Order no. 1150439.

## *Management of Poisoning. A Handbook for Health Care Workers.* J.A. Henry & H.M. Wiseman

This handbook provides a practical guide to the emergency management of poisoning in settings, such as the rural areas of developing countries, where doctors are scarce and rapid access to health services is difficult. Addressed to health workers having little or no medical training, the handbook communicates a wealth of information about specific poisons, the signs and symptoms they cause, and the immediate actions to take in order to save lives and minimize complications. While all common causes of poisoning—from natural plant toxins to medicines and household products—are covered, particular attention is given to pesticides as one of the most frequent causes of fatal poisoning in the developing world.

To ensure accuracy and practical utility, the handbook was prepared in consultation with numerous experts and widely field-tested in training workshops prior to finalization. Throughout, illustrations, lists of do's and don'ts, extensive cross-referencing, and a simple non-technical language are used to facilitate rapid action in emergencies. Recommended treatments are restricted to those that can be safely undertaken by nonmedical personnel with minimum equipment. Medical treatments that require hospital facilities are not included.

The handbook has two parts. The first, which helps prepare health workers to respond to emergencies, opens with basic information about the principal causes of poisoning and the preventive measures that can be taken by households, communities, workers, and their employers. Following a logical and clearly structured approach, subsequent chapters illustrate and explain the exact steps to follow in an emergency. Readers learn how to give first aid, get medical help, examine the patient, determine exactly what happened, and care for patients until they can be seen by a doctor. Part one concludes with a chapter on medicines and equipment, which includes a list of useful medicines and antidotes that can be given by nonmedical workers.

The second and most extensive part serves as a manual for the emergency management of some 70 specific causes of poisoning in four main groups: pesticides, chemicals and chemical products used in the home and the workplace, medicines, and plants, animals, and natural toxins. Each poison is covered according to a common format, which includes information on uses of the substance, how it causes harm, the severity of its effects, signs and symptoms of poisoning, and the exact steps to follow when poisoning occurs. The book concludes with definitions of terms and an extensive index.

WHO, Distribution and Sales, 1211 Geneva 27, Switzerland. *Management of Poisoning, A Handbook for Health Care Workers*, J.A. Henry & H.M. Wiseman, 1997, xiv + 315 pp. (available in English; French and Spanish in preparation), ISBN 92 4154481 3, CHF102.-/USD91.80, In developing countries: CHF71.40, Order no. 1150438.

## Press releases from WHO

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### **Starting materials for manufacturing of pharmaceuticals must comply with international standards**

The active and inactive starting materials used in the manufacture of pharmaceutical products often change hands many times before reaching the manufacturer of a pharmaceutical product. Along the distribution and trade chain, there are many opportunities for the type and quality of material to change. As a result, chemicals required for the production of pharmaceuticals can become contaminated, resulting in unsafe pharmaceutical products with grave dangers for the patients who use them.

The most often documented example of the above happening is the incorporation of diethylene glycol (DEG) into pharmaceutical preparations. Ingestion of DEG may affect the central nervous system, liver and kidneys, and can lead to death through kidney failure. The latest large-scale, well-documented instance of this happening was in Haiti in 1996, where some one hundred children died after taking contaminated cough syrup, but similar accidents have occurred previously in many countries, resulting in a total of at least 500 unnecessary deaths during the last 10 years.

International action is consequently needed urgently to prevent such accidents in the future and the World Health Organization (WHO) convened a meeting of experts at the WHO headquarters in Geneva from 25 to 27 May 1998 to address this issue. The experts came from 15 countries and represented national drug regulatory authorities, pharmacists' associations, traders, chemical and pharmaceutical manufacturers' associations, international nongovernmental organizations, major

pharmacopoeias, consumer organizations and world customs organizations. The meeting formulated several concrete recommendations.

In addressing the experts, WHO Assistant Director-General, Dr Fernando Antezana, underlined that 'the risk is not limited to diethylene glycol, similar incidents may happen at any time with other starting materials if quality assurance is not in place'.

As contamination is most likely to occur either during manufacture of the starting material itself or during its trading, transportation and distribution to the pharmaceutical manufacturer of the final drug product, the group's major recommendations addressed these areas. Manufacturing activities with starting materials for pharmaceutical products should be covered by an authorisation, from the competent health authority, requiring adherence to Good Manufacturing Practice (GMP). Governmental inspectorates should also be able to conduct inspections of manufacturing facilities at any time and place and be able to inspect containers of starting material produced.

Perhaps the major problem is in the transshipment of starting materials. Starting materials often pass through several agents or traders and can be repacked and relabelled at any stage, so that there can be an inaccurate indication of what a container holds by the time it has reached its final destination. To combat this, the group of experts insisted that a system of Good Distribution Practice be installed. Traders and agents should preferably hold an authorisation from the local government. Moreover, national inspectorates should have access to free ports, areas which are exempt from many regulations.

It was recommended that WHO itself should actively develop a list of critical excipients (inactive starting materials) and their nomenclature. This would aid manufacturers, traders, inspectorates and other officials in recognizing and checking the quality of starting materials for pharmaceutical products. Furthermore, the group recommended that each manufacturer or country should have testing facilities for analysis of starting materials and final pharmaceutical products. Where no such analysis is possible, WHO should also advise developing countries to use formulations in essential drugs with ingredients for which they have appropriate testing facilities. Whereas every party in the chain has his own responsibilities, the final responsibility remains with the manufacturer of the final product.

'We have to have safe trading in all starting materials for pharmaceutical manufacturing. There have been repeated catastrophes with diethylene glycol, and now WHO will help develop activities to prevent this happening again,' said Dr Juhana Idänääpn-Heikkilä, Director of WHO's Division of Drug Management and Policies (DMP).

## WHO experts re-evaluate health risks from dioxins

Forty specialists from 15 countries met at the headquarters of the World Health Organization (WHO) in Geneva from 25 to 29 May to evaluate the risks which dioxins might cause to health. Since the Seveso incident in 1976, this group of persistent environmental chemicals has consistently grabbed the headlines, although the real effect of these substances is difficult to determine. This group of chemicals includes polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs), although the most toxic dioxin of all is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). TCDD has been shown to cause dermatological problems, notably chloracne, a chronic and disfiguring skin disease.

These substances are omnipresent in the ground, river beds and air. They are involuntary by-products formed when thermal processes produce chlorine and other organic substances. They can also be produced by volcanic activity, which cannot be controlled, and by forest fires, but the principal controllable sources of dioxin production are waste incinerators.

In recent years, the WHO European Centre for Environmental and Health (WHOECEH) has been coordinating a comprehensive programme, in collaboration with the International Programme on Chemical Safety (IPCS) on PCDDs, PCDFs and PCBs, to evaluate the possible health risk, as well as methods of prevention and control of environmental exposure of the general population to these chemicals.

During a previous meeting on dioxins, held at Bilthoven, in the Netherlands, in 1990, WHO experts established a tolerable daily intake of 10 pg/kg body weight for TCDD, said to be the most toxic dioxin. (One picogram, pg, equals a millionth of a millionth of a gram).

Since then, new epidemiological data has emerged, notably concerning dioxins' effects on neurological development and the endocrine system, and WHO thus convened the consultation which has just taken place in Geneva to re-evaluate the tolerable daily dose of dioxins to which a human can be exposed. After ample debate, the specialists agreed on a new tolerable daily intake range of 1–4 pg/kg body weight. The experts, however, recognized that subtle effects may already occur in the general population in developed countries at current background levels of 2–6 pg/kg body weight. They therefore recommended that every effort should be made to reduce exposure to the lowest possible level.

The background documents for the experts' meeting discussed carcinogenic and noncarcinogenic effects of dioxins on humans and animals, the risks for young children, transmission mechanisms, general exposure to dioxins and the compounds of the same nature, as well

as current means of evaluating these risks in different countries.

'Recent exposure data show that measures introduced to control dioxin release in a number of countries have resulted in a substantial reduction in intake of these compounds in the past few years', emphasized Dr Maged Younes, Chief of the Assessment of Risk and Methodology unit in the WHO Programme for the Promotion of Chemical Safety. 'This is evidenced by a marked decrease in dioxin levels in human milk, as found in an exposure study conducted by the WHO European Centre for Environment and Health, with the highest rates of decrease being observed in areas which had the highest initial concentrations.'

## Tenth WHO Model List Of Essential Drugs

A World Health Assembly Report of 1975 recognized the urgent problems of lack of essential drugs in many countries, and provided the impetus for the first WHO Model List of Essential Drugs, published in 1977. Since that time, the concept of essential drugs has been widely applied. It has provided a regional basis not only for drug procurement at national level but also for establishing drug requirements at various levels within the health care system.

Essential drugs are those that satisfy the health care needs of the majority of the population and should therefore be available at all times in adequate amounts and in the appropriate dosage forms. This definition remains as valid today as it was 20 years ago.

The choice of such drugs depends on many factors, such as the pattern of prevalent diseases; treatment facilities; training and experience of the available health care personnel; financial resources; as well as genetic, demographic and environmental factors.

Since 1975, there have been nine reports in total, each one updating and improving the list and providing guidelines on selection and use. Because of differing views on the definition of an essential drug in terms of what is meant by the 'health care needs of the majority', the list has been gradually expanded since its introduction and has evolved with changing health needs and therapeutic options.

Over the 20 years, 166 new drugs have been added while 68 drugs have been deleted, resulting in an overall increase from the original 208 to 306 drugs after the last Expert Committee meeting, which took place in December 1997.

Each selected drug must be available in a form in which adequate quality can be assured and its stability under the anticipated conditions of storage and use must be verified.

Where two or more drugs appear to be similar in the above respect, the choice between them should be



made on the basis of a careful evaluation of their relative efficacy, safety, quality, price and availability.

The WHO List of Essential Drugs is a model, to guide countries and health services in developing their own national and local lists. Such lists should be evidence based, considering prevalent diseases, treatment facilities, training and experience of health personnel, financial resources, genetic factors and demographic factors.

The concept of essential drugs has been disseminated and promoted extensively at the country level by WHO's Action Programme on Essential Drugs, as well as by disease control programmes in WHO, international and nongovernmental organizations throughout the world and bilateral agencies.

Over the last 20 years the WHO Model List has proven to be an invaluable tool for saving lives and improving health through more rational use of drugs, wider access to drugs, and improved drug quality.

In the preparation of the Tenth WHO Model List of Essential Drugs which was recently published in *WHO Drug Information*, Vol. 12, No. 1, priorities were to 'fine tune' the list in the light of the latest evidence, to correct any major omissions and to address drug treatment issues for some of the major health priorities today, including the problem of antibiotic resistance, asthma and diabetes.

One important advance in the new Model List is the addition of a new drug, triclabendazole, for the treatment of liver and lung flukes. This illustrates the way the List can be used to highlight a therapeutic need and speed up availability of new drug treatment.

AIDS treatment was also addressed and zidovudine (AZT) has now been introduced into the WHO Model List of Essential Drugs for the specific treatment of HIV-infected pregnant women in order to reduce mother-to-child transmission and to protect the new-born baby.

A further note on triple therapy in HIV/AIDS was also included to the effect that it was a new therapy beyond the budgets of most National Drug Programmes and must be decided at country or institutional level. However, several drugs were added for the treatment of opportunistic infections.

The WHO Model List of Essential Drugs is considered to be as an informational and educational tool for professionals and consumers. Since concern about health care costs is now a priority even in developed countries, the Model List is of greater importance than ever as an aid to developing treatment guidelines, national formularies, consumer drug information, and other measures to improve drug use.

The List also serves as the basis for WHO model drug information, a new model formulary, and basic drug quality tests.

The List should be seen in the context of national drug

policies that address not only drug use, but also procurement and supply strategies, drug financing, drug donations, and research priorities.

### Major gaps in research on antibiotic resistance need filling

Fluoroquinolones are important members of the quinolone group of antibiotics which are licensed to treat diseases in humans and animals. However, their use in livestock animals can contribute to increased resistance in food-borne bacteria (such as *Campylobacter* and *Salmonella*) which may infect humans. Fluoroquinolones are important for the treatment of invasive *Salmonella* and *Campylobacter* infections in humans and an increase in the resistance in these bacteria is therefore of concern.

'To date, there has been little documented impact on human health of fluoroquinolone use in livestock, but there is concern over the potential human health consequences if resistance were to increase and spread. Further research and data gathering are thus essential,' said Dr David Heymann, Director of the World Health Organization's (WHO) Division of Emerging and other Communicable Diseases Surveillance and Control (EMC).

Consequently, the WHO convened a meeting on the medical impact of quinolone use in food animals at WHO headquarters in Geneva from 2 to 5 June. The meeting, in which over 60 experts from both the human and animal health fields participated, agreed that that major emphases of future research should include: determining the full extent of quinolone usage outside human medicine; improving epidemiological evidence on how resistance in both animals and humans develops, persists and spreads between animal species and humans; developing surveillance techniques specifically designed to capture the above data; determining the mechanisms and levels of resistance in important zoonotic pathogens to quinolones and how important these resistance levels are in terms of human health risk; developing strategies for prudent use in animals to maximize therapeutic benefit while minimizing development of resistance; developing alternatives, such as vaccines, to the use of antimicrobials for animal disease prevention.

Following the introduction of fluoroquinolones in several countries, *Salmonella* with reduced susceptibility to fluoroquinolones have emerged in food animals; resistant *Campylobacter* have also emerged. Although no human cases have been documented, the experts expressed concern that there could be treatment failures in humans infected with *Salmonella* with reduced susceptibility. The experts also noted that, with the use of fluoroquinolones in humans, human pathogens have

begun to develop resistant strains and there are now several circumstances in which resistance has limited the therapeutic use of this class of antibiotic for important diseases such as for gonorrhoea and typhoid.

While fluoroquinolones are not used as growth promoters, they are currently used for treatment of animal disease in many countries of the world and, in some regions, they are also used for disease prevention in animals. However, the data available so far on their usage are scarce and are often the proprietary information of the drugs' manufacturers. Consequently, correlations between quinolone usage and the emergence of resistance are hard to make. WHO and the meeting's participants welcomed the initiative by COMISA (the World Federation of the Animal Health Industry) at the 2–5

June meeting that provided sales and volume data for the major fluoroquinolones in more than 30 countries.

The experts, from 18 countries, requested that WHO, in conjunction with the Food and Agriculture Organization of the United Nations (FAO) and the Office International des Epizooties (OIE—the World Organization for Animal Health), work together to gather data, standardise testing methods and develop a code of practice for the prudent use of antimicrobials in food animals. WHO should also, the participants agreed, ensure that public health safeguards are given prominence in such a code of practice.

All WHO Press Releases, Fact Sheets and Features as well as other information on these subjects can be obtained on Internet on the WHO Home Page. URL: <http://www.who.int/>

## Conference announcements

### IUPAC Congress, 14–19 August 1999, Berlin, Germany

#### Invitation

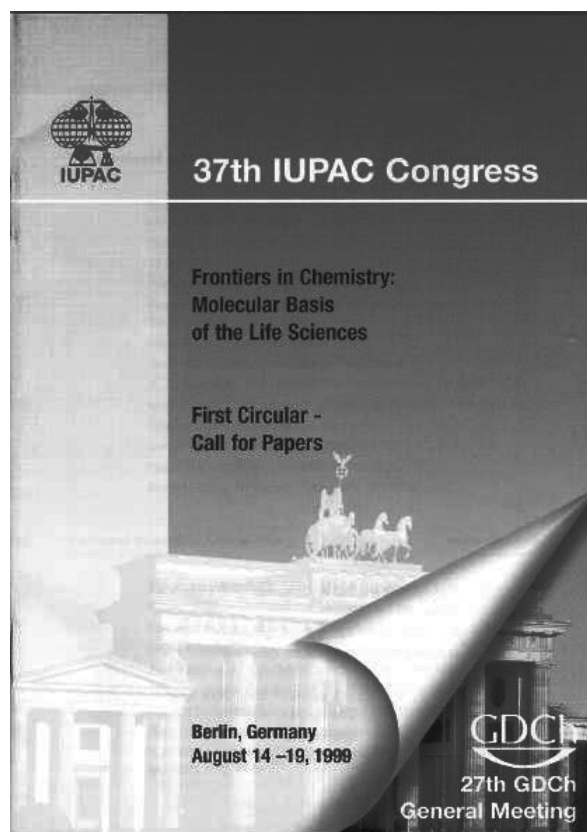
The 37th IUPAC Congress will be held in Berlin (Germany) from Saturday 14th August to Thursday 19th August 1999. On behalf of the German Chemical Society GDCh (Gesellschaft Deutscher Chemiker), the International Advisory Board and the National Scientific Committee it is a great pleasure for us to invite colleagues and advanced students from chemistry, biochemistry and from other areas of molecular sciences to attend this important event in the closing days of this century. It is an honour for the German Chemical Society to host the IUPAC Congress in the year 1999, the fiftieth anniversary of the post-war renaissance of our learned society which was originally founded in 1867.

IUPAC has redefined the scope and the format of the prestigious biennial Congress with the goal to constitute a central international event in the world of chemical research, to present outstanding developments and to inspire high standards of excellence. To achieve this a focus on an especially important and developing field is required.

The 37th IUPAC Congress will be the first to be organized according to the new statutes and will provide a focus on highly important interdisciplinary aspects under the title:

**Frontiers in Chemistry: Molecular Basis of the Life Sciences.**

We will thus provide an outstanding opportunity for scientists from academia and industry from all parts of



the world to get up-to-date information, to present their work and to exchange ideas about the scientific challenges and possible industrial innovations for the upcoming century.

The circular defines the scope of the scientific program and the reputation of plenary, keynote and invited

lecturers will guarantee outstanding quality. Our aim is to bring together distinguished experts and enthusiastic young scientists, experienced researchers from different scientific areas and professionals from chemical and life science companies. Ample time and space will be provided for oral contributions and posters, which will allow you to present your relevant results to an international audience.

The Congress will start just after the IUPAC General Assembly, held at the Free University of Berlin. Parallel to the 37th IUPAC Congress, the 27th General Meeting of the German Chemical Society will also take place, in which further areas of chemistry will be presented. A number of special symposia in cooperation with other European chemical societies will be organized in the frame of this double event, some of which are obviously related to the theme of the Congress; here, too, poster contributions are welcome.

Last but not least this double event, Congress and GDCh General Meeting, should inspire the young generation of chemists. There will be special program features organized by the GDCh Younger Chemists Forum in cooperation with young chemists from many other countries.

The IUPAC Congress and the other parallel events outlined above will be held at the International Congress Center of Berlin, not far from the western centre. Berlin is a city undergoing dramatic change since the German reunification and is a treasure chest of culture (three opera houses, art collections of world renown) and a good starting point for excursions.

We want to repeat our invitation to all scientists and we look forward to meeting you in Berlin during the sunny summer days in August 1999.

*Prof. Dr J. Jortner, President of the International Union of Pure and Applied Chemistry, Dr E. Meyer-Galow, President of the German Chemical Society, Prof. Dr R. Huber, Chairman of the International Advisory Board, Prof. Dr E. Winterfeldt, Chairman of the National Scientific Committee*

*For further information contact: Gesellschaft Deutscher Chemiker, IUPAC 99, PO Box 90 04 40, D-60444 Frankfurt-am-Main, Germany, Tel.: + 49 69 7917358, Fax: + 49 69 7917475, e-mail: tg@gdch.de, Home Page: <http://www.gdch.de>*

## **IUPAC General Assembly, 7–14 August 1999, Berlin, Germany**

This biennial meeting will host the meetings of IUPAC bodies as well as the executive and policy making bodies of the Unions, the Bureau and Council. The meeting will be held at the Free University of Berlin. Schedules

and other information will be distributed to National Adhering Organizations and all members of IUPAC bodies later in 1998.

## **Advanced Materials, 15–17 July 1999, Hong Kong**

This is the first Workshop of the new IUPAC series: 'New Directions in Chemistry'. The 1st IUPAC Workshop on Advanced Materials: Nanostructured Systems (IUPAC-WAM-1) will be held on the campus of the Hong Kong University for Science and Technology from 15 to 17 July 1999. The Philosophy of the series is to foster interaction among active scientists from different parts of the world with similar interests in new research area of chemistry. The scientific program will cover Theory, Nanoparticles, Quantum Dots and Quantum Wells, Nanotubes, Nanowires and Nanorods, Self assembly, Bio-inspired structures, Applications to Nanotechnology. Each session will include plenary and invited lectures, and contributed papers (oral and poster).

Organizing Committee: Prof. M. A. El-Sayed, Georgia Tech, Atlanta, GA, USA, *Chairman*; Prof. Joshua Jortner, President IUPAC, Tel Aviv U., Israel, *Honorary Chair*; Prof. Nai Teng Yu, HKUST, Hong Kong, *Chairman of Local Organizing Committee*; Dr. Stan Williams, Hewlett-Packard Co., California, USA, *Chairman of Program Committee*; and Dr. Clemens Burda, Georgia Tech, Atlanta, GA, USA, *Secretary*.

*Please visit <http://www.iupac.org/symposia/conferences/wam1> for further information, or contact Professor M. A. El-Sayed, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332-0400, USA. Tel.: +1 404-894-0292, fax: +1 404-894-0294, e-mail: [mostafa.el-sayed@chemistry.gatech.edu](mailto:mostafa.el-sayed@chemistry.gatech.edu).*

## **IUPAC–ISO/REMCO–BAM–EUROLAB-D Workshop on proper use of environmental matrix reference materials. 22–23 April 1999, Berlin, Germany**

Natural matrix reference materials represent a specific group of reference materials. The characterization and certification of these materials is fraught with many complex problems related to traceability and uncertainty of the assigned values. These materials are, due to variety of reasons, often misused in the analytical process.

The aim of the workshop is to build up the awareness of the RM users' about how various types of RM should be utilized. Representatives from various reference material producing organizations will present how they expect analysts to employ their respective reference materials.

Participation of representatives from BAM, IAEA, IRMM, NIST, NIMCR, NRCCRM, and some other RM producing organizations is foreseen. The Workshop will include also lectures related to the ISO Guide 33, Database COMAR and the activities of ISO/REMCO.

The Workshop will consist of lectures presented by the invited experts followed by immediate discussion and a general discussion related to the users' needs and new strategies in characterization and certification of natural matrix reference materials. (Due to technical reasons, the number of participants will be limited to 150.)

For further information, please contact: EUROLAB-D, Gudrun Neumann, D-12200 Berlin, Tel.: +49 30 81 04 37 69, Fax: +49 30 81 04 37 17, e-mail: Gudrun.Neumann@bam.de

### Biodiversity and Bioresources, 11–15 July 1999, Belo Horizonte, Minas Gerais, Brazil

II International Conference on Biodiversity and Bioresources—Conservation and Utilization,

Prof. Alaide Braga de Oliveira, Faculdade de Farmácia—UFMG, Av. Olegario Maciel 2360, 30.180-112 Belo Horizonte, Brazil, Fax: +55 31 337 9076, e-mail: ferna@dedalus.lcc.ufmg.br

The purpose of the conference is to bring together scientists from all over the world to discuss and exchange their ideas on how chemistry, biology, biotechnology and related fields might further enhance the possibility of conservation and utilization of biodiversity.

### 2000, Warsaw, Poland

13th International Conference on Organic Synthesis (ICOS-13).

The 13th Conference in this series will emphasize the creative aspects of modern organic synthesis.

Prof. M. Chmielewski, Institute of Organic Chemistry, Kasprzaka 44, 01-224 Warsaw 42, PO Box 58, Poland, Tel.: +48 22 6318788, Fax: +48 22 6326681, E-mail: icho-s@ichf.edu.pl

### Polymers In Medicine, 17–20 July 2000, Prague, Czech Republic

40th Microsymposium Polymers in Medicine

The Symposium will provide a forum for experts from academia and industry specializing in various aspects of biomedical materials. The primary objective is to provide an interdisciplinary forum for the discussion of the

relationship between the structure of biorecognizable systems on one hand and their physicochemical and biological properties on the other. The pros and cons of traditional synthetic pathways and genetically engineered materials will be evaluated.

Topics will include:

- 1 Tailor-made synthesis of biorecognizable polymers
- 2 Structural factors influencing the interaction of macromolecules with receptors/antigens
- 3 Soluble and vesicular drug delivery systems
- 4 Genetically engineered biomedical polymers and biomaterials.

Dr Jaromir Lukas, Institute of Macromolecular Chemistry, Academy of Science of the Czech Republic, Heyovskeho na. 2, 162 06 Praha 6, Czech Republic, Tel.: +420 2 360 341, Fax: +420 2 367 981, e-mail: sympo@imc.cas.cz

### Organo-metallic Chemistry, 18–22 July 1999, Versailles, France.

10th International Symposium on Organo-Metallic Chemistry Directed Towards Organic Synthesis (OMCOS 10)

The aims of the symposium are the presentation of recent results, the discussion of trends and the exchange of ideas relating to the use of metals in organic synthesis.

OMCOS 10 will include the following topics:

- Asymmetric Synthesis via Organometallics;
- Structural & Mechanistic Aspects related to Synthesis;
- Metal-Organics in Materials Research;
- Catalytic Processes Involving Organometallics;
- New C–C and C-Heteroatom Bond Forming Processes via Metals;
- Cyclizations/Ring-opening reactions Involving Organometallics.

Prof. J.P. Genet, Laboratoire de Synthèse Selective Organique et Produits Naturels, ENSCP—UMR CNRS 7573, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France, Tel.: +33 1 44 27 67 43, Fax: +33 1 44 07 10 62, e-mail: genet@ext.jussieu.fr

#### Obituary

**Prof. Dr. mult. Viktor Gutmann**, Professor Emeritus of the Technical University Vienna, Secretary of the Inorganic Division of IUPAC from 1959 to 1967, Vice President from 1969 to 1973, and President of the Inorganic Division from 1973 to 1975 died on 16 July 1998 at the age of 77.

# Conference Calendar

Visit <http://www.iupac.org> for complete information and further links

1998

## Medicinal Chemistry

6–10 September 1998

XVth International Symposium on Medicinal Chemistry, Edinburgh, Scotland, UK.

Dr J.F. Gibson, *The Royal Society of Chemistry, Burlington House, London, W1V 0BN, UK. Tel.: +44 171 437 8656/440 3321, fax: +44 171 734 1227.*

## Electrochemistry

13–18 September 1998

49th Annual Meeting of the International Society of Electrochemistry, Kitakyushu, Japan.

Prof. Rika Hagiwara, *Department of Fundamental Energy Science, Graduate School of Energy Science, Kyoto University, Sakyo-ku, Kyoto 606, Japan. Tel.: +81 75 753 5822, fax: +81 75 753 5906, e-mail: ise@g-chem.nucleng.kyoto-u.ac.jp*

## Chemistry of germanium, tin and lead

20–25 September 1998

9th International Conference on the Coordination and Organometallic Chemistry of Germanium, Tin & Lead (ICCOG GTL-9), Melbourne, Australia.

Prof. Dainis Dakternieks, *School of Biological & Chemical Sciences, Deakin University, Geelong 3217, Australia. Tel.: +61 3 52 271318, fax: +61 3 52 271040, e-mail: dainis@deakin.edu.au*

## Supramolecular science and technology

27 September–3 October 1998

1st International Conference on Supramolecular Science & Tech-

nology, Zakopane, Poland.

Prof. Marek Pietraszkiewicz, *Chairman, Institute of Physical Chemistry, ul. Kaszubska 44/52, 01-224 Warsaw, Poland. Tel.: +48 22 632 3221 (ext. 3226), fax: +48 39 12 0238, e-mail: pietrasz@ichf.edu.pl*

## Chemistry of natural products

11–16 October 1998

21st IUPAC symposium on the Chemistry of Natural Products, Beijing, China.

Prof. Xiaotian Liang, *Chairman, Prof. Xibai Qiu, Secretary, c/o Chinese Chemical Society, PO Box 2709, Beijing 100080, China. Tel./fax: +86 10 625 68157, e-mail: qiuxb@infoc3.icas.ac.cn*

## Excitonic processes in condensed matter

2–5 November 1998

Third International Conference on Excitonic Processes in Condensed Matter, Boston, MA, USA.

Prof. William M. Yen, *Department of Physics and Astronomy, University of Georgia, Athens, GA 30602-2451, USA. Tel.: +1 706 542 2491, fax: +1 706 542 2492, e-mail: wyen@hal.physast.uga.edu*

## Cuban Chemical Society

1–4 December 1998

III International Congress Cuban Chemical Society, Havana, Cuba.

Prof. Alberto J. Nunez Selles, *Sociedad Cubana de Quimica, Ave 21 & 200, Atabey Apdo 16042, CP 11600 Havana, Cuba. Tel.: +537 218 178, fax: +537 336 471, e-mail: cqf@infomed.sld.cu*

1999

## Functional dyes

31 May–4 June 1999

4th International Symposium on Functional Dyes, Osaka, Japan.

Prof. Yasuhiko Shirota, *Faculty of Engineering, Osaka University, Yamadaoka, Suita, Osaka 565-0871, Japan. Tel.: +81 6 879 7364, fax: +81 6 877 7367, e-mail: isfd@chem.eng.osaka-u.ac.jp*

## Polymer systems

7–10 June 1999

3rd International Symposium on Molecular Mobility and Order in Polymer Systems, St. Petersburg, Russia. Symposium Chairman: Prof. A.A. Darinskii, Symposium Coordinator: Mrs I. Kovalenko, *Institute of Macromolecular Compounds, Bolshoy pr. 31, St. Petersburg, 199004 Russia. Tel.: +812 213 2907, fax: +812 218 6869, e-mail: IMC@macro.spb.su*

## CHEMRAWN

20–25 June 1999

CHEMRAWN XII—African Food Security and Natural Resource Management: The New Scientific Frontiers, Nairobi, Kenya.

Dr Pedro Sanchez, *International Center for Research in Agroforestry, PO Box 30677, Nairobi, Kenya. Tel.: +254 2 521003, fax: +254 2 520023, e-mail: p.sanchez@cgnet.com*

## Memorial K.I. Zamaraev

28 June–2 July 1999

International Memorial K.I. Zamaraev Conference on Physical Methods for Catalytic research at

the Molecular Level, Novosibirsk, Russia.

*Prof. V.N. Parmon, Boreskov Institute of Catalysis, 5, Prosp. Akad. Lavrentieva, Novosibirsk, 630090, Russia. Tel.: +7 3832 343269, fax: +7 3832 343056, e-mail: parmon@catalysis.nsk.su*

### Biodiversity and Bioresources

New dates

11–15 July 1999

2nd International Conference on Biodiversity and Bioresources—Conservation and Utilization, Belo Horizonte, Minas Gerais, Brazil.

*Prof. Alaide Braga de Oliveira, Faculdade de Farmacia—UFMG, Av. Olegario Maciel 2360, 30.180-112 Belo Horizonte, Brazil. Fax: +55 31 337 9076, e-mail: fernaio@dedalus.lcc.ufmg.br*

### Polymerization methods

12–15 July 1999

39th Microsymposium, Advances in Polymerization Methods: Controlled Synthesis of Functionalized Polymers, Prague, Czech Republic.

*Dr Jaromir Lukas, Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, Heyovskeho na. 2, 162 06 Praha 6, Czech Republic. Tel.: +420 2 360341, fax: +420 2 367981, e-mail: sympo@imc.cas.cz*

### Advanced materials

15–17 July 1999

1st IUPAC Workshop on New Directions in Chemistry. Workshop on Advanced Materials:

Nanostructured Systems (IUPAC-WAM-1), Hong Kong. Professor M.A. El-Sayed, School of Chemistry and Biochemistry, Georgia Institute of Technology Atlanta, GA 30332-0400, USA. Tel.: +1 404 894 0292, fax: +1 404 894 0294, e-mail: mostafa.el-sayed@chemistry.gatech.edu

### Organo-metallic Chemistry

18–22 July 1999

10th International Symposium on Organo-Metallic Chemistry Directed Towards Organic Synthesis (OMCOS 10), Versailles, France.

*Prof. J.P. Genet, Laboratoire de Synthese Selective Organique et Produits Naturels, E.N.S.C.P.—UMR CNRS 7573, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France. Tel.: +33 1 44 276743, fax: +33 1 44 071062, e-mail: genet@ext.jussieu.fr*

### Carotenoids

18–23 July 1999

12th International Symposium on Carotenoids, Cairns, Australia.

*Prof. George Britton, School of Biological Sciences, The University of Liverpool, Crown Street, Liverpool, L69 3BX, UK. Fax: +44 (151) 794 4349.*

### Rheology of polymer systems

19–22 July 1999

19th Discussion Conference on the Rheology of Polymer Systems, Prague, Czech Republic.

*Dr Jaromir Lukas, Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, Heyovskeho na. 2, 162 06 Praha 6, Czech Republic. Tel.: +420 2 360341, fax: +420 2 367981, e-mail: sympo@imc.cas.cz*

### Ionic polymerization

19–23 July 1999

International Symposium on Ionic Polymerization, Kyoto, Japan.

*Dr Shiro Kobayashi, Department of Materials Chemistry, Graduate School of Engineering, Kyoto University, Kyoto 606-01, Japan. Tel.: +81 75 753 5608, fax: +81 75 753 4911, e-mail: kobayashi@mat.polym.kyoto-u.ac.jp*

### Analytical science

25–30 July 1999

Analytical Science into the Next Millennium (SAC 99), Dublin, Ireland.

*Prof. Malcolm R. Smyth, Faculty of Science, Dublin City University, Dublin 9, Ireland. Tel.: +353 1 704 5308, fax: +353 1 704 5503, e-mail: smythm@dcu.ie*

### Solution chemistry

26–31 July 1999

XXVI International Conference on Solution Chemistry, Fukuoka City, Kyushu, Japan.

*Prof. Hitoshi Ohtaki, Department of Chemistry, Faculty of Science and Engineering, Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu 525, Japan. Tel.: +81 775 61 2777, fax: +81 775 61 2659, e-mail: ohtaki@bkc.ritsumei.ac.jp*

### IUPAC General Assembly

6–13 August 1999

Frontiers in Chemistry: Molecular Basis of the Life Sciences, Berlin, Germany.

*IUPAC Secretariat. Tel.: +1 919 485 8700, fax: +1 919 485 8706, e-mail: secretariat@iupac.org*

### How to apply for IUPAC sponsorship

To apply for IUPAC sponsorship, conference organizers should complete an Advanced Information Questionnaire (AIQ). The AIQ form is available at <http://www.iupac.org> or by request at the IUPAC Secretariat, and should be returned between 2 years and 12 months before the conference. Further information on granting sponsorship is included in the AIQ and available on line

## IUPAC Congress

14–19 August 1999  
Berlin, Germany.  
Gesellschaft Deutscher Chemiker–  
GDCh, PO Box 90 04 40, 60444  
Frankfurt Am Main, Germany. Tel.:  
+49 69 7917 358/360/366, fax: +49  
69 7917 475, e-mail: tg@gdch.de

## Macromolecule–metal complexes

6–10 September 1999  
8th International Symposium on  
Macromolecule–Metal Complexes  
(MMC–VIII) Tokyo, Japan.  
Prof. Eishun Tsuchida, Waseda  
University, Tokyo 169-50, Japan.  
Tel.: +81 3 5286 3120, fax: +81 3  
3209 5522, e-mail:  
w169988@mn.waseda.ac.jp

## 2000

### Bio-organic chemistry

February 2000  
5th IUPAC Symposium on

#### Visas

It is a condition of sponsorship that organizers of meetings under the auspices of IUPAC, in considering the locations of such meetings, should take all possible steps to ensure the freedom of all *bona fide* chemists from throughout the world to attend irrespective of race, religion, or political philosophy. IUPAC sponsorship implies that entry visas will be granted to all *bona fide* chemists provided application is made not less than three months in advance. If a visa is not granted one month before the meeting the IUPAC Secretariat should be notified without delay by the applicant.

Bio-Organic Chemistry (ISBOC-V),  
New Delhi, India.  
Prof. S. Ranganathan,  
Biomolecular Research Unit, Re-  
gional Research Laboratory,  
Trivandrum 695 019, India. Tel.:  
+91 471 491 459, fax: +91 471 490  
186.

## High temperature materials chemistry

4–10 April 2000  
10th International Conference on  
High Temperature Materials Chem-  
istry, Aachen, Germany.  
Prof. K. Hilpert, Forschungszentrum  
Julich GmbH, Institut für Werkstoffe  
der Energietechnik (IWE 1), 52425  
Jülich, Germany. Tel.: +49 2461 61  
3280, fax: +49 2461 61 3699, e-  
mail: k.hilpert@fz-juelich.de

## Organic Synthesis

1–5 July 2000  
13th International Conference on  
Organic Synthesis (ICOS-13), War-  
saw, Poland.  
Prof. M. Chmielewski, Institute of  
Organic Chemistry, Kasprzaka 44,  
01-224 Warsaw 42, PO Box 58, Po-  
land. Tel.: +48 22 631 8788, fax:  
+48 22 632 6681, e-mail: icho-  
s@ichf.edu.pl

## Macromolecules

9–14 July 2000  
38th International Symposium on  
Macromolecules (MACRO 2000),  
Warsaw, Poland.  
Prof. Stanislaw Penczek, Polish  
Academy of Sciences, ul.  
Sienkiewicza 112, 90363 Lodz, Po-  
land. Tel.: +48 42 81 9815, fax: +48  
42 684 7126, e-mail:  
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## Coordination Chemistry

9–14 July 2000  
34th International Conference on  
Coordination Chemistry (34-ICCC),  
Edinburgh, Scotland.  
Prof. P. Tasker, Chairman, Dr John

F. Gibson, Secretary, The Royal  
Society of Chemistry, Burlington  
House, London W1V 0BN, UK,  
Tel.: +44 171 440 3321, fax: +44  
171 734 1227, e-mail:  
gibsonj@rsc.org

## Polymers In Medicine

17–20 July 2000  
40th Microsymposium Polymers In  
Medicine, Prague, Czech Republic.  
Dr Jaromir Lukas, Institute of  
Macromolecular Chemistry, Acad-  
emy of Science of the Czech Re-  
public, Heyovskeho na. 2, 162 06  
Praha 6, Czech Republic. Tel.:  
+420 2360341, fax: +420 2367981,  
e-mail: sympo@imc.cas.cz

## Chemical Thermodynamics

6–11 August 2000  
16th IUPAC Conference on Chemi-  
cal Thermodynamics, Halifax, Nova  
Scotia, Canada.  
Dr Peter G. Kusalik, Department of  
Chemistry, Dalhousie University,  
Halifax, Nova Scotia B3H 4J3,  
Canada. Tel.: +1 902 494 3627, fax:  
+1 902 494 1310. e-mail:  
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## Natural products

1 September 2000  
22nd International Symposium on  
the Chemistry of Natural Products,  
Sao Paulo, Brazil.  
Dr M. Fátima das G.F. da Silva,  
Universidade Federal de Sao  
Carlos, Depto. de Quimica, Via  
Washington Luiz, km 235, CP676,  
Sao Carlos, Brazil. Tel.: +55 16 274  
8208, fax: +55 16 274 8350, e-mail:  
dmfs@power.ufscar.br

## Biotechnology

3–8 September 2000  
11th International Biotechnology  
Symposium, Berlin, Germany.  
Prof. G. Kreysa, DECHEMA eV—  
c/o 11th IBS, Theodor-Heuss-Allee  
25, 60486 Frankfurt/Main, Ger-  
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