



Marie Curie Fellowship Association

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Preface

The Annals of the Marie Curie Fellowship Association

The idea to create the *Annals* originated in a spontaneous manner in the mailing list of the Marie Curie Fellowship Association (MCFA) during the summer of 1998. A group of members of the newly-formed Association proposed the establishment of a scientific publication, which would demonstrate the excellence of the research carried out by Marie Curie fellows, their scientific reputation as high-level researchers, and would also draw attention to European Commission-funded research. The *Annals* has been established as an interdisciplinary, annual journal of the MCFA, representing the different fields of knowledge of MCFA members. It publishes papers reviewing the research projects devised and carried out by Marie Curie fellows. Thus, the *Annals* provides the fellows with an opportunity to publicise their research to a wide audience.

Our goal is not to compete with other well-established and prestigious scientific publications, but rather to present the most outstanding achievements of Marie Curie fellows, therefore helping to fulfill some of the MCFA's aims as stated in the statutes:

- help the advancement of science in Europe
- create a clear and visible identity for Marie Curie fellows
- promote and increase the reputation of Marie Curie fellowships
- develop and foster the international dimension of Marie Curie fellowships

We wanted to substantiate the widely-held opinion in the scientific community, that the EU-training of researchers programmes (Marie Curie fellowships) are of a very high standard. The same is true regarding the scientific proficiency of Marie Curie fellows themselves. The MCFA needed to develop an activity to emphasize, reinforce and confirm these opinions.

An *Annals* Editorial Board was formed and later approved at the MCFA Annual General Meeting in November 1998. Many people devoted a lot of time and work to the "Annals" project, to develop the initial concept and to turn it into reality. The Editorial Board is composed of panel editors representing the broad scientific categories in which the Marie Curie fellowships are granted. The scientific panels included in this issue are: Chemistry, Earth Science, Economics, Engineering, Human Sciences, Information Sciences, Life Sciences, Mathematics, Physics and Social Sciences. The issue is completed with an Interdisciplinary section, which emphasizes the broad scope, and spin-off, of a lot of research activities carried out by MCFA members.

It was decided to limit the number of selected papers to 2-3 per panel. The selection was based not only on the excellence of the work presented, but also on the possible impact of the research on society, and on the readability of the paper. Papers had to be written so as to be easily understood by an educated non-specialist, while maintaining at the same time the appropriate scientific rigor. This condition was a major challenge for the authors, but we believe they have managed to fulfill it reasonably well.

The call for abstracts was published in May 1999 and more than 130 abstracts were received. After the appropriate refereeing, 24 abstracts were selected and their authors invited to write up their papers, which were reviewed again prior to publication. Most of the reviewing process was carried out by the *Annals* Editorial Board under the supervision of senior MCFA members. This reflected the initial concept of a Scientific Journal, edited by MCFA members, with contributions from MCFA members. This concept might change for future editions to ensure an even higher scientific standard.

We are now proud to present the first issue of the *Annals of the Marie Curie Fellowship Association*. We would like to thank the authors for their contributions and all the panel editors for their invaluable work and assistance in making this project a reality.

For the Annals Editorial Board:

Luc Deneire (Electronic Editor)

Moises Canle Lopez (Co-ordinating Editor)

Jennifer McClarey (MCFA Publications Manager)

Marco Valentini (MCFA Board Member responsible for the Annals)

Foreword by the Chair of the MCFA

8000 researchers have benefited so far of successive European Union training and mobility programmes. Most of these were young scientists at doctoral and post-doctoral level, and about the same number will be trained through the current Fifth Framework Programme. The Marie Curie Fellowship Association (MCFA) brings together all these fellows across their different disciplines and countries, through various stages of their career, and as such represents a most significant intellectual capital. It aims to create a visible identity for Marie Curie Fellowships and advance science in Europe through networking, conferences, and publication activities.

The objective of this first edition of the annals of the MCFA is to represent the diversity and scientific level of the research undertaken by Marie Curie fellows. It is in a way a snapshot of research in Europe, and a means of disseminating the results of the European Commission's investment in future generations of researchers.

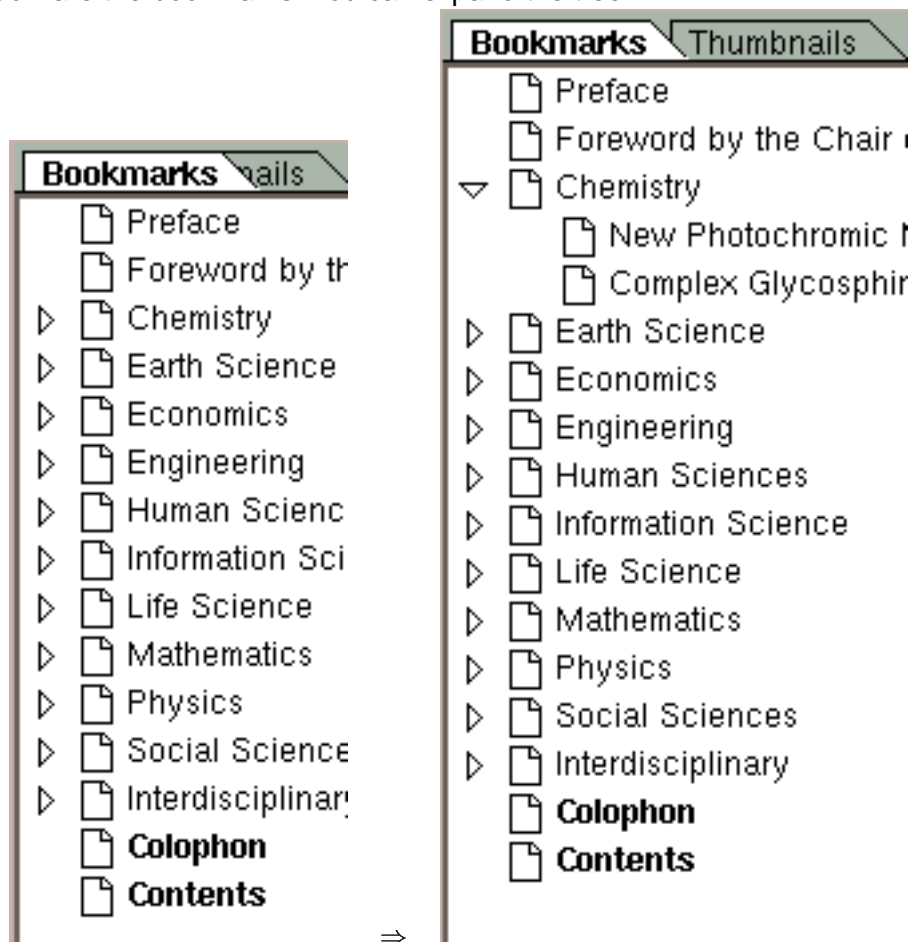
I hope that each year, the annals of the MCFA will project to a wide readership an image of the diversity of European research and where it is heading.

Laure Ledoux

MCFA Chair.

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Chemistry

Chemistry is centered on the study of the structure and composition of substances, their production, transformation and interactions, and of the natural laws which control such processes. We, chemists, wish to be able to produce substances at will, and to predict how a substance or a mixture of substances would behave under certain conditions. Such challenges are still nowadays the main driving force of chemical research, as reflected by the three articles included in this first volume of the Annals of the MCFA.

J.M. Lassaletta reports on a general synthetic strategy to obtain globosides, which present interesting biological properties but are difficult to obtain from natural sources in reasonable quantities. This paper is an interesting example of how the chemical synthesis of natural products can make pharmacologically interesting substances more easily available.

Chemical synthesis is also the subject of the article written by G. Tsivgoulis. However, in this case the targets are new materials with specific physical properties. These physical properties are due to the presence in the molecules of certain functional components, which must be correctly assembled in order to obtain molecules of the desired characteristics. As the author himself points out, this has been a central area of research in the field of supramolecular chemistry in the last few years, due to the technological importance acquired by molecular electronic devices, i.e., molecules that could act as rectifiers, transistors, switches, photodiodes or molecular wires.

The interdisciplinary article by A.C.T. van Duin exemplifies the links between chemistry and other sciences, in this case Earth Sciences. A computational technique is used to simulate the partitioning of organic compounds in the soil subsurface during its migration through sediments. The article shows the capability of this computational simulation to predict changes in the composition of mixtures due to physical and chemical processes, even when dealing with systems as complex as petroleum.

Finally we would like to thank all those Marie Curie fellows who submitted an abstract for this volume of the Annals of the MCFA. In spite of the exceptional quality of them all, space constrictions obliged us to select only a few. We hope that the highly positive response of the fellows to this first volume will continue for the following volumes. If such is the case, the Annals of the MCFA will soon become a solid reality, accomplishing its objectives of reflecting and spreading the high quality of the scientific research carried out by MC fellows with the financial support of various EU programmes throughout the years.

Moisés Canle López, Angel Cuesta Ciscar, Paulo Figueiredo

“**New Photochromic Materials**”,
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Abstract

The development of **molecular electronic devices** such as rectifiers, transistors, switches, photodiodes and molecular wires requires the design of functional components capable of handling electrons and is of basic importance in supramolecular chemistry. Systems that allow the reversible modulation of a given physical property, like conjugation, by an external trigger such as **light** consist one important category of switches. The aim of this work was the synthesis and study of photochromic compounds (molecular switches) with new properties. Five dithienylethene type compounds were synthesized and studied. They can reversibly interconvert between two thermally stable forms, an open and a closed one, by using light of different wavelengths as triggers.

Three of the synthesized compounds represent oligothiophenes endowed with a photoactivated switch and in view of their potential use as switched oligothiophenes they are of special interest in molecular electronic devices. Also, two compounds present absorption bands whose excitation gives very large differences in fluorescence between the two forms with very little effect on the opening/closing state, a feature of interest for optical memory data systems.

**“[Synthesis of Complex Glycosphingolipids of the Globo Series](#)”,
J.M. Lassaletta**

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Abstract

Versatile strategies were designed for the synthesis of biologically important glycosphingolipids of the globo series, as illustrated for the synthesis of the hexasaccharide of the human breast cancer antigen (Globo H, MBr1) and of the stage-specific embryonic antigen 4 (SSEA-4, Sialylgalactosylgoboside).

Earth Science

Three papers have been presented for the Earth Sciences panel.

The first paper is for the Oceanography section. Satellites images are used in order to study internal waves. By observing satellite radar images over areas where internal wave characteristics are more or less well known, it may be possible to say something about the concentration of surfactants on the sea surface. This possibility has not been explored in the past and it is not accurately understood yet.

The importance and application of these studies are potentially in the field of air-sea interaction studies, the detection of surfactants even when there are no slick-like features visible, and possibly in the work of biologists and environmental scientists.

The innovation of this research is the use of a relatively well-studied phenomenon, such as internal waves, to retrieve information about the sea surface microlayer. Furthermore, the use of remote sensing to measure parameters can be relevant to other areas in Earth Sciences.

The second paper presented here is for the Geology section. No volcanic eruption occurs without warning signs, although the warning signs may occur without a subsequent eruption. Seismicity is unquestionably the most useful indicator of the state of an active volcano. More than a century of seismological observation testifies that seismicity, in the form of discrete earthquakes, volcanic tremors or both, nearly always precedes, accompanies, or follows unrest at all type of volcanoes (andesitic, dacitic and basaltic, central volcanoes, and restless caldera). The eruption time can be empirically estimated by analyzing specific seismic patterns. This study is concerned with the analysis of deep earthquakes preceding the September-October 1989 eruption at the Mt. Etna Volcano.

The final paper is an interdisciplinary paper related to Geological-Chemical studies. The distribution of organic compounds in sediments has been one of the focal points of geochemical research over the years. Special interest exists, from an environmental viewpoint, for the chemical and physical fate of toxic compounds and, from a commercial viewpoint, for the diagenetic processes that eventually lead to oil formation. The increasing availability of fast computers, combined with developments in computational chemical research, nowadays allows for detailed studies into the affinities of these sedimentary compounds for the organic, aqueous and inorganic phases found in the subsurface. The outcome of these computational studies allows prediction of the effects of diffusive processes on organic compound distributions, thus providing valuable constraints for the study of the physical and chemical processes in sediments.

Jürgen Fröhn and Anita Grezio

**“[Satellite Radar Observations Of Oceanic Internal Waves](#)”,
J.C. da Silva, S.A. Ermakov and I.S. Robinson**

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Abstract

This paper is concerned with satellite radar images of oceanic internal waves (IWs). It is an attempt to infer information from the sea surface microlayer, in particular about surface films, by observation of characteristics of IWs imaged by the radar on board the ERS satellites. Classification of the radar signatures of IWs based on the analysis of a set of ERS SAR images of the Iberian shelf is presented. The circumstances under which the different types of IW signatures are observed is analysed, and it is concluded that surface films can play an important role in the kind of signature observed. A mechanism to explain radar imaging of internal tidal waves (ITW), which was not understood until recently, is presented. Transitions of signatures within the same wave-packet are reported and interpreted according to a model that accounts for the presence of films.

**“ Deep Earthquakes at Mt. Etna volcano:
a forerunner of flank eruptions occurrences”**,

S. Vinciguerra

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Abstract

The September-October 1989 flank eruption at Mt. Etna marked a change in the recent eruptive style of the volcano. Seismicity, at mid (order of months) and short (order of days) time, preceding the eruption onset has been analysed by means of D (time fractal dimension), and of materials science equation. The behaviour of the upper and lower crust volumes has been investigated, by considering shallow ($h < 7$ km) and deep ($h \geq 7$ km) events. Clear patterns of ‘deep’ events have been found to precede flank eruption onset, at the order of months, while the overall volcanic edifice is affected by seismic events at the order of days, prior the eruption onset.

Economics

Economics is undoubtedly an extremely wide area of research, ranging from labour or health economics to microeconomics and mathematical finance. Selecting papers from such a diverse range is therefore a difficult task. Two papers have however been singled out for the first issue of the MCFA Annals which reflect this diversity.

The first article "No woman, no cry": is unemployment less costly for women than for men ? deals with labour economics. In this paper Glenda Quintini compares the costs of unemployment for women and for men in the United Kingdom. The costs are measured as lost earnings after the unemployment spells and specifically the costs associated with lower wages and opportunities often following unemployment. The article is one of the rare pieces to study empirically the problem of unemployment costs for women. An interesting finding is that although costs for women follow the broad picture of men's cost, they tend to be much lower. High skilled employees and older employees are found to be those who suffer most.

The second paper is a contribution to Behavioural Economics. This field has emerged only very recently and is now a field of great dynamism. From a general perspective, one of the major criticisms of the neo-classical utilitarian approach in Economics has always been the inability of formal models to capture the true preferences of individuals. Consequently, the standard theory often fails to provide results that fit the empirical evidence we have on human decision-making and is unable to predict the behaviour of economic agents in an environment that is changing over time.

The paper by Peter Roelofsma investigates methodological and theoretical contributions to the study of time preferences. His paper provides an overview of his own work within the literature. People take decisions about events that occur in different moments in time. In addition, they have the tendency to discount short-term

events more heavily than long term events (immediacy effect). Traditional theory does not account for this type of discounting. However, it has important implications since it translates into intra-personal conflicts of preferences leading to self-control problems. Individuals behave as if their choices were governed by at least two different 'selves': one which is concerned with current payoff and takes the decision and one which is concerned with future payoffs. Given this, an optimal plan from the perspective of the current self is no longer optimal when reconsidered in the future. For instance, taking into account the current cost of fixing the bedroom shelf and the future benefit of having it fixed, the current self may want to delay the fixing until tomorrow. However, this decision may be reconsidered when "tomorrow" comes. More importantly, the agent may end not fixing the shelf, though it would be optimal to fix it at some point. This suggests that imposing constraints on the behaviour of future selves is the only way to avoid self-control problems.

From an empirical perspective, one of the most important questions is how to measure the discount rate. In addition, the fact that the payoffs at each period are nominal amounts or utilities matters. The reason is that the relationship between amount and utility is non-linear. Usually, discount rate measures are made for nominal amounts and not for utility. The author offers a computational method to estimate the discount rate for utility. He shows that systematic differences occur when using either the one or the other elicitation method.

These papers are two good examples of the type of articles we call for in the economics section of the Annals. Authors should however not feel limited by the two fields as the editors are willing to consider submissions in all areas of economics.

Isabelle Brocas and Olivier Renault

**“[Methodological and Theoretical Contributions to the Study of Time Preference](#)” ,
P.H.M.P. Roelofsma**

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Abstract

On a boat trip from Boston to Philadelphia Benjamin Franklin, the American statesman and scientist, found himself in a tangling decision problem when confronted with the delicious smell of fried codfish coming out of the ship kitchen's window. Franklin was a strict vegetarian and his next vegetarian meal was scheduled only within an hour. Should he wait for a decent vegetarian meal or should he take fish and chips immediately? Although he was a vegetarian the impulse of his appetite was too strong for him. He reconsidered his valuations about codfish on the spot: 'The codfish stomach probably is full of small other little fishes. Perhaps codfish was not really the peaceful kind of fish he had always assumed. And, if those fishes eat each other, I might as well eat the codfish immediately'. Benjamin Franklin devoured the fried codfish to his full and immediate satisfaction. ...

“ ”No Woman, No cry”: is unemployment for women less costly than for men? ”,

G. Quintini

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Abstract

In this present paper we focus on the consequences of unemployment for the earnings of women. The literature is very rich on displacement costs for men but little work has been done on women. We find that the cost of unemployment in terms of lower earnings is much smaller for women than for men. We also find evidence that high skill, middle age women who experience long spells of unemployment are among those who lose the most.

Engineering

Engineering covers a vast variety of topics, so the selection task was rather tough, and the selected paper are both excellent papers and covering hot-topics.

The paper of Dr. da Costa Sousa tackles the problem of model-based control, which is of utter importance in most of the industrial processes. He attacks the problem by resorting to the rather new fuzzy logic paradigm, which has proven to be a sound method in classical control. Covering the topic in a highly scientific way, the author enables non experts to understand the nature of his problem and how the fuzzy control can bring a good and simple solution in complex situations.

Dr. Spyrou gives us a deep overview on a totally different topic, namely the movements of a ship (recent wrecking of the Erika boat has shown importance of these movements). The author explains in detail some of the fundamental movements of the boat and their (possibly unstable) dynamics. He further introduces a new non linear model, linked to the chaos theory, and shows how this model can account for most of the behavior of the boat. His results can help in conducting boats in adverse weather as well in designing ships and establishing sea regulations.

Luc Deneire

**“Fuzzy Model-Based Control of Complex Processes”,
J.M. da costa Sousa**

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Abstract

This paper presents recent developments on fuzzy model-based control applied to complex processes. First, a brief description of the main steps in fuzzy model-based control, i.e., the identification of the model and the design of the controller is presented. Recent research developed by the author is aggregated to present a complete approach based on fuzzy tools. Various problems encountered in fuzzy model-based control are addressed. Keywords: fuzzy model-based control, fuzzy modeling, model predictive control, branch-and-bound optimization, adaptive decision alternatives.

**“*The Nonlinear Dynamics of Ships in Broaching*”,
K.J. Spyrou**

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Abstract

Recent research on ship motion dynamics has led to the discovery of the underlying causes of broaching. This is a type of ship motion instability which is manifested on the horizontal plane with a sudden divergence from the initial course and it may end with a rapid ship capsize. We shall summarise the key dynamical phenomena which are responsible for broaching.

Human Sciences

The current section represents the sub-division 'Human Sciences' of the Training through Research and Mobility Panel 'S' (Economic, Social and Human Sciences). For this edition, a paper has been chosen on conditional connectives in the legal language of four official European Union languages, English, Italian, German and French. Dr Visconti's paper is representative of the work being undertaken by Marie Curie Fellows in the field of Linguistics. This research illustrates that it is the Commission's desire to support high-level innovative research into Linguistics under the auspices of the Research Directorate-General. The Education and Culture Directorate-General also supports a wide variety of programmes, to encourage citizens of member states to master at least three European languages (see the Commission's 1995 White Paper 'Teaching and Learning'; the Lingua section of the Socrates programme; the Leonardo da Vinci programme; and the European Label initiative). Such support is not to be confused with that of the Research Directorate-General for proposals under the Marie Curie Fellowship scheme, where applicants compete for funds for training through research against fellow-scholars from all the disciplines represented in this publication and, more fully, all the panels and sub-disciplines of the TMR programme. Work has been undertaken or is currently being carried out under the Marie Curie Fellowship scheme both in a variety of specifically linguistic areas and in multidisciplinary projects where linguistic methodology combines with the insights of other academic fields. Studies have been supported on such projects as Language and Social Cognition (Grant number 972352); Business Communication (972454); Italian and English Conversational Styles (982938); and Linguistic Markers (983467). Dr Visconti's work is significant because of its comparative and interdisciplinary approach. By choosing authentic examples of legal language in the four languages studied, Visconti is applying the latest insights of Corpus Linguistics to the applied field of legal use in order to guarantee that the translation of such legal documents as the Maastricht Treaty can be undertaken as accurately as possible; this is done by basing analyses on documented cases of usage in authentic legal texts in each of the languages examined (and not, for example, by merely having recourse to previously published translations).

Micheàl Ó'Dùill

**“ A Comparative Glossary of Conditionals in Legal Language:
English, Italian, German, French”**,

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Abstract

This paper describes the combined results of two projects: the Human Capital and Mobility project on Conditionals in legal language ; the Training and Mobility of Researchers project on A Contrastive Glossary of Conditionals in Legal Language . The aims of the projects were: (i) the analysis of Complex Conditional Connectives (henceforth cccs) in English, Italian, German and French legal language; (ii) the compilation of a comparative Glossary of such connectives in the four languages. After a brief introductory section, I shall outline the method of research and the structure of the compiled Glossary.

Information Science

Information Technology (IT) has seen exceptional developments in recent years, in terms of new possibilities offered by cheaper and more powerful technology, new infrastructures, new software tools, and new ideas. IT could not have evolved to its current state without original, revolutionary, and visionary ideas. Marie Curie fellows are making an important contribution to these new ideas and they are contributing to the confirmation of Europe as one of the IT powers of the future.

Computers are used today in many applications and in completely different situations including, for example, Internet browsing and industrial production. But how can information contained in a web page arrive in a short time to our personal computer? Is it possible to simulate a complex industrial process and how? In this issue of the MCFA Annals two papers are presented, as possible answers to these questions. These works tackle different problems but aim at the same things: reduction of costs, improvement of existing techniques, and development of new products and services. In this way new ideas in research will contribute to achieving a better quality of life, and offering new working possibilities to end users.

The paper "How to improve the World Wide Wait? Large Caches and Satellites" by P. Rodriguez and E.W. Biersack is concerned with the speed up of the World Wide Web. We all know the often frustrating latency in network response when requesting a document, which is not already stored on the local site. With further growth of the World Wide Web this is expected to occur even more frequently in the future.

The authors describe a topology of Web caches (network proxies) that use a satellite distribution of requested documents. This means that one Web cache exists that serves as a master to all institutional caches, e.g. various main computers of local area networks in companies or universities, that are connected to it. If one user asks for a document in the World Wide Web, which is not yet stored in his institutional cache, this document is requested from the original remote site and directly delivered to the user's institutional cache. Additionally a copy is stored in the satellite cache and distributed to all other institutional caches connected to it. If the document is later requested by another user, he is served from his institutional cache which largely reduces the waiting time.

The article gives an overview and an evaluation of Web caching with satellite distribution in comparison to hierarchical caching. Cache-satellite distribution shows a significant advantage with respect to latency and hit rate, which makes it a feasible topology to cope with the future growth of the World Wide Web.

The paper "An Aide for the Off-line Training of Plant Operators" by Belen Ruiz Ruiz deals with the problem of simulation of complex industrial processes. Simulation environments and tools can be a great support in designing, analysing and controlling complex industrial processes, where fault-tolerance, real-time reaction and security are highly critical constraints. On-line decision support and off-line training of operators of industrial plants are interesting application areas of simulation tools.

The paper describes an Intelligent Simulation System, developed in the framework of the EXTRAS Project (BRITE/EURAM Programme), which implements artificial intelligence based techniques and advanced simulation techniques, aimed at both on-line decision support and off-line operator training. The system is targeted towards the application domain of Energy Production, and case studies range from thermal power plants, to gas turbines for combined power generation, to control of regional energy distribution centres. The system is designed to be capable of reconfiguration and not dependent on a particular application domain.

We hope you enjoy reading the papers in this section and we are looking forward to new and exiting projects in the next issue of the Annals.

Roberto Bresin, Beniamino Di Martino, Sabine Kroener and Michel Schellekens

**“How To Improve The World Wide Wait? Large Caches and Satellites”,
P. Rodriguez, E. Biersack**

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Abstract

The World Wide Web is becoming increasingly popular and already accounts for a big percentage of the traffic in the Internet. However, the frustrating response times are turning the World Wide Web into the “World Wide Wait”. As a result, Web caching is emerging as an important technique to reduce client’s latency, network bandwidth, and server’s load. With Web caching, when a client requests a document for the first time, the document is delivered directly from the origin server and a copy of the document is stored in the cache. Further requests for the same document are satisfied directly from the cache without contacting the origin server. For Web caches to be able to satisfy most client requests, they need to contain a large number of documents. In this paper we analyze a distribution model where caches are filled with many documents using a satellite distribution. In a cache-satellite distribution when a cache fetches a new document, the document is immediately broadcast to all other caches via the satellite. Caches connected to the satellite distribution end up containing all documents requested by a huge community of clients, where the probability that a client finds a document in the cache is very high. Clients with local caches connected to the satellite distribution can avoid slow modem connections and virtually browse the whole Web locally. Internet Service Providers (i.e ISPs) with a cache connected to the satellite distribution can achieve very important bandwidth savings. We evaluate a cache-satellite distribution in terms of the number of documents that are found in the cache, the latency experienced by the clients, the required satellite bandwidth, and the storage capacity needed in the cache.

“An Aide for the Off-line Training of Plant Operators”,

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Abstract

One of the essential requirements on the operation of complex industrial processes is to deal with uncommon and unusual situations. The need for the continual re-configuration of plant and the constant modification of operating conditions to meet production demands, means that operating staff are required to face situations where they cannot react or decide on the basis of their experience alone. The large number of possible situations makes it very difficult, if not impossible, to enumerate the correct responses for use in a decision tree or expert system based approaches. One solution to this problem is to utilise simulations of the process to train operators to recognise such situations and to investigate the effectiveness of possible control decisions. However, simulators that industrial processes are presently provided with are intended for design purposes rather than for operations guidance and are therefore too complex and detailed for operating staff to understand and use effectively. Further, this lack of usability makes it difficult to use simulations for on-line decision support, thereby limiting operations to known a priori situations. The industrial need is for simulation systems that allow direct interaction with the user and consequently are much easier for operators to use. Such Intelligent Simulation Systems can then be used for effective on-line decision support and training situations, thereby improving the efficiency, safety and quality of the associated industrial processes.

Life Science

When the 'Call for Abstracts' was published on the Web in May 1999, we hoped, but did not expect to see, so many diverse and qualified entries as we did. The Life Science panel alone received over 35 submissions, covering all the aspects from botanical over molecular biological and neurobiological to medical aspects. All of those proposals revealed a high scientific excellence that was proven by often numerous referred publications in highly reputable journals. This richness in submissions and the restrictions in available space made it very hard for us to choose the articles presented in this first issue of the 'Annals of the MCFA'. We had long and lively discussions, yet our main concern was always to try to reflect both the scientific excellence and the diversity of the original abstracts. We hope that in the upcoming issues of the Annals, we shall have the same hard time to choose from such a broad variety of themes, and we encourage those authors who were not chosen this time to monitor the 'Annals' and the schedule of the next issues.

The three articles by Bénédicte Sanson, William M. Gallagher, and José Pérez de la Lastra deal with three very different, yet highly important aspects in Life Sciences.

Bénédicte Sanson describes her work on the biology of development of organisms by using a useful model system in genetics, the fruit fly *Drosophila*. This animal model has yielded key results in the study of genes and their functions that have also been found in other animals, including humans. The characterisation of molecules that control the different stages of the development in all organisms and how these molecules govern cell fate and behaviour is an exciting and active field in current biological science. Moreover, these studies may be important for the elucidation of molecular aspects of some human cancers and genetics diseases. One of the intriguing matters of developmental biology is how individual cells interact and communicate between them, in order to give rise to the global pattern of the organ or organism. Sanson focuses her work on the so-called Wnt genes, which are involved in these processes of intercellular communication. Proteins coded by these genes are liberated into the extracellular space where they bind to target cells. Once activated, they send a specific signal from the cell surface to the nucleus in order to modulate gene expression and induce subsequent changes in the different organs. One of the main questions of her work is how these secreted molecules travel long distances through developing tissues in order to produce their effects, which has been the origin of debates in this field.

The contribution by William M. Gallagher summarizes the enormous success in the understanding of cancer therapy, where a single gene has been identified, the gene p53, that seems to be involved in more than 50% of all human cancer types. This gene regulates cell response to adverse stress such as damage to the DNA. His work suggests that the lack of protein function following mutation of that gene can account for further tumour-promoting properties and that understanding of the p53-dependent pathway may contribute to improve cancer therapy. Indeed, the identification of a novel protein that interacts with certain mutants of p53, a so-called Mutant Binding Protein 1 (MBP1), raises the hope that, by targeting this specific protein, treatments may arise that help to determine and improve patient prognosis.

In José Pérez de la Lastra's article an important issue in clinical sciences is addressed that poses until today a major obstacle for organ transplantation, i.e. the low and insufficient availability of human donor organs. This problem has encouraged scientists to use organs from other species to bypass the lack of availability of required organs. This technique, called xenotransplantation (i.e. the transfer of organs between different species), is still under development and before this technique becomes a reality for clinical purposes further studies are required, primarily in terms of safety and effectiveness. The major problems are rejection by the host's immune system, the risk of transmission of pathogens, e.g. animal viruses to humans, and effectiveness. Perez de la Lastra describes the hyperacute rejection and subsequent destruction of grafted pig organs after transplantation, and how these reactions are mediated by the complement system, a system that controls the immune response to the introduction of foreign tissue. Attempts are being made to block this mechanism of

rejection by the introduction of genes encoding human complement regulators into the pig, a sort of "humanising" these organs. The work of Pérez de la Lastra focuses on the characterisation of endogenous pig complement inhibitors. He suggests that the experimental success of the overexpression of complement regulators of human origin in pigs leads to methods to reduce the adverse reactions to the grafted tissues but that this success may be due to an increment in endogenous porcine complement inhibitors. "The human origin [of complement regulators] may be of secondary importance" for xenotransplantation.

Stefan Clemens, Ana María Cerdeño-Tárraga, Oliver Schwickerath, and Amelia Sánchez-Capelo

**“At the Edge of Developmental Biology
Advances and Mysteries about the WNT Genes”**,

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Abstract

The past decade have witnessed amazing progress in our understanding of how animals arise from a single cell, the fertilised egg. Looking at embryos was in the past the occupation of embryologists, who carefully described the development of a wide range of organisms. It is now the occupation as well of geneticists and biochemists, since development of all organisms is under the control of genes, and genes code for proteins that have specific structural or enzymatic properties.

The meeting of these three disciplines of biology have generated a very dynamic field of research, which is called developmental biology. This field has attracted considerable attention with the realisation that many genes and biochemical pathways essential to the development of embryos are precisely those disrupted in human cancers and in many genetic diseases. Moreover, workers in the field have come to the astonishing realisation that many genes involved in the development of organisms as different as flies and humans are essentially identical. This implies that studying less complex organisms that are easily accessible to experimentation can yield relevant information for the development of humans, as well as for the understanding of human diseases. ...

“Xenotransplantation : contribution of endogenous pig complement regulatory molecules”,

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Abstract

A shortage of donor organs is the major obstacle in clinical transplantation. Successful xenotransplantation using pigs as a source of organs and tissues may quickly become a biomedical reality. Xenotransplantation is a new and rapidly expanding field which may save thousand of human lives each year. Clinical application of xenotransplantation is limited by a severe immunological reaction of the recipient against the graft, known as hyperacute rejection. This destruction of the grafted organ occurs within minutes of implantation and is mediated by natural antibodies and complement. One of the strategies being tested to reduce complement activation is the breeding of pigs expressing human complement regulators, in the expectation that organs from these pigs will be better protected from hyperacute rejection. However, the potential roles of the endogenous pig complement inhibitors have received little attention. This paper reviews the current knowledge of the endogenous pig complement inhibitors and their relevance in the context of current efforts to express human complement regulators in the pig.

**“Contemporary Strategies for Cancer Therapy The p53 Gene as a Paradigm”,
W. Gallagher**

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Abstract

Since its discovery in 1979, p53 has become one of the most intensively studied genes of all time (over 15,000 articles published so far). However, some issues concerning p53 biology remained unresolved. What is in no doubt is the important role that p53 plays in regulating the response of cells to adverse stresses such as DNA damage. Indeed, this control mechanism is lost in over 50% of human cancers due to mutation of the p53 gene. A large number of therapies have been devised with p53 in mind, ranging from genetic therapies to more conventional drugs. Crucially, it is still controversial as to whether p53 mutants (i.e. the dysfunctional proteins produced upon mutation of the p53 gene) have additional tumour-promoting (oncogenic) properties that are independent of wild-type p53 inhibition. Our work has provided further evidence that mutant p53 proteins do portray such gain of function activities. We have identified a novel protein that interacts in both a physical and functional manner with certain mutant forms of the p53 protein. This protein was assigned the term MBP1 -for Mutant p53 Binding Protein 1. MBP1 is the fourth member of the emerging fibulin family. It displays both mutant p53-dependent and independent oncogenic properties. As such, MBP1 may be useful as a target for cancer therapy, along with being informative in terms of determining patient prognosis.

Mathematics

We all encountered this science at some point in our lives. In our youth, we all solved a quadratic equation or two. With "in our youth", one might as well mean the youth of civilisation; the oldest recorded solution of a quadratic equation is on a Babylonian clay tablet from 1700 BC. The problem dealt with on this clay tablet was the calculation of the length of the sides of a rectangular piece of land with given area and perimeter.

It is in such humble dwellings that the science of mathematics was born. Geometry arose out of the need to measure up rich agricultural land in a fair (or not so fair!) way after a river had made its periodic flooding. (Yet another phenomenon giving rise to a myriad of complex and mathematically extremely enticing models.). Algebra and number theory had their cradle in the world's first accountant's offices. Archaeologists had a serious disappointment when the mysterious Kretan clay discs written in Linear B were finally deciphered: instead of the expected stunning poetry, all they got was the bookkeeping of an olive oil trader.

So, mathematics, in different shapes and sizes has been with us for about as long as civilisation itself. Some mathematicians even claim to have the oldest profession in the world. This claim is of course heavily contested by bakers, brewers and goat herdsman. Whatever the truth about the mathematicians claim to seniority, about all mathematics of these early days has one thing in common: its immediate applicability to everyday down-to-earth problems.

A tendency towards a more abstract, "l'art pour l'art" attitude first flourished in classical Greece. It was in this highly-refined culture that a number of schools were established which are often referred to as the first universities. Although, not quite. In the school of Pythagoras (yes, the one from the celebrated theorem), numbers were used to describe relations between individuals. A person was attributed a "prime character" and a sentence like "he stands to me like 4 to 7" was in standard use among the disciples of Pythagoras. When one of the students managed to prove that the square root of 2 could not be a rational number (i.e. a fraction of two integers), it seriously shattered the master's image of the world. Rumour has it that Pythagoras had the "unruly" disciple killed.

Since then, on the average, mathematicians have become a lot better behaved. And quite a lot of them have become more applied or application oriented. Mixture with other sciences is utterly commonplace. Albert Einstein is reputed to have said, "Since the mathematicians have invaded the theory of relativity, I don't understand it myself anymore". And this was only the very beginning! Since then, mathematics has successfully reshaped entire fields of research. The "obvious victims"- physics, engineering and computer science - have been joined by e.g. econometrics and theoretical chemistry. Not even the life sciences are safe anymore, as more than just one geneticist or population dynamics researcher will be able to testify.

It is in this line of "original motivation from outside the discipline" that both articles in this section can be situated. Motivation from outside is far from a one-way street as very often an original problem becomes generalised and embellished beyond the point of recognition, thereby giving rise to entirely new theory which eventually might end up (and very often does!) being useful for a completely different set of unrelated problems. Even some of the work of the famous G.H. Hardy (author of *A Mathematician's Apology*) has found applications, namely in coding theory. An astonishing fact for a man who declared with pride: "I have never done anything 'useful'. No discovery of mine has made, or is likely to make, directly or indirectly, for good or for ill, the least difference to the amenity of the world. I have helped to train other mathematicians (...), but their work has been as useless as my own." If a clear-cut division between pure and applied mathematics ever made sense, it seems to have lost all credibility by now.

An interaction between virtually all the sciences and mathematics generates, luckily for mathematicians, an abundance of problems. This explosion of questions inevitably leads to an explosion of answers and thus it is estimated that about 200 000 "new" theorems are published yearly. In the following two papers, we present just a few of them.

Marc Corluy

“ **Mathematical Analysis of Extended Semiconductor Device models**”,

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This paper presents the basic ideas and results of my applied mathematics TMR project dealing with the modeling and the analysis of state-of-the-art semiconductor equations which incorporate e.g. phenomena like quantum tunneling of electrons that are not covered by classical models.

**“Two-point boundary value problems
for integrable evolution equations in one space dimension”**,

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Abstract

We illustrate a method of solving two-point boundary value problems for arbitrary linear evolution equations on the line, and its generalization to integrable nonlinear evolution equations, such as the famous Korteweg-deVries equation. This method is the extension of a general transform method recently introduced by Fokas to this particular class of problems, and it yields an explicit representation of the solution in a spectrally decomposed form. The new feature arising with two-point boundary value problems is the presence of a discrete spectrum in addition to the continuous spectrum associated with initial or boundary value problems on infinite or semi-infinite intervals.

Physics

The mission of Physics is to investigate the fundamentals of our World and of our Universe and to provide an understanding of the basic principles. But there is more than fundamental research going on, apart from e-clat spin-offs (see for example the invention of the World Wide Web at CERN); there are a lot of applied research activities which have, or might have, an impact on our daily lives. This complexity is somehow represented in this section in which fundamental and applied physics merge.

The contribution of J.R. Klaus represents a real projection into the future and it is also at the frontier between physics and biology. In his paper (included in the Interdisciplinary section of the Annals) he proposes an interdisciplinary approach to material science, involving biological methods to complement existing physical and chemical coating techniques.

The study presented by Ralf-Hendrik Menk indicates that the application of holographic techniques to X-ray imaging leads to superior image quality and better resolution (even down to atomic scale) with respect to standard imaging techniques. These novel techniques are expected to have an impact on all kind of X-ray imaging, from material testing to medical imaging. Objects almost transparent to standard radiography will become clearly identifiable, at a radiation dose much lower than that used to date, when adequate detection systems are developed. This is very important for all medical applications. In the field of fundamental research, X-ray holography could play a key role in the determination of complex protein structures.

Antonaldo Diaferio in "The Large Scale Distribution of Galaxies" tries to probe, with sophisticated computer simulations, our present understanding of the Universe we live in. As simulation results depend on the adopted cosmological model and on the working hypothesis, their comparison with observation gives an indication of the validity of our current knowledge of the Universe. The Universe as we know it today is not a static and uniform set of galaxies. Due to cosmic expansion, galaxies are moving apart from one another. In addition, galaxies are concentrated in clusters and super-clusters: these have formed as a consequence of initial inhomogeneities in the primitive Universe and of the distribution of the so-called "dark matter", a special kind of matter which is not observable, but accounts for about 90% of the total matter in the Universe. A detailed comparison of the simulation results with real surveys shows that the simulation of the galaxy clustering process is quite accurate. But the investigation is not over yet. Diaferio foresees a full comparison of the simulation of the evolution of galaxies with the data from the space-based Hubble telescope. More exciting results on the formation of the Universe will be coming soon.

In the era of information revolution, physics is playing a key role in providing new technologies for more rapid and more efficient storage of the ever-increasing quantity of information, which is becoming available to us. Magnetic multi-layers and spin-dependent tunnel junctions are emerging as prime candidates for information storage in magnetic recording technology (such as in computers, video and audiotapes). This is a rapidly growing industry with an estimated annual market of \$1 billion. In his contribution J.M. de Teresa describes an exciting set of experiments which, for the first time, demonstrate the important role of the insulating barrier in the working of spin-dependent tunnel junctions. The active role of the barrier provides technologists with an additional way to control and improve the performance of these devices. The experiments by J.M. de Teresa also provide an explanation for a long-standing puzzle regarding the transport of electrons in such systems.

Joerg Heber, Maziar Nekovee, Marco Valentini

“**Holographic techniques applied to X-ray imaging**”,
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Abstract

Holographic techniques applied to X-ray imaging Ralf-Hendrik Menk, ralf.menk@elettra.trieste.it
Abstract Up to now standard X-ray imaging technologies, rely primarily on the amplitude properties of the incident radiation, and do not depend on its phase. This is unchanged since Rntgen's discovery [1] that the intensity of an X-ray beam, as measured by the exposure on a film or an equivalent X-ray detection device, was related to the relative transmission properties of an object. However, the new imaging techniques, which have been emerged, depend on the phase of the X-rays as well as the amplitude. Phase becomes important when the beam is coherent and the imaging system is sensitive to interference phenomena. Significant new advances have been made in coherent optic theory and techniques which now promise phase information in medical and material imaging. In this article an overview of the field with special regard to future applications will be given.

**“ Manganite-based Magnetic Tunnel Junctions:
new ideas on Spin-polarised Tunnelling”**,

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Abstract

We present experimental evidence of the active role played by the barrier in magnetic tunnel junctions. We have prepared tunnel junctions of the type $Co/I/La_{0.7}Sr_{0.3}MnO_3$ with four different insulating barriers: $I = Al_2O_3, SrTiO_3, Ce_{1-x}La_xO_2$, and double barrier $Al_2O_3/SrTiO_3$. Depending on the used barrier, the tunnel magnetoresistance can be normal (for Al_2O_3 and $Al_2O_3/SrTiO_3$) or inverse (for $SrTiO_3$ and $Ce_{1-x}La_xO_2$).

“*The large scale distribution of galaxies*”,

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Visible matter in the Universe concentrates in well separated islands – the galaxies. Galaxies are not distributed uniformly in space, but they rather show a complex network of sheets, filaments and regions almost devoided of galaxies. The formation of galaxies depends on physical processes which occur on very different scales: from the scale of stars to that of clusters of galaxies. By combining models of the large scale structure formation in the Universe and models of the main processes driving the formation of galaxies, we are able to investigate, at the same time, the large scale distribution of galaxies and their internal properties. The properties of a large region of the Universe modelled this way are remarkably similar to those of the observable Universe. This approach has substantially improved our current understanding of the galaxy formation processes and provides a powerful tool to constrain cosmogonic theories.

Social Sciences

The social sciences section in the Annals contains two interesting articles on topics which are timely in all European countries. In her article on nest leaving, Mariana Irazoqui Solda investigates changes in the nest leaving patterns in the Netherlands and Spain. Since these two countries are culturally relatively distant from each other, they provide a fruitful starting point for modelling different strategies in nest leaving. Southern European countries present the highest proportions of people still living with their parents in their late twenties, whereas in Western and Northern European countries more than 85% of young people are independent before their thirties. In her article, Mariana Irazoqui Solda presents first a review of the historical context of nest leaving. In this illuminating review, the roles of both socio-cultural and economic factors in nest leaving are discussed. Interestingly, differences in nest leaving patterns between Western/Northern and Southern Europe seem to reflect differences in economic opportunities. After reviewing the historical context of nest leaving, Mariana Irazoqui Solda presents results on more recent developments in nest leaving in the Netherlands and Spain.

The second article, written by Alberto Migliore, explores the current practices in assisting people with learning difficulties to gain competitive employment. This largely unexamined but topical issue is investigated by using data from employment provider agencies in four European countries (Germany, Italy, Spain and UK). According to the author, three different strategic training models emerge from the data. These models can be named as a "teaching a job" model, an "intermediate" model and a "teaching for work" model. In addition to analysis of the empirical data, Alberto Migliore reviews the philosophical aspects of the models. According to the author, models reflect two different philosophical approaches: "care/welfare" and "human rights oriented" approaches. In the former approach, a person with learning difficulty is seen as a "patient" who needs treatment whereas the latter approach focuses on a person's abilities and adopts terms such as "client" or "customer".

In addition to theoretical interests, these articles deal with very topical issues and provide applicable information for policy makers.

Timo Lajunen and Jaro Stacul

“*Nest leaving and housing. A comparison between the Netherlands and Spain.*”,
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The study of nest leaving in the European context appears particularly relevant in explaining recent retards in family formation and fertility, as to explain recent changes in household composition. In southern countries, there is an important link between postponement of departures, low incidence of household formation and family living arrangements out of the parental home. In North-western Europe, co-residence situations are characterised by an early pattern of home leaving parallel to the importance of living alone or in unmarried cohabitation, suggesting the expansion of a phase of non-family living.

This article presents some insights of a Marie Curie fellowship project designed to study home leaving in two European countries, the Netherlands and Spain, representing different contexts in terms of housing, welfare provision, employment and educational opportunities for young people. A description of main developments concerning nest leaving processes is presented in historical perspective as well as for the period of the eighties, examining both study cases with data derived from the Dutch Housing Demand Surveys (WBO 1981, 1985/1986, 1989/90) and Spanish Sociodemographic Survey (ESD 1991). Exploratory analysis allows to detect basic differences in timing of residential transitions out of parental home and patterns of union formation, which may be further related to contextual elements. In the project, this is done by directing the attention towards differences in housing market context as well as to the existence of distinct family models in Europe. In addition, the characterisation of first housing attainment further contributes to consider the effect of particular housing structures on nest leaving processes.

“Models of good Practice in Assisting People with learning Difficulties to Gain Employment”,

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Abstract

This paper shows the main results of a study completed in August '99. The study aimed to explore patterns of good practice in developing paths to employment in mainstream companies for people with primary learning difficulties. The purpose of the study was to contribute to the production of a guide on tested paths of good practice and the identification of a framework of key issues and models utilisable as a basis for further studies. The study also explored employment policies for people with disabilities and provided some general statistics on employment provider agencies.

The investigation of good practices was conducted through an analysis of process and context variables, and outcomes of four employment provider agencies located respectively in Germany, Italy, Spain and the UK. These agencies, which operate a 'place, then train' approach, were selected taking into account the advice of a panel of European experts. Data was obtained through the collection of written documentation and through open-ended (face to face) interviews with the managers and collaborators of the agencies.

General findings revealed three different models of employment practice. The distinctive characteristics between models included the varied sequences of training and actual employment, the duration of client training, and the level of client support provided. While two of these models included key elements typical of the American 'supported employment' approach, one model was independent. In addition, results indicated that, although the concept of employment practices implies a 'human rights oriented' approach, all the agencies studied were characterised by a number of 'care/welfare oriented' elements with no regard for the degree of the clients' difficulties.

Interdisciplinary

“*Computational Chemical Investigation into the Partitioning of Organic Compounds in the Subsurface*”,

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Abstract

Partitioning between organic, water and mineral phases is one of the main processes controlling the transport properties of organic compounds in sediments. The measurement and prediction of these transport properties are central topics in various fields of organic geochemical research. Important geochemical issues, ranging from the changes in petroleum composition during migration to the bioavailability of carcinogenic polyaromatic hydrocarbon (PAH) compounds in urban environment sites, are all directly controlled by organic compound partitioning.

**“*Functional Biomimetic Surface Coatings*”,
R. Joerger, T. Klaus, C.G. Granqvist**

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Abstract

An interdisciplinary approach to materials science is proposed, involving biological methods that complement existing physical and chemical coating techniques. Silver-dielectric composite thin films were produced by a bio-logical technique, using microbial biomass and metallic silver nanoparticles, biosynthesised in the bacterial strain *Pseudomonas stutzeri* AG259. The organic material, together with the metal particles, is used as precursor for film synthesis. Heat treated films backed by a metal displayed pronounced spectral selectivity of a kind that makes them interesting for photothermal conversion of solar energy. Tailoring of the optical properties of the films is discussed in terms of effective medium theory with respect to particle shape and metal volume fraction. The metal content of the films is controlled and monitored in-situ in the biological system.

“**Numerical Simulation Of Embedded Non-Volatile Memory**”,

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Abstract

Non volatile memories have in recent years become an established component of all electronic systems, especially portable systems. The general trend towards a higher level of integration and speed are pushing towards their integration with complex logic - embedded non-volatile memory. Non Volatile memory research in the NMRC, which was stimulated by a Marie Curie Fellowship, has focused on the model development which has facilitated the use simulation in the exploration and analysis of advanced embedded flash memory solutions.

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