

Annual
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Report

2008

POLISH ACADEMY of SCIENCES

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Address by PAN President Professor Michał Kleiber

The year 2007 was a period of intensive and consolidated action undertaken by the Polish research community towards reforming science and higher education in Poland, as dictated by determination on the part of Polish scholars and a sense of responsibility for Poland's socioeconomic progress. We want to stress, more emphatically than we have done so far, our expectation that the developmental strategies now being devised must finally acknowledge science's due import and status. This attitude has also found expression in the joint position adopted by the presidiums of the Polish Academy of Sciences and the Conference of Rectors of Academic Schools in Poland, addressing in particular the principles for reforming Polish science and higher education and the model of scientific advancement in Poland.

During the past year, the statutory authorities of the Academy devoted a great deal of diligent attention, energy, and concern to engaging in discourse with the state authorities – not just highlighting the Academy's historical merits, but also resolutely and effectively stressing the Academy's modern role in shaping scientific life in Poland, and the need to account for its continued activity within the general organizational plan for scientific life in our country. The Polish Academy of Sciences has formulated its own, internal proposals for change, dovetailing with the general trend of broader reforms now under preparation. Mindful of the extant research organization solutions implemented within individual Academy institutions and with due respect for the fruitful day-to-day work being done by the research teams, a process of reorganizing the Academy's research segment has nonetheless been initiated.

We are convinced that changes in organizational structure will help modernize research processes in Poland. The measures being undertaken aim on the one hand to streamline and restructure our research teams (including by granting the status of research institute to those units lacking such legal status), while on the other hand gradually consolidating these teams, helping pave the way for large-scale, world-caliber research programs, more efficient uti-



lization of EU science funding, and above all generating the right environment to maximally harness our scientists' intellectual potential. One aspect of particular importance within this program involves the identification of long-term professional opportunities: offering a vision of intellectual development for young scientists and developing a rapid and effective scientific career-path model to encourage the best graduates of Polish schools to remain in Poland and link their professional future to Polish universities and research establishments.

The Presidium of the Academy has adopted a resolution altering the competitive nomination procedures for new directors of the Academy's Institutes. Advanced work is also underway on further defining the criteria evaluating the quality of work at our research establishments. Overall, the systematic reforms we have embarked upon aim to underscore that the Polish Academy of Sciences recognizes, as the foremost aspect of its public mission, the pursuit of research demanding the highest qualifications and aspiring to excel by even the strictest world standards.

In this context, we take great satisfaction in the numerous successes achieved by research teams working at Academy establishments, many examples

of which are presented in this *Annual Report*. Another source of such satisfaction is the outcome of the Ministry of Science and Higher Education's parametric evaluation, which has classified 70 Academy research establishments into the topmost category and 5 in the second-highest category, thus recognizing the Academy's establishments as being among Poland's leading scientific institutions. Also noteworthy are the prizes won by Academy-affiliated scholars from the Foundation for Polish Science.

The Polish Academy of Sciences perceives the need for its research operations to be more open to initiatives and efforts made by other scientific communities in Poland, and has therefore launched additional mechanisms of cooperation with higher-education institutions. These include agreements which lay the foundation for direct cooperation on specific research objectives between Academy- and university-affiliated teams, such as with the University of Białystok (spurring more intense investigation of the unique natural environment of the Biebrza Valley) and with the University of Gdańsk on establishing the National Quantum Computing Center in Gdańsk (a platform for research work in the quantum IT field). Talks are also at an advanced stage on the topic of the Institute of Hydroengineering, Polish Academy of Sciences, becoming part of the Gdańsk University of Technology.

We have attached greater import than previously to the Academy's presence in national and international public debates, addressing issues of import for European regional development and of global impact. We want our scholarly community not only to be active in such discussions, but also to initiate them. In 2007, representatives of the Academy's research teams repeatedly organized numerous symposia and conferences, spoke out on various forums on topics including energy dilemmas and threats faced by Poland and the world, and were involved in forecasting Europe's development through 2050. The Polish Academy of Sciences organized fruitful discussion about intellectual property in science, the practice of commercializing scientific discoveries, and preventing the use of research findings for unethical purposes. Among the

problem-focused conferences initiated by our scientists, we should likewise mention the debate evaluating the role and significance of the Academy itself during the past era. The General Assembly and the Presidium of the Academy have repeatedly taken a stance on significant problems of scientific and social life in Poland, including on the development of Polish science, the role of science in shaping the country's spatial development, the development of Poland's energy industry, as well as other more specific issues like the zero VAT rate for specialist journals. We do not shy away from involvement in public discussions on such controversial issues as Poland's position on genetically modified organisms and public health care reform. At the December session of the General Assembly, a conference including top Polish specialists was held on the issue of global warming and climate change, probing various aspects of the phenomena underpinning these processes. This conference initiated preparations by our scientific community for the World Summit on Global Climate Change, to be organized by Poland in Poznań in December 2008.

The Academy has worked consistently to promote science and disseminate greater awareness of broad scientific issues, as well as more specific fields and research achievements. At the end of 2007, an agreement was signed with Polish public television to undertake joint projects to further public education, spread science awareness, and boost the level of education and culture in Poland.

This short foreword has only been able to present a concise overview of the main directions of our activities in 2007, via which the Academy joins in the worldwide effort to forge ahead with scientific research and harness science for the good of mankind and the environment, while at the same time keeping our country's interests firmly in mind. More detailed information illustrating the past year's multifaceted activities by the many organizational and research units of the Polish Academy of Sciences is available in the following individual chapters of this *Annual Report*.

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Social Sciences

Division I – Social Sciences embraces a wide range of both the social sciences and the humanities. The Division consists of 13 institutes, 2 units, and 25 scientific committees. The institutes and the committees publish their own journals and book series. During the current term of office, the Division has been headed jointly by its chairman, Prof. Stanisław Mossakowski, and by two deputy chairs: Prof. Mirosława Drozd-Piasecka and Prof. Andrzej Wiatrak.

Three plenary sessions and an election meeting were held in 2007. The first session held on March 1 addressed the most important matters in the Division's activity during the 2007-2010 term. It established a work schedule and rules for the evaluation of the scientific units, and named the reviewers (Academy members) to evaluate their activity. A set of election rules for the scientific committees affiliated with the Division for the 2007-2010 term was drafted. At the end of the meeting the Division identified the disciplines in which its awards would be given, and appointed the boards of jurors responsible for granting each award. Committee members were also appointed to select new directors for the scientific units.

At the session on 21 June, Michał Głowiński and Hubert Orłowski, both full members of the Academy, evaluated the activity of the Institute of Literary Research, while the activity of the Institute of the Polish Language was evaluated by Kazimierz Polański, full member of the Academy, and Jacek Fisiak, corresponding member of the Academy. Professor A. Wiatrak gave an account of the elections to the scientific committees. The Division's chairman reported on the difficulties of performing parametric evaluation in the humanities according to generally accepted criteria. Therefore, the chairman announced that a special team led by Jerzy Brzeziński, full member of the Academy, would be established to set the criteria of evaluation. Moreover, the chairman presented the situation of the scientific units without legal personality in the light of a new project of public finances.

The third session held on 18 October was exclusively an election meeting, at which candidates to become full and corresponding members of the Polish Academy of Sciences were selected. During

the meeting on 22 November the Institute of History was evaluated by Andrzej Wyczański, full member of the Academy, and the Research Center for Mediterranean Archeology was evaluated by Piotr Skubiszewski, corresponding member of the Academy. The Division passed a resolution to establish an Institute of Mediterranean and Oriental Cultures on the basis of two existing units, the Research Center for Mediterranean Archeology and the Center for Studies on Non-European Countries. The candidacy of Prof. Irena Stasiewicz-Jasiukowa for Honorary Chair of the Committee on the History of Science and Technology was approved. Jerzy Brzeziński, the chairman of a team developing criteria for parametric evaluation in the social sciences and humanities, presented a progress report on his team's work, informing the gathering about the subject-matter of scientific research projects. Representatives of the Division were assigned to a board of jurors to select new directors for scientific units whose directors' appointed terms end in 2008. The Division bestowed its scientific awards and distinctions for scientific and organizational activity in 2007. Scientific awards were conferred as follows: the **Fryderyk Skarbek Award in economics** to Dr. Tomasz Tokarski, Professor of Jagiellonian University, for the work *Statystyczna analiza*



Scientific Awards of Division I. From left: Prof. Józef Fiszer, Prof. Stanisław Gajda, Prof. Krystyna Skarżyńska, Dr. Michał Kaczmarczyk, Prof. Stanisława Borkowska, Prof. Stanisław Mossakowski, Prof. Tomasz Tokarski, Dr. Aleksandra Bernatowicz, Prof. Jacek Lech

regionalnego zróżnicowania wydajności pracy, zatrudnienia i bezrobocia w Polsce (Statistical Analysis of Regional Diversification of Labor Efficiency, Employment, and Unemployment in Poland); the **Tadeusz Kotarbiński Award in philosophy** to Prof. Adam Grobler from the University of Opole for the work *Metodologia Nauk* (Methodology of Science); **in art history** to Dr. Aleksandra Bernatowicz from the Institute of Art History, Polish Academy of Sciences, for the work *Niepodobne do rzeczywistości. Malowana groteska w rezydencjach Warszawy i Mazowsza 1777-1820* (The Unreal: Grotesque Paintings in Warsaw and Mazowsze Residences 1777-1820); the **Władysław Witwicki Award in psychology** to Prof. Krystyna Skarżyńska from the Institute of Psychology, Polish Academy of Sciences, for the work *Człowiek a polityka. Zarys psychologii politycznej* (Man vs. Politics: Outline of Political Psychology); the **Ludwik Krzywicki Award in sociology** to Dr. Michał Kaczmarczyk from Gdańsk University for the work *Wstęp do socjologicznej teorii własności* (Introduction to the Sociological Theory of Property). Distinctions for scientific and organizational work benefiting the scientific community were conferred upon the following individuals: Prof. Stanisława Borkowska, chair of the Committee on Labor and Social Policy Sciences in the 1999-2006 term; Prof. Małgorzata Książek-Czermińska, chair of the Committee on Literature Studies in the 1999-2006 term; Prof. Stanisław Gajda, chair of the Committee on Linguistics in the 1999-2006 term; Prof. Józef Fiszer, vice-chair and Scientific Secretary of the Committee on Political Sciences; Prof. Jacek Lech, chair of the Committee on Prehistoric and Protohistoric Sciences in the 2003-2006 term.

In September, in collaboration with the Institute of Literary Research, the Division organized the “Slavic Meetings” Summer School in Warsaw, attended by young researchers from Bulgaria, the Czech Republic, Finland, France, Russia, Ukraine, and Italy. Moreover, the Division together with the Institute of Philosophy and Sociology organized a series of seminars entitled “The Interdisciplinary Character of Social Sciences and the Humanities – Possibilities and Limitations,” with successive meetings devoted to the following subjects: “The Interdisciplinary Character of Social Sciences and the Humanities – An Advantage or a Duty?,” “Sociology and its Experience in Interdisciplinary Disciplines – Unsentimental Outcome;” and “So-

ciology and Philosophy – Social and Academic Contexts.”

The Division has 56 national members of the Academy (33 of whom are full Academy members, 23 corresponding members), plus 36 foreign members. We note with great sorrow that one Division member – René Rémond, foreign member of the Academy – passed away in 2007. The new full members elected last year included Jerzy Brzeziński, Henryk Olszewski, and Stanisław Waltoś, while Stanisław Filipowicz (political sciences), Zbigniew Kwieciński (pedagogy), Aleksander Posern-Zieliński (ethnology), Aleksander Welfe (economics), and Elżbieta Witowska-Zaremba (musicology) became new corresponding members.

The members of Division I published a total of 202 works in 2007 (including 28 authored and co-authored books, 83 chapters in collective works, 101 journal articles) and in **16 cases they acted as editors-in-chief of journals** and publishing series. Moreover, the Division’s members held a number of prestigious scientific, social, and organizational positions; they participated in the work of the Academy’s scientific committees and the scientific councils of the individual institutes. They delivered numerous papers at conferences in Poland and abroad, and **24 members** of the Division **lectured at universities** and other higher education institutions. They **supervised 8 students earning doctorate degrees**, and reviewed the dissertations of numerous doctoral and DSc (*habilitation*) candidates. Andrzej Koźmiński served as rector of the Leon Koźmiński Academy of Entrepreneurship and Management, while Jan Strelau served as vice-rector of the Warsaw School of Social Psychology.

The title of *doctor honoris causa* was bestowed upon the following members of the Division: **Zbigniew Kwieciński** by the Kazimierz Wielki University in Bydgoszcz, **Henryk Samsonowicz** by the University of Wrocław, **Stanisław Waltoś** by the Immanuel Kant State University of Russia, Kaliningrad, and **Zbigniew Radwański** by the University of Szczecin. **Stanisław Filipowicz** received the first rank award granted by the rector of the University of Warsaw for his publication entitled *Demokracja. O władzy iluzji w królestwie rozumu* (Democracy: The Illusion of Power in the Kingdom of Reason).

Karol Modzelewski received the Foundation for Polish Science Award in the humanities, and **Gerard**

Labuda was awarded the prize granted by the Minister of Science and Higher Education for his outstanding scientific achievements.

Jacek Fisiak became a full member of the European Academy of Science, Arts and Humanities in Paris. He was also commended by the Polish Minister of Science and Higher Education for his organizational activity on the State Accreditation Committee.

Prestigious medals were granted to the following individuals: **Jan Baszkiewicz** received the Medal of the University of Warsaw, **Henryk Samsonowicz** earned the Gloger Medal, and **Stanisław Waltoś** received the “*Plus ratio quam vis*” Gold Medal of Jagiellonian University and the Honorary Medal of the National Museum in Kraków.

Other awards, distinctions and honors were conferred upon the following individuals: **Marian Biskup** received honorary citizenship of Elbląg and the Honorary Badge of “Merit for the Warmia and Mazury Province;” **Maria Janion** won the prize granted to “culture creators” by *Polityka* magazine; **Jerzy Szacki** received the prize of the Ksawery and Mieczysław Pruszyński Polish Pen-Club; **Piotr Sztopka** won a prize from the Allianz Insurance Company; and **Andrzej Rottermund** was distinguished with the Commander’s Cross with Star of the Order of Malta and the Commander’s Cross with Star of Italian Solidarity.

Overall, 935 members participated in the work of the Division’s committees in 2007. Last year was a year of reckoning for many Division I committees. They analyzed their own activity, discussed organizational and logistic matters, and planned disciplinary congresses. Special attention was devoted to the newly created **Committee on Financial Sciences** and its new journal *Finanse*. The **Committee on Science Studies** was incorporated into the scientific committees of the Division I, while the Research Committee on Human Migrations and the Polish Diaspora was shifted to the group of committees affiliated with the Presidium of the Academy.

The **Committee on History of Science and Technology** discussed the scientific activity of Charles Linnaeus and a project to publish a bilingual work on “The Contribution of Polish Science and Technology to World Heritage.” Its Commission on Social Sciences co-organized the conference “The Beginnings of Knowledge on China in Poland.”

The **Committee on Linguistics** discussed the list of ranked linguistic journals and the possibility of making linguistics a separate field of study, independent from philology. Its Commission on Stylistics, together with the Institute of Polish Philology at the University of Białystok, co-organized a conference devoted to “Meaning and Style,” while the Dialectological Commission organized an International Dialectological Conference on “Today’s Dialects: Four Dialectological Contexts.”

The members of the **Committee on Demographic Studies** discussed its current activity as well as demographic processes and phenomena. The Section of Demographic Analyses co-hosted a conference entitled “The Influence of Demographic Processes on the Nature of Human Resources – Present State and Future Perspectives,” where participants (J. Józwiak and I. Kotowska) pointed out the methodological problems of conducting research on demographical changes in Europe and their impact on the economy.



Symposium of the Standing Joint Commission of Economists of the Polish Academy of Sciences and Russian Academies of Sciences (M. Baranowski)

The **Committee on Economic Sciences** met to discuss the strategy of transforming the Polish countryside and agriculture, as well as the scale effect and economic growth. The Standing Joint Commission of Economists of the Polish Academy of Sciences and Russian Academies of Sciences held its 17th Symposium on “Conditions for Shifting Poland and Russia Towards Innovative Development,” at which L. Nikiforov and T. Kuznietsova delivered their papers on “Partnership, Private State, and the De-

velopment of Innovative Processes in the Russian Economy;” I. Bukina delivered a paper on “Tax Stimulation of Innovative Activity;” U. Płowiec presented a paper on “Political and Social Conditions in Developing Poland’s Innovative Capacity;” and E. Mączyńska talked on “Innovations vs. the Job Market.”

The **Committee on Ethnological Sciences** devoted its session to the following issues: preparing a publication for the 2008 International Ethnological Congress in China, the functioning of the faculty of ethnology at the University of Szczecin, and the need for analyses and expert opinions concerning the current state and development of ethnological sciences in Poland. The committee co-hosted a conference on “The Anthropological View on Globalization: Experiences and Challenges.”

The members of the **Committee on Philosophical Sciences** talked about preparations for the Polish Convention of Philosophers and evaluated recommendations for the Prime Minister’s Award in several categories. The committee decided to nominate Division I for the Tadeusz Kotarbiński Award in philosophy.

The **Committee on Historical Sciences** addressed issues of historians’ participation in the International Congress of Historical Sciences and discussed a paper entitled “Methods and Criteria of Scientific Promotion.” Its Numismatic Commission during its open meeting presented an “Announcement of the International Session on Byzantine Coins in 5th- to 10th-Century Central Europe.”

The **Committee on Cultural Studies** dealt with the preparations for the 1st Cultural Studies Congress and discussed the specific nature of surveys conducted in the history of culture (K. Modzelewska). The Committee was a co-organizer of a conference on “Change in Culture” in Wrocław.

The plenary sessions of the **Scientific Committee on Ancient Culture**, the **Committee on Oriental Studies**, and the **Committee on Legal Sciences** were wholly devoted to the presentation of papers and to the discussion of their substance.

The **Committee on Literature Studies** focused on a bill to amend the authorship law, new parametric evaluation, recommendations to the Nobel Prize Committee, and conference and publishing plans. The Committee co-organized a conference on “Bolesław Prus – Modern Writer,” which took place in Kazimierz Dolny.

The **Committee on Labor and Social Policy Sciences** raised the following topics for discussion: the problem of excluding the disabled from society, the problem of pension safety, the current state of affairs and the Polish Academy of Sciences plan of action. It co-organized the following conferences: the 25th Anniversary Social Policy Conference entitled “Social Policy: Research, Didactics, Development,” “Labor Quality in Human Resources Management,” “Regional Policy with Regard to Aging Society,” and “Human Resources Management at the Outset of the 21st Century: Macroeconomic and Regional Aspects.”

The **Committee on Organizational Management Sciences** discussed the problem of educational standards at management faculties with a special interest in “Management Sciences.” Conferences devoted to “Management Sciences in Poland: Current State and Future Perspectives” and “Intercultural Management” were organized under the auspices of the Committee.

The **Committee on Art Studies** focused on substantive issues within its scientific disciplines. The Committee acted as co-organizer of the International Symposium entitled “*De la mort au tombeau. Les pratiques ceremonielles*” (From Death to Grave: Ceremonies in Practice).

The **Committee on Pedagogical Sciences** reviewed its current activity, the form and scope of an expert report on the state of education. The Committee co-hosted conferences on “Pedagogy with Regard to the Antinomy of Education and the Job Market” and “Education, Process Definition, Processes, and Contexts.”

The plenary session of the **Committee on Political Sciences** was devoted to the internal situation and foreign policy of Poland in the years 2005-2007, Poland’s place in the European Union from the political, economical, and international point of view, as well as from the standpoint of Polish political knowledge. The Committee co-organized a conference entitled “Poland in the European Union: Opportunities and Threats.”

The **Committee on Prehistoric and Protohistoric Sciences** during its plenary sessions considered organizational matters within its research community and discussed the second rank of archeological journals. It organized a conference on “Polish Archeological Journals in Comparison with European Journals.” Its Commission on the History of Archeology co-hosted an International Conference on

“The History of Archeology and Archeological Thought in the 20th Century,” while the Commission on Medieval and Modern Archeology was an organizer of an International Conference devoted to “Regional Differences in Adornment and Forms of Tiles from the Middle Ages to Modern Times.”

The members of the **Committee on Psychological Sciences** discussed the threats to democracy in Poland, T. Witkowski’s paper “Psychology vs. Pseudoscience,” and a proposed definition of psychological services. This proposal was then included in a letter addressed to the Ministry of Labor and Social Policy. The Committee co-hosted a psychological symposium on “Social Exclusion.”

The **Committee on Theological Sciences** worked on a plan for building the 2nd National Pantheon and a Museum and Educational Center in Kraków. The Committee was the organizer of a conference on “Polish Individuality” attended by participants from abroad.

During the plenary sessions of the **Committee on Science Studies** two conferences were held: “Foresight – A New Instrument of Scientific Policy” and “The Links between the History of Science and the Sociology of Science.” The Section on Methodology of Science organized a conference on “Media in Education – Opportunities and Threats.”

The members of the **Committee on Slavic Studies** at its presidium discussed papers and main issues related to preparing for the 14th International Congress of Slavists in Macedonia. The Committee co-organized a conference on the “Early History of Slavic Languages,” which commemorated Professor Leszek Moszyński.

The **Committee on Sociology** held a debate about papers by K. Kłosiński, J. Mariański, and A. Sułek on the ethical problems of doing sociology. The Committee was a co-organizer of the 13th Polish National Sociological Conference in Zielona Góra.

The **Committee on Statistics and Econometrics** considered M. Szreder’s paper “Selected Aspects of the Statistical Education of Society.” The first “Aleksander Zeliaś National Scientific Conference,” the 34th International Conference on “Macromodels 2007,” and Doctoral Workshops in Econometrics and Statistics were all held under the Committee’s patronage.

Overall, the Division’s Committees published 34 journal titles with a total circulation of 47,610 copies, 5 publication series, 23 journals, and 8 books.



Prof. J. Lech delivers a paper at the conference on “Polish Archeological Journals in Comparison with European Journals,” held on 11-12 October, 2007, chaired by A. Buko (F.M. Stępniewski)



An International Conference on “The History of Archeology and Archeological Thought in the 20th Century.” Among the participants, in a wheelchair, is Lady Mollie Clark (W. Piotrowski)



A psychological symposium on “Social Exclusion”

Issues of the following journals were published: *Onomastica* by the **Committee on Linguistics**, *Studia Demograficzne* (Demographic Studies) by the **Committee on Demographic Studies**, *Przeszłość Demograficzna Polski* (Poland's Demographic Past) by the **Committee on Demographic Studies**, *Ekonomista* (Economist) by the **Committee on Economic Sciences**, *Wiadomości Numizmatyczne* (Numismatic News) by the **Committee on Economic Sciences**, *Przegląd Kulturoznawczy* (Overview of Cultural Studies) vol. 1 by the **Committee on Cultural Studies**, *Meander* by the **Scientific Committee on Ancient Culture**, *Problemy Polityki Społecznej. Studia i Dyskusje* (Social Policy Problems – Studies and Discussions) by the **Committee on Labor and Social Policy**, *Organizacja i Kierowanie* (Organization and Management) by the **Committee on Organizational and Management Sciences**, *Rocznik Orientalistyczny* (Oriental Studies Yearbook) by the **Committee on Oriental Studies**, *Rocznik Historii Sztuki* (History of Art Yearbook) by the **Committee on Art Studies**, *Rocznik Pedagogiczny* (Pedagogical Yearbook) by the **Committee on Pedagogical Sciences**, *Państwo i Prawo* (State and Law) by the **Committee on Legal Sciences**, *Polish Psychological Bulletin* by the **Committee on Psychological Sciences**, *Studia Psychologiczne* (Psychological Studies) by the **Committee on Psychological Sciences**, *Slavia Orientalis* by the **Committee on Slavic Studies**, *Pamiętnik Słowiański* (Slavic Chronicle) vol. 1 and 2 by the **Committee on Slavic Studies**, *Rocznik Slawistyczny – Reveue Slavistique* (Slavic Studies Yearbook – Reveue Slavistique) by the **Committee**

on Slavic Studies, *Studia Socjologiczne* (Sociological Studies) by the **Committee on Sociology**, *Kultura i Społeczeństwo* (Culture and Society) by the **Committee on Sociology**, *Przegląd Statystyczny* (Statistical Overview) by the **Committee on Statistics and Econometrics**, *Zagadnienia Naukoznawstwa* (Problems of Science Studies) by the **Committee on Science Studies**.

New volumes in the series published by the Committees included: *Prace Komitetu Nauk Etnologicznych* (Papers of the Committee on Ethnological Sciences) vol. 15 entitled “Plemię, państwo, demokracja” (Tribe, State, and Democracy) by the **Committee on Ethnological Sciences**, *Rozprawy Literackie* (Literary Treaties) vol. 85 entitled “Przez skreślenie do kreacji. Analiza procesu twórczego” (Through Cross-off to Creation – Analysis of the Process of Creation) by the **Committee on Literature Studies**, *Kolokwia Psychologiczne* (Psychological Colloquia) vol. 16 entitled “Psychologia wobec dylematów współczesności” (Psychology with regard to the Dilemmas of the Present) by the **Committee on Psychological Sciences**, *Traktaty* (Treatises) and *Studia Nauk Teologicznych* (Studies on Theological Sciences) both edited by Prof. M. Rusecki from the **Committee on Theological Sciences**, *Polska – Unia Europejska – Świat; Sytuacja wewnętrzna w krajach postkomunistycznych Europy i Azji oraz ich polityka międzynarodowa w latach 2006-2007* (Poland – The European Union – World: Internal Situation in Postcommunist Countries of Europe and Asia and their International Policy in 2006-2007) by the **Committee on Political Sciences**.

Kaplica Zygmuntowska (1515–1533). Problematyka artystyczna i ideowa mauzoleum króla Zygmunta I

(The Sigismund Chapel (1515-1533) – Artistic and conceptual issues of the mausoleum of King Sigismund)

S. Mossakowski | Institute of Art | Polish Academy of Sciences

This volume, the result of research initiated by the author over a quarter of a century ago, is a monograph on the Sigismund Chapel at Wawel Cathedral in Kraków. The chapel is an extremely valuable example of Polish Renaissance art and architecture,

as well as being a very important work of art on the European scale. The chapel has been the focus of interest for successive generations of scholars for over a hundred years, yet the issues it poses still seem inexhaustible.



The subject of the book is the mausoleum of King Sigismund in the shape given to it by the king, its founder, and excluding all of its later transformations, beginning with the changes made in the latter half of the 16th century. A detailed analysis is given of such issues as the origin of the architectural forms and sculptured ornamentation of the building, the artistic formation of the chapel's creator, Bartolomeo Berrecci, and his Italian collaborators, and the classification of the stylistic features of the building. The book presents a number of new conclusions regarding the chapel, its creator and his collaborators, the environment in which their skills developed, and finally, the place of the Wawel chapel in the history of Polish and European Renaissance architecture and sculpture.

The most important outcomes of the research are: a more precise chronology of work on the chapel based on a new interpretation of the source material; a precise formal analysis of the original parts of the chapel's ornamentation and an attempt to establish their authorship; the discovery of traces of Berrecci's work in his native Florence, as well as establishing the environment which shaped the artistic development of the chapel's creator and his collaborators. Particular emphasis should be given to the presentation of genetic links between the structure at Wawel and works by such luminaries

as Michelangelo, Raphael or Antonio da Sangallo the Younger, which point to the important position of Wawel Chapel in the history of European architecture and Renaissance sculpture. This presentation of the full extent of the links between the chapel's ornamentation and the antique Roman art familiar to Renaissance artists, plus an explanation of the conceptual sense of using antique motifs in the mausoleum of King Sigismund I, are particularly significant achievements of this volume. Another important achievement lies in the presentation of the gradual changes in the chapel's ideological program during its construction, and the role played by the king both as the originator of the project, and also as a co-creator of the chapel, who took decisions regarding not only its ideological content, but also those affecting the choice of artistic forms, particularly in respect of the purposeful "antiquisation" of the work.

References

- Mossakowski S. (1986). Zmiany kamiennej dekoracji rzeźbiarskiej kaplicy Zygmuntowskiej przy katedrze krakowskiej w XVIII i XIX w. [Changes in the Stone Sculpture Decoration of the Sigismund Chapel in Wawel Cathedral in the 18th and 19th Centuries]. *Kwartalnik Architektury i Urbanistyki*, XXXI, 3-4, 223-277.
- Mossakowski S. (1986). Proweniencja artystyczna twórczości Bartłomieja Berrecciego w świetle dekoracji Kaplicy Zygmuntowskiej. [Artistic Provenance of the Work of Bartolomeo Berrecci in the Light of the Sigismund Chapel Decorations]. *Biuletyn Historii Sztuki*, XLVIII, 2-4, 165-191.
- Mossakowski S. (1993). Bartolomeo Berrecci à Cracovie: la chapelle Sigismond, *Revue de l'Art*, 101, 67-85.

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U schyłku życia. Starość mieszkańców wsi Beskidu Śląskiego i Podhala

(The twilight of life – Old age among village residents in the Silesian Beskid and Podhale regions)

U. Lehr | Institute of Archeology and Ethnology | Polish Academy of Sciences

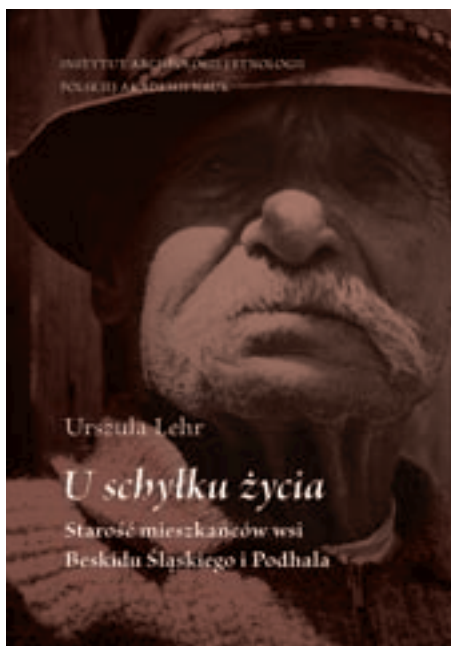
This study, the first publication of its kind in Polish ethnography, is dedicated to the subject of old age in its social and cultural dimension. The ethnographic material is drawn from two mountain village communities (mostly Roman Catholic) situated in the Carpathian mountains in southern Poland (Istebna in the Silesian Beskid region with a small number of inhabitants belonging to the Evangelical Church, and Małe Ciche in the Podhale region with all Catholic residents).

The main thesis of the work concentrates on the creative and reconstructive role of the elderly in rural life. It concerns both everyday activities (farming and household chores) and different fields of cultural activity: customs and rituals, social relationships, and cultural transmission. The final phase of life is analyzed in terms of cultural patterns and the role and position of the elderly in both the family and local community. The latter is illustrated by attitudes towards seniors in their years of illness, senility, and disability.

Patterns relating to old age have been described and analyzed both as part of contemporary rural culture and in retrospective. The author aimed to explain how attitudes towards old age and the elderly have been influenced by historical factors and how they are related to regional variants of rural culture and religious differences. This multi-faceted approach, with special emphasis on the functional stance, was meant not only to fill a gap in ethnological descriptions but also to modify the current stereotype underestimating the role of older generations in the transmission of cultural heritage.

The main problems discussed in this publication refer to:

- cultural patterns of old age as manifested in customs and ceremonies. This convention includes forms of verbal communication as well as signs in the system of non-verbal communication (visual and behavioral).
- traditional functions and occupations assigned to the elderly (senior shepherds, midwives, therapists and herbalists, masters of ceremony at funerals), pointing to social prestige and authority growing with age. Folk beliefs and superstitions indicated that the final phase of human life was considered mediatory – between this world and the next. Old age was the topic of different forms of folklore.
- the roles and functions of seniors within cultural space like home and family, farm, neighborhood, and village. Everyday life and holidays (rituals of life and annual cycle) were considered. This picture is completed with a presentation of the ways seniors rest, spend their leisure time, and what their religious life is like. They are still an active part of the local community, guided by traditional values (work, land, faith) which have persisted in their ethos. They guard traditional customs and rituals, participate in them, and transmit them to their grandchildren.
- mutual relationships of the local community and its senior members. The elderly engage in nu-



merous forms of social and cultural activity – verbal activity (giving advice), as well as artistic creation and folkloristic events. Nowadays old age is increasingly recognized by villagers and local authorities as a difficult phase in life; jubilee celebrations and other kinds of religious and non-religious meetings are held for seniors.

- family and local ties, of vital significance for the elderly. Such ties are strong in the villages in question, where extended families are still popular. Those villages are organized around “squares” i.e. separate neighborhoods with close-knit network of relationships resembling great families (Istebna) and social groupings of similar character in the village of Małe Ciche (lineages), characteristic for the region of Podhale. Among the various ties of solidarity there are some which take the form of responsibility for everyone who is elderly, senile, sick, or disabled.

- illness and infirmity. Elderly individuals in both villages can find care and support in their families, owing to traditional and religious norms governing the local people’s behaviors. The problem of receiving such care is especially vital for childless and lonely individuals. According to traditional norms, such people can count on aid from their relatives and neighbors. Another solution, also a continuation of old customs, is for childless individuals to become foster parents, thus securing care for themselves in old age. In keeping with traditional peasant customs, the basic form of security for elderly parents was known as *dożywocie*, or annuity. While the same procedure remains present, nowadays there is another, more stable form: various kinds of benefits and old age pensions for elderly farmers provided by the state social insurance system.

The residents of the villages studied by no means regard the final phase of life as a stage of decline and social degradation. Elderly individuals’ status in the family, sense of being useful, and active way of life have contributed to this attitude. Above all, they

seem to distance themselves from the disadvantages of old age.

The social differences assumed at the beginning of the research turned out not to influence attitudes towards the elderly. Rather, those attitudes have been formed by tradition, religious norms, and family socialization, which were the same in each of the villages. These norms include respect for the elderly (regardless of their financial situation or assets), a sense of responsibility, strong family ties, and a still-extant solidarity among neighbors. All this, as well as large family ties, are the *differentia specifica* of the village communities in question.

References

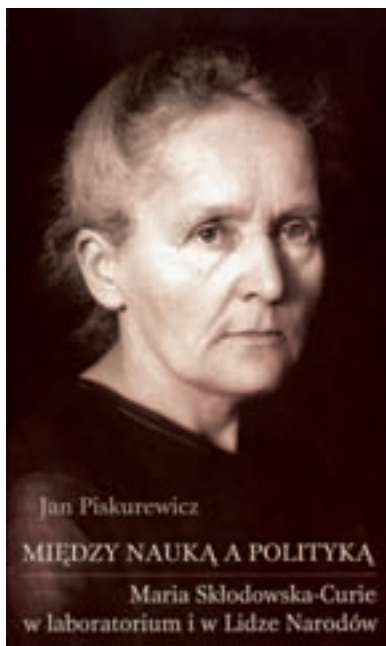
- Lehr U. (2003). Oblicza starości. [The Face of Old Age]. *Etnografia Polska*, vol. 47, 1-2, 71-102.
- Lehr U. (2004). Old Age: The Memory of Generations. [In:] A. Paládi-Kovács (ed.) *Times, Places, Passages. Ethnological Approaches in the New Millennium. Selected Papers of the 7th SIEF Conference*, (Akadémiai Kiadó, Budapest, Institute of Ethnology, Hungarian Academy of Sciences), Budapest, 362-367.
- Lehr U. (2006). Niekochani zmarli. [The Unloved Deceased]. *Etnografia Polska*, vol. 50, 1-2, 243-266.
- Lehr U. (2007). Jestem głodny(a). Przestrzeń jako kontekst zdarzeń codziennych. [I’m Hungry: Space as a Context of Everyday Events]. *Lud*, vol. 91, 207-229.

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Maria Skłodowska-Curie – Between science and politics. A forgotten agenda

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This book probes an unknown and forgotten field of activity pursued by Madam Curie. Apart from her research, which earned her a double Nobel Prize in 1903 and 1911, she was also a trend-setter in organizing and managing scientific programs, in the practical application of research results, in training university students, and – above all – in the scholarly life of her own academic milieu, simultaneously



in France and abroad. Her exceptional skills might be seen in a brighter light and more clearly when we compare her activities on the microscale (in her lab) vs. the macroscale (in the international lime-light). She was confident and strongly concerned, as she expressed it, that her duty was to “counteract scientific anarchy on a worldwide forum.” That

meant not just the worldwide coordination of research, but also and equally the harnessing of its results as an instrument for strengthening closer bonds between intellectuals, mostly from European circles, in their efforts for peaceful international cooperation. Madam Curie’s status in scholarly life ensured her a unanimously privileged position on this last issue in particular, but her achievements in this field – such as her activity in the League of Nations – are nearly forgotten today. This study marks the first time all of these issues have been addressed and explained based on unknown or rarely used archival records, i.e. epistolography, official documents, and memoirs. This forgotten agenda of Madam Curie reveals to us her true personality as a fascinating woman and a sensitive and wise human being.

References

Piskurewicz J. (2007). *Między nauką a polityką. Maria Skłodowska-Curie w laboratorium i w Lidze Narodów*. [Between Science and Politics – Maria Skłodowska-Curie in the Laboratory and League of Nations]. Lublin, Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej, 248.

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Contemporary changes in spatial variations in the level of socio-economic development of rural Poland

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For historical reasons, Poland is a country exhibiting great spatial variations in the level of socio-economic development. The existing lines of regional division largely coincide with 19th-century borders and also result from shifts in borders after World War II. In the 19th century each of the three parts of occupied Poland developed in different fashion. The most important rural reform, whereby the serfs' dependence was abolished and peasants were granted property rights to the land they worked, proceeded differently in each of the annexed Polish territories. The policies pursued by the occupying powers – Prussia, Russia, and Austro-Hungary – differed from each other and this led to the emergence of different economic structures, different legal and educational systems, and different patterns of relationship between rural areas and local towns. The shifts in borders after World War II resulted in mass migrations connected with the need to settle Poles in former German territories and to develop these areas quickly.

Generally, all research studies show that Poland's eastern part is less developed than its western regions and that socio-economic problems are concentrated in the country's eastern border areas and areas whose economies were dominated by state-owned farms until 1989. However, the social and economic problems of these areas are of differing nature.

This research project implemented by the Institute of Rural and Agricultural Development aimed to identify whether spatial variations in the level of socio-economic development of rural Poland were increasing, decreasing, or undergoing other changes as a result of the economic policy carried out in the pre-accession period. Such policy included a number of instruments designed to enhance cohesion, one of them being equalization payments, i.e. schemes which tax richer communities to support poorer ones. On the other hand, market economies exhibit a tendency to exploit either location rent, associated with proximity to urban markets and a high development level previously achieved (e.g. existing infrastructure, high-quality workforce) or backwardness rent (e.g. lower labor costs, cheaper

land). The actual geographical distribution of socio-economic transformation dynamics is the product of many factors which are difficult to measure.

This research attempted to identify relationships among the existing level of socio-economic development, the dynamics of socio-economic transformation, and the activity of local authorities in exploiting the economic policy instruments avail-

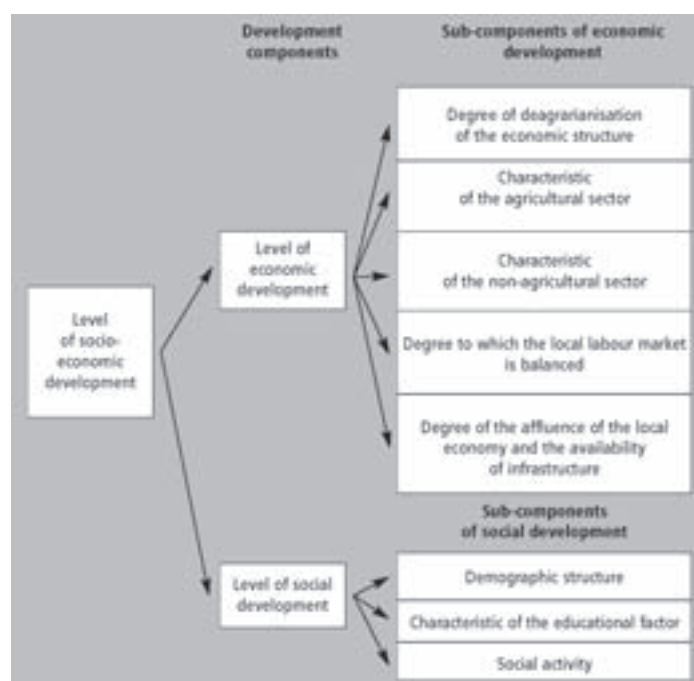


Fig. 1. Structure of the notion of socio-economic development as adopted for the purpose of this analysis

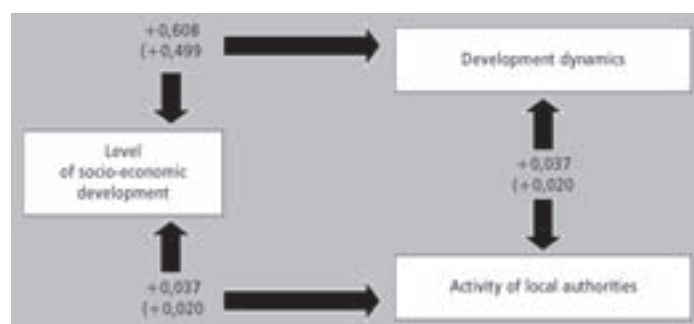
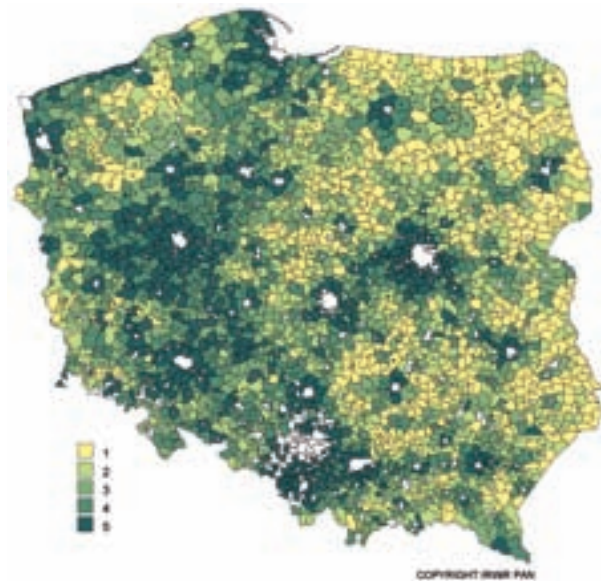
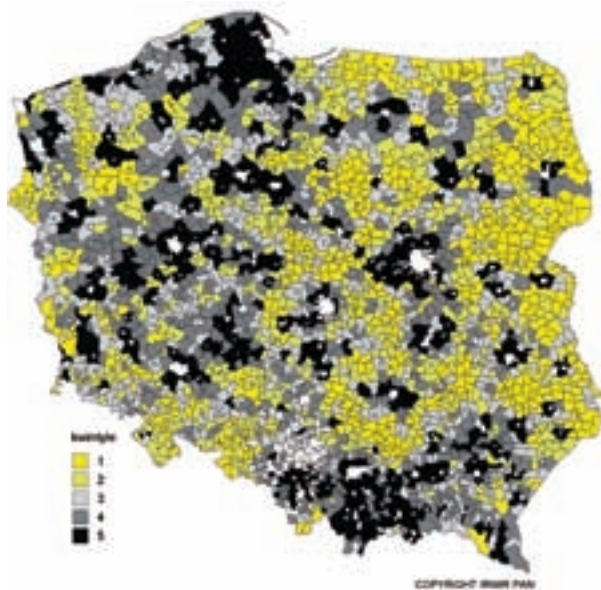


Fig. 2. Correlations among the three main variables, obtained via two different statistical methods. The study employed two different methods so as to verify the assumptions adopted



Map 1. Spatial variations in the level of socio-economic development



Map 2. Spatial variations in development dynamics

able to them. The study encompassed 2171 rural communes and rural parts of so-called rural-urban communes.

The development level of each of the units analyzed was determined on the basis of available statistical data. The operational definition of this value was based on a measurement involving eight sub-components grouped into two components (economic and social). Each used a set of appropriately weighted empirical indicators. Figure 1 shows in the most general way how the measure of development level was constructed.

The remaining main variables – i.e. transformation dynamics and the local authorities' degree of activity in pursuing economic policy – were determined on the basis of a wide range (over 40) of empirical indicators appropriately grouped and weighted.

Figure 2 and Map 1 show the most general outcome of the analysis made.

The main findings of the study are as follows:

- Although cohesion policy (aimed at equalizing opportunities) is pursued in Poland, disparities between highly developed and relatively backward regions tend to increase.

- The historically determined spatial variations in development level are now increasingly modified by a new criterion associated with the core-periphery continuum. At present, Poland's most developed rural areas are suburban zones located around large cities. The influence of the urban market diminishes as the distance from the city increases. Another factor which has some influence on the shape of the suburban zone is the location of the main transport routes. The influence of the urban market is stronger in areas situated along such transport routes and weaker in areas situated farther away.

- In the case of medium-sized cities, the issues of whether highly developed suburban zones emerge around them or not and how large such zones are depends on how well the structure of the city's economic function is developed. Such zones emerge around cities with a well developed structure of urban functions, and are much smaller or do not emerge at all around monofunctional cities whose economies rely on a single industry or a single large industrial plant.

- Peripheral areas, located remotely from the main urban centers, develop at a slower pace than suburban zones and intermediary zones. These areas experience depopulation trends (decreasing population density, steady out-migration of young people, relatively fast population aging) and a slower pace of development in their non-agricultural economic functions.

- Two factors exert a decisive influence on changes in spatial variations in socio-economic development. One is associated with the broadly-understood notion of location rent, especially easy access to urban markets. The other factor is associated with cohesion policy instruments. The impact of the latter factor is much weaker than that of the former. This study has shown that the third factor, i.e. the

degree of activity on the part of the local authorities, plays only a marginal role. There are two possible explanations: either the instruments which local authorities have at their disposal are insufficient or they need a long time to yield effects, something which this project was unable to identify.

References

- Golinowska S. (2004). *Out of Concern for Jobs – Report on Social Development in Poland 2004*. UN Program, Warsaw.
- Nurzyńska I., Wilkin J. (2006). *Polish Village 2006 – Report on the Condition of the Countryside*. Foun-

ation for the Development of Polish Agriculture, Warsaw.

- Rosner A. (2002). *Countryside Areas of Development Barriers Commutation*. Institute of Rural and Agricultural Development, Warsaw.

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The heritage of gentry culture in the former Grand Duchy of Lithuania: A vestigial aspect of European culture on the verge of total extinction

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Until the Second World War the Lithuanian gentry held onto its cultural distinctions in relation to the peasantry, which resulted in shaping a kind of homogenous and closed community. Strong consolidation and the drive for autonomy were characteristic factors of the gentry in all territories of the former Grand Duchy of Lithuania (currently the Lithuanian and Belarusian republics). Contemporary research conducted in Belarus and Lithuania confirms that such a way of thinking remains preserved in the mentality of the older generation.

This consciousness is based on the idea of the gentry's cultural exclusiveness and its superiority over peasant culture. The gentry is distinguished from the peasantry by possession of a multigenerational cultural memory which includes a myth of descent (genealogical) and an imagined history in the form of *realms of collective memory* (e.g. connected with the November and January Uprisings).

Members of the Lithuanian and Polish (from Mazowsze and Podlasie regions) gentry possess the

same systems of values and attitudes. The most important cultural components of all gentry strata are: community spirit, homogeneity, identity, honor, and religiousness.

What distinguishes the Lithuanian gentry from the Polish (Mazowsze, Podlasie) gentry is the presence of other ethnic/national cultures and its existence outside of Poland. There is a huge problem with national identification and choice of language in multiethnic conditions. All minor gentry in both the territories researched identify with *Polishness* and adopt a patriotic stance as part of honorable attitudes.

The Polish language was always an indicator of nationality and an attribute of social class or estate (gentry), and thus the synonymic triad *Pole – gentry member – Polish speaking* still functions in the consciousness of older informants. A characteristic drive for preservation of group self-identity and strong support for Polishness connected with honorable attitudes result in community self-protection from others, an aversion to other national groups, and



a lack of understanding for their aspirations. This exclusive attitude is strengthened by the fact of the Polish national group's marginalization in Lithuania and the attempts made in recent years by Aleksander Lukashenka's regime in Belarus to portray the Polish minority as a group of criminals. Consequently, the culture of the Lithuanian gentry becomes "the bulwark" of national values and there is a real danger that ideas and values derived from the gentry culture may be easily exploited by nationalist political orientations.

Among the wealthy "testified" gentry in Lithuania, alongside persons with pro-Polish or pro-Lithuanian attitudes, there is a group with a double identity referring back to the Grand Duchy of Lithuania. The statutes of the Lithuanian Royal Union of Nobility and an analogous institution in Belarus state that the aim of their activities is to promote and develop Lithuanian and Belarusian national cultures.

Among the petty gentry, national attitudes are totally different. Rejection of Polishness is in that case equal to the exclusion of such a gentry member from his social stratum.

The petty Lithuanian gentry considers its own language to be Polish, which we studied from the historical and sociological perspectives. Within this

gentry-spoken Polish we identified some archaic elements and convergences with the Polish dialectal area and old Ruthenian-Lithuanian borrowings characteristic of the communicative community in the Grand Duchy of Lithuania. It is thus a common aspect for the Podlasie and Lithuanian gentry to create their own distinctions by means of language. The gentry language is far and wide a cultural fact and a symbol of class distinction.

Finally, resuming our line of reasoning, reflection should be given to what will happen to the gentry heritage when the oldest generation, born before the Second World War, passes away. Therefore, this is *spoken* heritage which is not transferred by cultural transmission and it will elapse with the people who preserve that inheritance in their memory. The language – Polish continuing the gentry sociolect – will also fade away with them.

The Second World War and the following communist period were real cataclysms for the gentry culture, because generational succession ceased. Thus, writing down and describing this spoken heritage is the basic research objective.

Irrespective of questions of national identification and choice of language, Lithuanian gentry culture has not been the heritage of one particular nation but a common good of all the nations of the former Grand Duchy of Lithuania. Honor, freedom and continuity of identity – these are values and ideals of the gentry culture which constitute the foundations for building democratic, open societies in this particular region of Europe.

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Biological Sciences

Division II – Biological Sciences supervises a wide variety of the Academy’s biological institutions and activities. It now comprises 17 institutes (as this year the Institute for Ornithology in Gdańsk became part of the Museum and Institute of Zoology in Warsaw). These institutes employ an overall total of 634 researchers, whose work embraces virtually all fields of biological research, including anthropology, biochemistry, biophysics, botany, cellular and molecular biology, ecology, evolutionary biology, microbiology, neurobiology, paleobiology, parasitology, virology, and zoology. Similarly, the 11 Scientific Committees affiliated with the Division cover a comparably wide spectrum of the biological sciences. By the end of 2007, the Division had 38 national members (20 full and 18 corresponding), plus 26 foreign members of the Academy.

Two plenary sessions of the Division were held in 2007, both in Warsaw. The spring session took place at the Nencki Institute of Experimental Biology, this being the first session under the new term of office of the Academy authorities. The scientific part of the session comprised a lecture entitled “A Renaissance for Mitochondria” given by Prof. Jerzy Duszyński, director of the Nencki Institute. Discussions during the session first and foremost focused around the Academy’s stance regarding GMOs (genetically modified organisms), as well as proposals concerning Academy research centers. Furthermore, the Division accepted new regulations for the appointment of honorary members of the Division’s scientific committees. Prof. Henryk Okarma, director of the Institute of Nature Conservation in Kraków, was also elected Division Representative to the Council of Directors of the Research Units of the Academy for the years 2007-2010.

The autumn plenary session of the Division, in turn, was held in the Palace of Culture and Science. This was an electoral session devoted to the election of new candidates for Academy membership. Two full members, Profs. Jerzy Fabiszewski and Maciej Żylicz, as well as two corresponding members, Profs. Jerzy Duszyński and Jacek Oleksyn, were elected. The members of the Division also voted to accept notification rules on the assessment of the Division’s institutes and research establishments during the

2007-2010 term of office. During this meeting the Division’s Award was given to the team of Prof. Ewa Sikora, Dr. Katarzyna Piwocka, Dr. Adriana Magalska, Dr. Grażyna Mosieniak, Dr. Agnieszka Brzezińska, Dr. Anna Bielak-Żmijewska, Kamila Wolanin, and Małgorzata Śliwińska from the Nencki Institute of Experimental Biology, for their studies on “Molecular ageing mechanisms and cell death.” In addition, honorary mentions were made of Prof. Jerzy Duszyński, Wojciech Brutkowski, Rafał Kozieł, Dr. Joanna Szczepanowska, Dr. Mariusz R. Więkowski, and Dr. Krzysztof Zabłocki – a team from the Nencki Institute responsible for a series of publications on “Mitochondrial metabolism regulation: a focus on calcium homeostasis and apoptosis.”

In 2007 both the Division and its Scientific Committees were involved in the assessment of statutory acts, laws, and by-laws in force in the domains of science financing and nature protection (including the Joint Appeal of the Committees on Botany, Nature Conservation, Ecology, and Zoology in defense of Poland’s threatened natural heritage). Work to transform the International Center for Ecology into the European Regional Center for Ecohydrology was continued under the auspices of



Field station of the Institute of Biology, University of Białystok, Gugny. Scientific session followed by the signing of a declaration of cooperation between the Polish Academy of Sciences and the University of Białystok. From left: Dr. Jan Taylor, Dr. Ada Wróblewska, Dr. Mirosław Ratkiewicz, Dr. Emilia Brzosko, Prof. Andrzej B. Legocki, Prof. Michał Kleiber, Prof. Anatol Kojło, Prof. Zygmunt Reklewski, Prof. Grzegorz Józefaciuk, Prof. Jan M. Wójcik (J. Kupryjanowicz)



4000 Adele penguin couples nest near the Arctowski Polish Antarctic Station during the Arctic summer. For years Adele penguins have been a topic of study by Polish ornithologists, microbiologists, and geneticists (T. Janecki)

the Polish Academy of Sciences and UNESCO. The Division also initiated work to draw up a cooperation agreement between the Academy and the University of Białystok regarding joint investigations of nature in the Biebrza Valley. The Division also accepted a motion calling for the conferment of Honorary Chair titles upon Prof. Włodzimierz Korohoda (Committee on Cytobiology) and Prof. Roman Andrzejewski (Committee on Ecology).

The Committees of the Division also organized or co-organized several research meetings and workshops, such as the 14th Symposium of the International Work Group for Palaeoethnobotany (Committee on Botany), the 5th International Conference on Inhibitors of Protein Kinases (Committee on Biochemistry and Biophysics), the conference

on “Biochemical and Genetic Basis of Neurological Diseases and Novel Therapeutic Approaches” (Committee on Neurobiology), and the 9th International Symposium on Allergenic and Venomous Parasitic Arthropods (Committee on Zoology). The Committees were also involved in organizing special events dedicated to Prof. Rudolf S. Weigl (Committee on Microbiology) and Prof. Włodzimierz Korohoda (Committee on Cytobiology). In addition, the Institute of Antarctic Biology and the Committee on Polar Research co-organized the autumn 2007 session celebrating the 30th anniversary of the founding of the Henryk Arctowski Polish Antarctic Station.



At this ceremony marking the 30th Anniversary of the Henryk Arctowski Polish Antarctic Station, Prof. W. J. Stec, Vice-President of the Academy, gave the Academy's 50th Anniversary Medal to Prof. S. Rakusa-Suszczewski, who accepted it on the Polish Antarctic Station's behalf (T. Janecki)

Critical transitions during plant development are controlled by complex regulatory networks

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The life cycle of plants involves several distinctive developmental phases separated by strictly controlled transition periods. The transition between an initial embryonic phase and the postembryonic seedling phase occurs during germination. The next

transition separates the juvenile seedling phase from the flowering-competent adult vegetative phase. At this stage the plant is ready to enter the transition to flowering, which marks the beginning of the reproductive phase in the life cycle (Fig. 1).

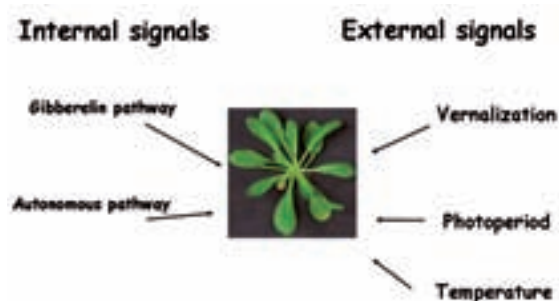


Fig. 1. Signals affecting flowering time

The commitment to flowering requires evaluation of many different inputs coming from both inside (developmental signals) and outside (environmental signals) the plant.

In a model plant *Arabidopsis thaliana*, a central element of the genetic system underlying the ability to integrate different signals is the product of the *FLC* (*Flowering Locus C*) gene, a MADS box transcription factor that represses the transition to flowering (Fig. 2). Expression of the *FLC* gene is subject to complex regulation, part of which depends on chromatin-mediated (epigenetic) mechanisms. Chromatin, a complex of DNA and small basic proteins – histones – residing in the cell nucleus (Fig. 3), in addition to packaging huge quantities of cellular DNA, provides a platform for an intricate system enabling precise control of genes (1, 2). It is now considered a highly dynamic system in which arrays of chromatin's basic structural units, nucleosomes, are often rearranged, disrupted, or removed, with histone proteins modified or exchanged for different variants (3). The regulation of *FLC* involves changes in the status of histone modifications, in particular by acetylation and methylation, and is also dependent on LHP1, the *Arabidopsis* homologue of HETEROCHROMATIN PROTEIN 1 (HP1).

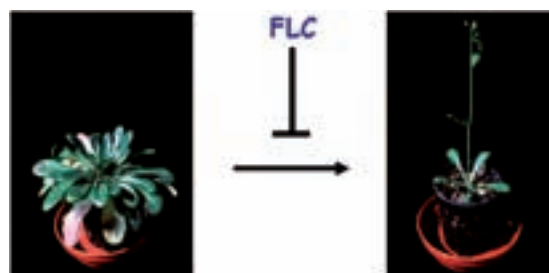


Fig. 2. The product of *FLC* gene is a central negative regulator of flowering in *Arabidopsis*

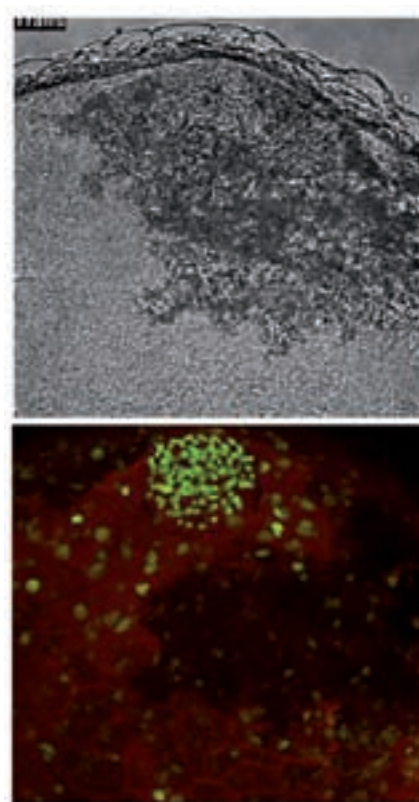


Fig. 3. Flower meristem in *Arabidopsis thaliana*. Upper panel: view under light microscope. Lower panel: green fluorescence of GFP-tagged histone H1 shows the distribution of chromatin in cell nuclei

It is now well documented that in plants and animals both transcriptional and post-transcriptional gene silencing is regulated by a potent system of RNA interference (RNAi). Double-stranded RNA (dsRNA) generated from transcription of one strand of tandem repeats or multiple copies of transposable genetic elements and the occasional transcription of the antisense DNA strand generate dsRNAs which are amplified by the RNAi machinery including an RNA-dependent RNA polymerase (RdRP) function. The dsRNA is cleaved by an enzyme called DICER to produce siRNAs (small interfering RNAs), which are incorporated into a chromatin complex that guides histone modifications, particularly methylation, to regions of the chromatin containing complementary DNA sequence. The siRNAs and chromatin modification complexes are tethered to the silenced loci, so maintaining continued production of siRNAs and the silenced state. In *Arabidopsis*, the production and function of siRNAs mediating the silencing of repeated sequences requires RDR2, DCL3, HEN1, and AGO4 proteins

and two functionally distinct forms of a plant specific RNA-dependent DNA polymerase IV complex, containing either NRPD1a or NRPD1b with NRPD2 proteins. As well as functioning in the control of repeated sequences, RNAi-mediated gene silencing is now being recognized as a potential major regulator of single copy sequences. Intergenic and antisense transcripts are surprisingly extensive in the Arabidopsis, Drosophila and mammalian genomes. However, until recently, their involvement in an RNAi-mechanism regulating single copy endogenous genes was not convincingly documented.

In the last year, our laboratory, in collaboration with the group of Professor Caroline Dean from John Innes Centre in Norwich, United Kingdom, provided important proof that a single copy *FLC* gene is indeed regulated by the RNAi-dependent pathway (4). *FLC* is a target of multiple regulatory pathways that suppress its expression, including cold-induced chromatin remodeling during vernalization, chromatin-mediated gene silencing, and RNA processing. We detected a small 27 nucleotide RNA corresponding to the reverse strand of *FLC* just 3' to the major poly A site. This region lacks any known transposon elements and does not share close homology with any other region in the Arabidopsis genome. The small RNA was absent from mutants defective in RNAi-machinery and was found to mediate DICER-dependent chromatin changes in a localized region of the gene. An antisense RNA was found that covered this region and this RNA contained an intron not present in the sense strand, suggesting it originated from antisense transcription. Mutation of this genomic region led to *FLC* mis-expression and delayed flowering, suggesting that this RNAi-transcriptional gene silencing pathway is a functionally important component of the endogenous pathways which suppress *FLC* expression.

The simplest model to account for these observations is that perhaps through activity of NRPD1a, a putative DNA-dependent RNA polymerase, an antisense transcript is generated that is a target of DICER. The small RNAs would then act to guide chromatin complexes to specific *FLC* sequences and introduce chromatin marks at the nucleosome located at the *FLC* 3' end, which would lead to reduced expression of the *FLC* gene (Fig. 4). Indeed, we have found such chromatin marks in the form of di-methylation of histone H3

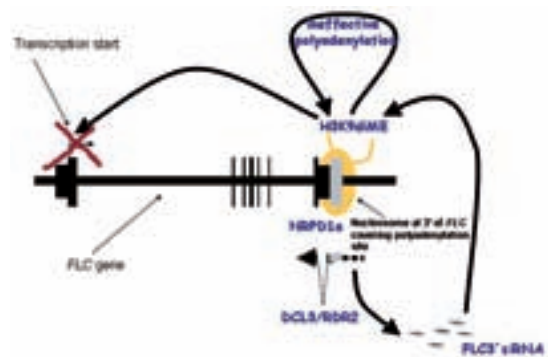


Fig. 4. Schematic representation of the proposed role of small RNAs in regulation of *FLC* gene. Small RNA (*FLC* 3; siRNA) generated via RNAi machinery including NRPD1a, DCL3, and RDR2 induce di-methylation of lysine 9 of histone H3 (H3K9diME) in the nucleosome (yellow) covering polyadenylation site. This in turn prevents effective polyadenylation of the *FLC* transcript and decreases the efficiency of *FLC* transcription

lysine 9 in the 3' region of the *FLC*. Two mechanisms seem plausible to account for the reduction in expression. The first one would involve a reduced level of transcription leading to less *FLC* mRNA being made. The other one could include inefficient polyadenylation of *FLC* transcripts. The coincidence of the small RNA and localized chromatin changes to just a few nucleotides downstream of the major poly A site makes the second possibility an attractive idea.

By showing that antisense transcripts generated from overlapping genes can be directed into RNAi pathways to produce small RNA molecules, which in turn could target complementary chromatin and mediate expression changes of *FLC* gene, our study uncovers a new level of complexity in the regulatory network which controls flowering transition in plants.

References

- Sarnowski T., Rios G., Jasi J., Świeżewski S., Kaczanowski S., Kwiatkowska A., Pawlikowska K., Koźbiał, M., Koźbiał P., Koncz C., Jerzmanowski A. (2005). SWI3 subunits of putative SWI/SNF chromatin remodeling complex play distinct roles during Arabidopsis development. *The Plant Cell*, 17, 2454-2472.
- Sokół A., Kwiatkowska A., Jerzmanowski A., Prymakowska-Bosak M. (2007). Up-regulation of stress-

inducible genes in tobacco and Arabidopsis cells in response to abiotic stresses and ABA treatment correlates with dynamic changes in histone H3 and H4 modifications. *Planta*, 227, 245-254.

Jerzmanowski A. (2007). SWI/SNF chromatin remodeling and linker histones in plants. *Biochim. Biophys. Acta*, 1769, 330-345.

Świeżewski S., Crevillen P., Liu F., Ecker J.R., Jerzmanowski A., Dean C. (2007). Small RNA-mediated chromatin silencing directed to the 3' region of the Arabidopsis gene encoding the developmen-

tal regulator, FLC. *Proc. Natl. Acad. Sci., USA* 104, 3633-3638.

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Trinucleotide repeat polymorphism in human genes

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Protein coding regions account for less than 2% of the total human genome, while as much as 55% is comprised of different types of repetitive DNA. Microsatellites are a family of tandem repeats having short mono- to hexanucleotide motifs repeated many times. Some of these simple sequence repeats occur within gene sequences, including their coding regions, and are polymorphic in length in a normal population. In some genes the repeats may undergo pathogenic expansions and cause a number of human genetic disorders known as Triplet Repeat Expansion Diseases (TREDs).

Although the main interest in the field of human diversity is currently focused on easy-to-genotype

single nucleotide polymorphisms (SNPs), functional variation can be hidden in any type of genetic polymorphism, including copy number variation, as well as different types of tandem repeats, including trinucleotide repeats. The natural polymorphism of triplet repeats is poorly characterized and not easy to predict. In addition, the repeat interruptions, which are defined as either single or multiple substitutions that occur within the repeat tracts, may contribute considerably to the variability of these sequences.

To clarify several important issues regarding the triplet repeat polymorphism, in our study we decided to answer the following questions:

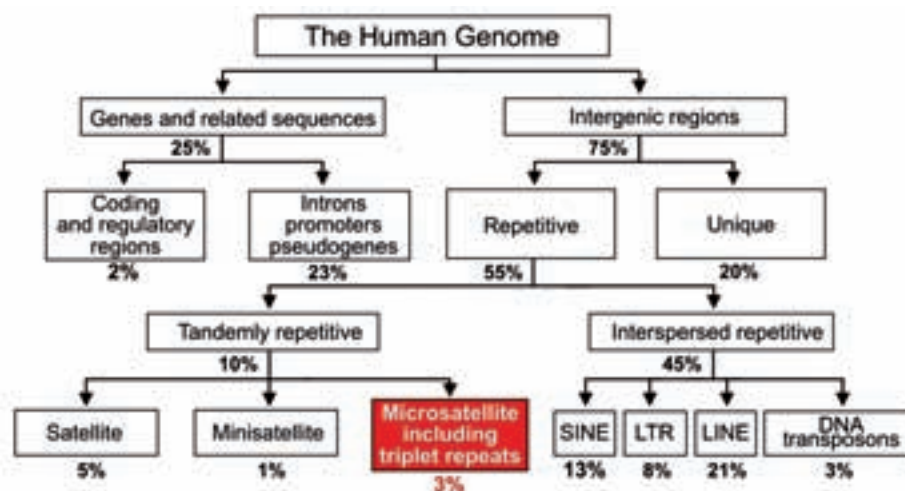


Fig. 1. Composition of the human genome

- What is the length range of different trinucleotide repeat tracts in human genes in a normal population?
- What are the factors determining that some of the repeat tracts are polymorphic and others are not?
- What is the rate of the repeat interruptions within the tandemly repeated sequence, and what types of these substitutions occur most often and what localizations do they prefer?

We addressed these questions experimentally and genotyped the repeat regions in a large number of human genes containing the most frequently occurring CAG and CTG repeats, both uninterrupted and containing various types and configurations of the repeat interruptions. The DNA samples analyzed in this study were from 200 unrelated healthy women representing the Polish population. The genotyping analysis was performed at 103 triplet repeat containing loci, including 92 TREDs-unrelated and 11 TREDs-related. To identify all the sequence variants of the studied repeat tracts, we used a combination of the single-strand conformation polymorphism (SSCP) and heteroduplex (HD) analysis methods.

Our study revealed that in genes other than those implicated in the Triplet Repeat Expansion Diseases, the very long and highly polymorphic repeats are rather infrequent. The length of pure repeat tract in the most frequent allele was found to correlate well with the rate of the repeat length polymorphism, and CAA triplets were shown to be the most frequent CAG repeat interruptions. As both the CAG and CAA triplets code for glutamine, our results may suggest that the selective pressure disfavors the long uninterrupted CAG repeats in genes and transcripts but not the long normal polyglutamine tracts in proteins.

It also appears from this genotyping analysis that the longer the polyglutamine tract, the higher the likelihood that it is encoded by the CAA interrupted CAG repeat rather than by pure CAG repeats. The presence of interruptions in the nucleotide sequences causes important changes in the structures of ssDNA. In DNA, the less stable structures shaped by the interruptions may be more easily tolerated by the cells than those formed by pure repeats, and may also increase the genetic stability of the repeat tracts by shortening the longest pure repeats. In RNA, the interruptions prevent the formation of

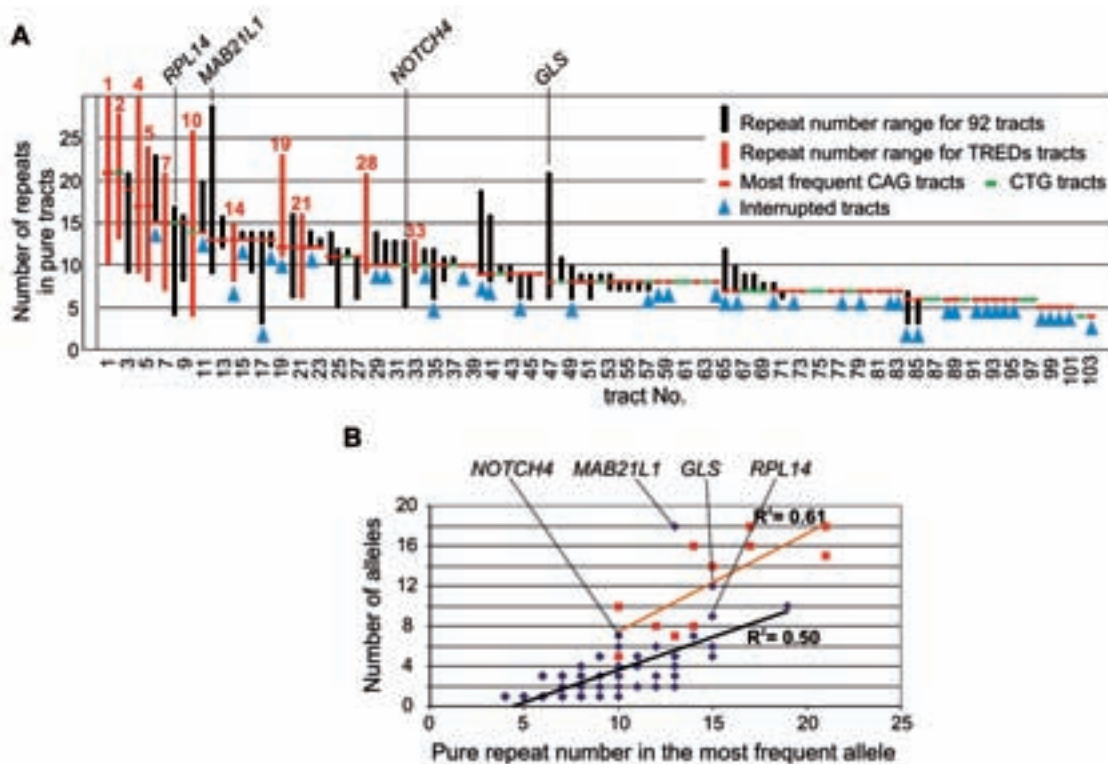


Fig. 2. Differences in repeat polymorphism between triplet repeat tracts in TREDs-unrelated and TREDs-related genes. A: The ranges of repeat number and repeat lengths of the most frequent tracts are shown for 103 tracts (x-axis). B: The relationship between the length of uninterrupted repeat in the most frequent alleles and number of allelic variants

long hairpins by giving rise to branched structures which are unable to interfere with normal RNA metabolism in cells. In contrast, long normal poly-Q tracts in proteins may increase their potential for regulatory functions in gene expression. Thus, the result of our genotyping study allows us to postulate that long poly-Q tracts may be either beneficial or less deleterious to cells than long uninterrupted triplet repeats in DNA and RNA.

References

Różańska M., Sobczak K., Jasińska A., Napierała M., Kaczyńska D., Czerny A., Koziol M., Kozłowski P., Olejniczak M., Krzyżosiak W. J. (2007). CAG and

CTG repeat polymorphism in exons of human genes shows distinct features at the expandable loci. *Hum Mutat.*, 28, 451-458.

Krzyżosiak W.J., Sobczak K., Napierała M. (2006). Structural Characteristics of Trinucleotide Repeats. *Transcripts in Genetic Instabilities and Neurological Diseases*. Wells R. D., Ashizawa T., (eds.) Academic Press, 705-716.

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The brain, the amygdala, emotions, and their memories

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The brain processes and stores a multitude of information throughout its various sub-structures. Some of them, however, appear to specialize in dealing with specific aspects of information. Advancing our knowledge of this phenomenon is of pivotal importance for understanding the workings of the brain.

The amygdala is a heterogeneous brain structure implicated in processing emotions and storing the emotional aspects of memories. Gene activity markers such as c-Fos have been shown to reflect both neuronal activation and neuronal plasticity. Over the last ten years, we have experimentally analyzed the expression patterns of gene activity markers in the amygdala in response to either behavioral training or treatment with drugs of abuse.

In a recent study, we approached the problem of how emotional states displayed by an animal or a human can seriously affect the behavior of their conspecifics. Our study described an experimental rat model of the transfer of emotional information between subjects and its effects on activation of the amygdala. The rats were kept in pairs, with one animal (the “demonstrator”) treated to specific behavioral training of either foot-shock reinforced context conditioning or just exposure to a novel context. We next examined the influence of the dem-

onstrators on the exploratory behavior of their cage-mates (called “observers”) and the observers’ performance of the acoustic startle response. We reported that we were able to distinguish both groups of observers from the control animals (as shown by startle response measure), as well as to distinguish between observers (by means of indexing the exploration) with respect to whether they were paired with demonstrators treated to different experimental conditions. Furthermore, we showed that the observers had most of their amygdala activated (as revealed by c-Fos mapping) to the same level as the demonstrators, and even to a higher level in the case of the central amygdala. Moreover, the level of c-Fos expression in the observers reflected the specific behavioral treatment of the demonstrators they were paired with. This study has thus shown for the first time that undefined emotional information transferred by a cohabitant rat can be evaluated and measured, and that it evokes very strong and information-specific activation of the amygdala.

In another set of experiments we addressed the question of how ethyl alcohol-related cues may induce relapse to heavy alcohol drinking accompanied by molecular adaptations in discrete brain regions. In our study, rats initially trained to self-administer ethanol were next treated to 30-day abstinence

period and then tested for the reinstatement of the ethanol-seeking reaction. Afterwards, a detailed immunocytochemical analysis of activation of transcription factors (c-Fos and c-Jun) and their putative regulators (extracellular signal-regulated kinases and c-Jun N-terminal kinases) was performed within 7 nuclei of the amygdala. We found that the reinstatement test potentiated c-Fos expression within the basolateral and central amygdala. Furthermore, we observed that not only the c-Fos, but also the c-Jun component of AP-1 transcription factor as well as extracellular signal-regulated kinases were co-activated specifically in the basolateral amygdaloid nuclei after the “between-within-session” reinstatement. This observation may suggest that these nuclei are the loci of neuronal plasticity associated with perception of alcohol self-administration and controlled by AP-1 transcription factor and extracellular signal-regulated kinases.

Recently we have confronted our work with the results of the other authors to approach the internal complexity of the amygdala. c-Fos has been most often studied in the amygdala, showing specific

expression patterns in response to various treatments, most probably reflecting functional specializations among amygdala subdivisions. In the basolateral amygdala, c-Fos expression appears to be consistent with the proposed role of this nucleus in the plasticity of the current stimulus-value associations. Within the medial part of the central amygdala, c-Fos correlates with acquisition of alimentary/gustatory behaviors. In the lateral subdivision of the central amygdala, on the other hand, c-Fos expression relates to attention and vigilance, while in the medial amygdala c-Fos appears to be evoked by emotional novelty of the experimental situation. Data on the other major subdivisions of the amygdala are scarce.

In conclusion, studies on gene activity markers, confronted with other approaches involving neuroanatomy, physiology, and the lesion method, have revealed novel aspects of the amygdala, especially pointing to a functional heterogeneity of this brain region which does not fit very well into the contemporary debate on serial vs. parallel information processing within the amygdala.

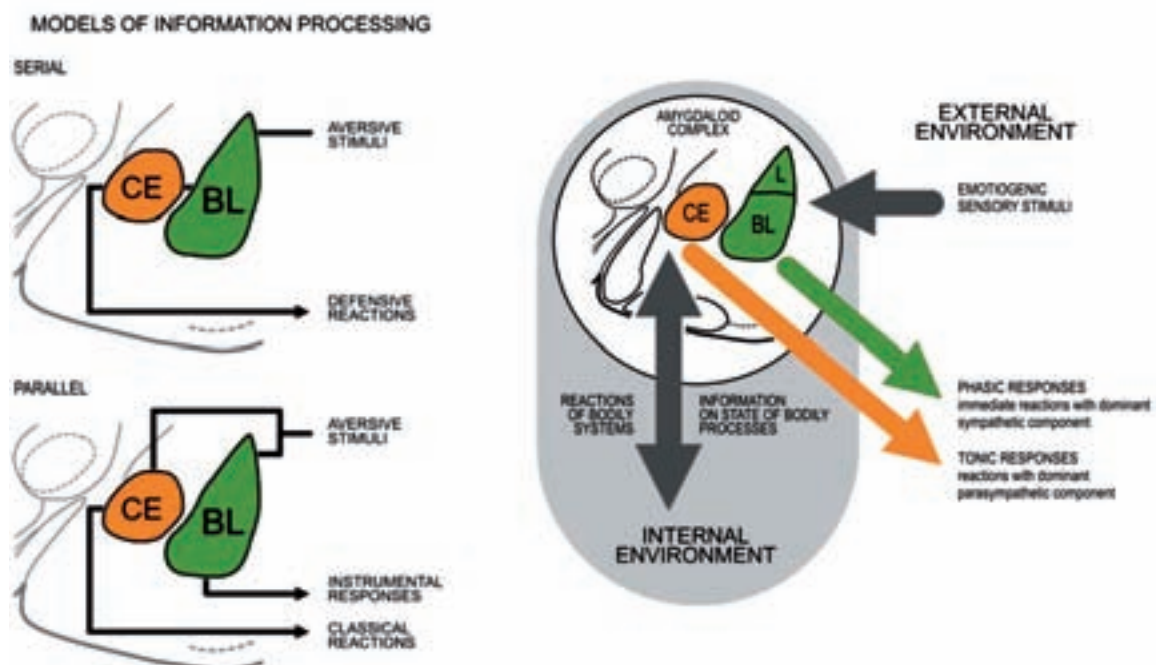


Fig. 1. Information processing by the amygdala. Knapska et al. (2007) challenges dominant contemporary theories of amygdala functions, namely of serial vs. parallel processing. The former assumes that information flows from the basolateral amygdala (BL) to the central one (CE) and then to the subcortical brain structure eliciting body responses; the latter proposes that either central or basolateral amygdala is involved in learning, depending on whether instrumental or classical (Pavlovian) conditioning is involved. Knapska et al. (2007), following an extensive review of the published data, proposes a novel interpretation that plastic changes within the central nucleus of the amygdala mediate tonic behavioral responses, whereas plastic changes in the basolateral amygdala enable phasic behavioral responses

References

- Knapska E., Nikolaev E., Boguszewski P., Walasek G., Błaszczak J., Kaczmarek L., Werka T. (2006). Between-subject transfer of emotional information evokes specific pattern of amygdala activation. *Proc. Natl. Acad. Sci. USA*, 103, 3858-3862.
- Knapska E., Radwańska K., Werka T., Kaczmarek L. (2007). Functional internal complexity of amygdala: focus on gene activity mapping following behavioral training and drugs of abuse. *Physiol. Rev.*, 87, 1113-1173.
- Radwańska K., Wróbel E., Korkosz A., Rogowski A., Kostowski W., Bieńkowski P., Kaczmarek L. (2008).

Alcohol relapse induced by discrete cues activates components of AP-1 transcription factor and ERK pathway in the rat basolateral and central amygdala. *Neuropsychopharmacology*, 33, 1835-1846.

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p66Shc protein as a determinant of the mammalian life span

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The p66Shc protein and its signaling properties have attracted major interest in ageing research in recent years. Since 1999 it has been known that the mammalian life span may be controlled by the p66Shc protein due to the regulation of the cellular response to oxidative stress. Studies on transgenic mice lacking the p66Shc protein showed that mutation in the gene encoding the protein appeared to increase life span by 30%. Interestingly, ablation of the p66Shc gene has no pathological consequences, such as increased tumor frequency or endocrinological abnormalities. The animals have enhanced resistance to oxidative stress [1]. For this reason the p66Shc protein has been recognized as being related to the oxygen radical theory of ageing, which generally states that ageing is connected with the accumulation of ROS-associated damages. The superoxide anion is one of the reactive oxygen species (ROS) involved in this process. Its production in mitochondria during oxidative phosphorylation is connected with a leak of electrons from components of the respiratory chain. The interaction of these electrons with O₂ results in the generation of free radical species. Accumulation of ROS-associated damages results in cell damage, tissue degeneration and, finally, loss of homeostasis, increasing the probability of organism death [2].

The p66Shc protein is an alternatively spliced isoform of the growth factor adapter. Recently, three proteins from the ShcA family have been identified (p66Shc, p52Shc and p46Shc). Each of them contains three functionally identical domains: the C terminal (SH2) domain, the central domain (CH1), and the N-terminal domain (PTB). The p66Shc protein differs from p46Shc and p52Shc by the presence of an additional N-terminal proline-rich domain (CH2) with the serine phosphorylation site, Ser36. Phosphorylation of this residue seems to play an important role in the cellular response to the oxidative stress. It has recently been demonstrated that, in response to UV or H₂O₂ treatment, p66Shc is phosphorylated mainly at serine 36. This kind of phosphorylation is an important step in the initiation of cell death upon oxidative stress and can be mediated by one of the serine-threonine kinases.

The p66Shc-dependent apoptotic pathway is a multi-step process. Briefly, protein kinase Cβ (PKCβ), which is activated by oxidative conditions in the cell, induces phosphorylation of p66Shc. Then, phosphorylated p66Shc is recognized by the prolyl-isomerase Pin1 and triggers mitochondrial accumulation of p66Shc. Once imported, p66Shc perturbs mitochondria structure and function, mainly causing alterations of mitochondrial Ca²⁺ responses and inducing fragmentation of mitochon-

dria. Caspase cofactors, such as cytochrome c, are released and the “mitochondrial” route to apoptosis is initiated.

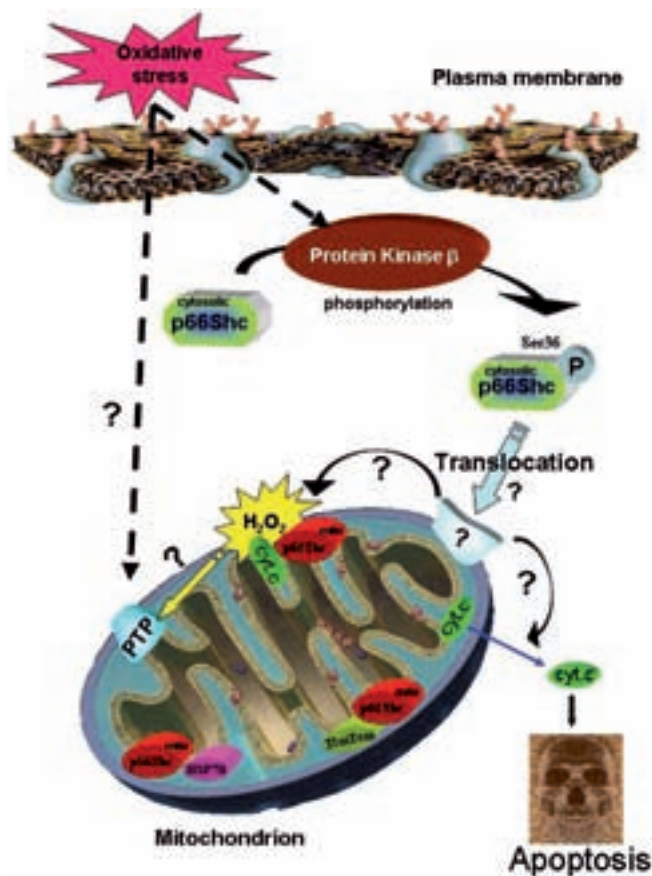


Fig. 1. Signal transduction pathway of p66Shc during oxidative stress. The protein kinase Cβ (PKCβ) induces phosphorylation of the p66Shc protein. Then, phosphorylated p66Shc is isomerized by the prolyl-isomerase Pin1 and translocated to the mitochondria, where it leads to mitochondrial permeability transition pore (PTP) opening. Cytochrome c is released, including apoptosis

Mitochondria play an important role in this process. Under stimulation by physiological agonists or toxic agents mitochondria receive Ca^{2+} signals, which are decoded within them into effects as diverse as stimulation of aerobic metabolism or alterations of organelle structure leading to the release of proapoptotic cofactors into the cytoplasm. Our recent findings indicate that the responsiveness

of mitochondria to Ca^{2+} signals can be modulated by cross-talk with other signaling pathways and the activation of regulatory proteins, such as PKCβ [3].

The molecular pathway presented above, which is probably responsible for the ageing properties of the p66Shc protein, links an oxidative challenge to the activation of p66Shc and the recruitment of mitochondria in apoptosis. Understanding this novel signaling mechanism, which is operative in the pathophysiological condition of oxidative stress, may open new possibilities for the pharmacological modulation of organ deterioration processes during ageing.

References

- Migliaccio E., Giorgio M., Mele S., Pelicci G., Reboldi P., Pandolfi P.P., Lanfrancone L., Pelicci P.G. (1999). The p66Shc adaptor protein controls oxidative stress response and life span in mammals. *Nature*, 402, 309-313.
- Giorgio M., Migliaccio E., Orsini F., Paolucci D., Moroni M., Contursi C., Pelliccia G., Luzi L., Minucci S., Marcaccio M., Pinton P., Rizzuto R., Bernardi P., Paolucci F., Pelicci P.G. (2005). Electron transfer between cytochrome c and p66Shc generates reactive oxygen species that trigger mitochondrial apoptosis. *Cell*, 122, 221-233.
- Pinton P., Rimessi A., Marchi S., Orsini F., Migliaccio E., Giorgio M., Contursi C., Minucci S., Mantovani E., Więckowski M.R., Del Sal G., Pelicci P.G., Rizzuto R. (2007). Protein kinase Cβ and prolyl isomerase Pin1 regulate mitochondrial effects of the lifespan determinant p66Shc. *Science*, 315, 659-663.

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Mathematical, Physical, and Chemical Sciences

Division III – Mathematical, Physical, and Chemical Sciences covers scientific activity in astronomy, physics, mathematics, and chemistry. The Division consists of 75 members of the Academy (46 full members and 29 corresponding members) plus 48 foreign members. It is with deep sorrow that we note that Prof. Bohdan Paczyński, full member of the Academy, passed away in 2007.

Division III coordinates the activity of 14 research institutes (15 in 2006), with 1003 researchers (977 in 2006) pursuing fundamental research in domains represented in the Division as well as in various applied research fields. In 2007 the institutes carried out 1119 (925 in 2006) research projects, 166 (161) of which were foreign. Over the past year, researchers from the Division's institutes published 2063 (2087) papers in refereed journals of international circulation, and the institutes were engaged in editing 14 (14) scientific journals.

Twelve of the institutes affiliated with the Division are authorized to confer doctorate (PhD) degrees, while 11 may confer *habilitation* (DSc) degrees. The institutes run their own four-year post-graduate studies leading to PhD degrees, or participate in such programs conducted by local universities. Scientists from the institutes are also engaged in teaching and joint research programs in collaboration with neighboring universities. The procedures for the nomination of directors for the next term were carried out in 2007. The following professors were nominated: Aleksander Jabłoński at the Institute of Physical Chemistry, Jacek Kossut at the Institute of Physics, Stanisław Słomkowski at the Center of Molecular and Macromolecular Studies, and Andrzej Dworak at the Center of Polymer and Carbon Materials.

Six scientific committees, encompassing 287 members, are affiliated with the Division. Four of them deal with the branches of knowledge represented within the Division – astronomy, chemistry, mathematics and physics – and function on a permanent basis. The other two – the Committee on Analytical Chemistry and the Committee on Crystallography – are appointed for the term of the Academy's Presidium. As bodies representing the entire scientific community, these committees express scientific opinions, discuss research directions,

and are engaged in organizing scientific events and publishing journals. Committees associated with the Division play the role of National Committees within the scope of their disciplines and represent the Polish scientific community among corresponding international scientific organizations.

The institutes and committees of Division III are involved in publishing numerous scientific journals: *Acta Physica Polonica A*, *Artificial Satellites – Planetary Geodesy*, and *Molecular Physics Report* in the domain of astronomy and physics, *Polish Journal of Chemistry*, *Biotechnologia* (Biotechnology), *Chemia Analityczna* (Analytical Chemistry), and *Polish Journal of Applied Chemistry* in the domain of chemistry, *Fundamenta Mathematicae*, *Studia Mathematica*, *Acta Arithmetica*, *Colloquium Mathematicum*, *Annales Polonici Mathematici*, *Bulletin Polish Acad. Sci. Math.* and *Dissertationes Mathematicae* in the domain of mathematics.

During the year the Division was engaged, directly or via its Committees, in the promotion of gifted high school and university students. The International PhD Studies established in affiliation with Division III in 2000 continued this program. The Division's institutes participate in International EU Programs, and specific attention is paid to activities pursued through Centers of Excellence. Close collaboration with scientific societies active in the domains represented in the Division has been continued – particularly contacts with the Warsaw Scientific Society, with which a common seminar on “100 years of Nobel Awards” was organized in 2007.

During the present term of office of the Academy authorities, Division III is headed by Prof. Janusz Jurczak as chairman, and Prof. Jacek Kossut and Prof. Jerzy Zabczyk as deputy chairmen.

Two plenary sessions of the Division were held in 2007. At its spring session, attended by the President of the Academy, Prof. M. Kleiber, and the Vice-President of the Academy, Prof. W.J. Stec, the Division accepted its activity program presented by Division III Chairman, Prof. J. Jurczak, and several divisional commissions were elected for the term 2007-2010. At the fall session, the Division elected four candidates (Professors W. Pleśniak, K. Redlich, M. Witko, H. Woźniakowski) to become corresponding members and three candidates (Professors

W. Dziembowski, W. J. Stec, H. Szymczak) to become full members of the Academy.

As is traditional, the Division granted its annual prizes. In 2007, the prestigious M. Skłodowska-Curie Award was bestowed upon Prof. Jakub Zakrzewski from the Institute of Physics at Jagiellonian University for research on correlation in multibody systems. The Division III research awards, in turn, were given as follows: the W. Sierpiński Award in mathematics to Dr. Jan Dymara from the Mathematics Institute of Wrocław

University for a series of papers on cohomology of Coxeter groups, the S. Pieńkowski Award in physics and astronomy to Dr. Jacek Dziarmaga from the Institute of Physics of the Jagiellonian University for a research on the Bose-Einstein theory and the Kibble-Žurek mechanism, and the Kołos Award in chemistry to Dr. Jacek Młynarski for work in the field of asymmetric aldol reactions. Division III members and employees were frequently honored and rewarded over the course of 2007 for their outstanding achievements in science.

The smallest telescope detects the largest cosmic explosions

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Gamma ray bursts are powerful explosions which occur when massive stars run out of nuclear fuel. Their cores collapse to form black holes or neutron stars, releasing an intense burst of high-energy gamma rays and ejecting particle jets that rip through space at nearly the speed of light like turbocharged cosmic blowtorches. When the jets plow into surrounding interstellar clouds, they heat the gas, often generating bright afterglows. Gamma ray bursts are the most luminous explosions in the universe since the big bang.

Gamma ray bursts are considered one of the most mysterious objects in the Universe, but the trouble is, no one knows in advance where and when the next explosion will happen. One possible strategy in such circumstances is to construct a relatively

inexpensive apparatus capable of monitoring the whole sky simultaneously. Such an idea was advanced by the late Professor Bogdan Paczyński from Princeton University, who convinced us to try this approach. A team of researchers from the Center for Theoretical Physics of the Polish Academy of Sciences, Cardinal Stefan Wyszyński University, the Sołtan Institute for Nuclear Studies, Warsaw University, and Warsaw Technical University has since designed and built a prototype, 2 CCD cameras armed with photolenses and located on a mount which is capable of fast, yet very precise movements. It has been installed in the small dome belonging to the ASAS experiment from the Warsaw University Astronomical Observatory, located in the Las Campanas Observatory in the Atacama desert in Chile. It is quite unique because all its components, i.e. advanced electronics, precision mechanics, control and analysis software, and artificial intelligence, have been created in Poland using a relatively limited budget and the know-how of young-generation students and researchers.

Our usual strategy is to follow the field of view of “Swift,” the NASA satellite equipped with gamma-rays detectors. On the morning of March 19th, 2008, Swift detected a GRB and we moved promptly in the right direction. Most GRBs have so far had optical afterglows which were too dim to be detected by our detector. However, when the second burst occurred just about 30 minutes later and within the angular distance of a few degrees from the first one, we were already in place and so we



Fig. 1. Pi of the Sky telescope at the Las Campanas Observatory in Chile

were the first to register the most luminous object probably ever visible from the Earth in history. Our images showed the afterglow brighten to visual magnitudes between 5 and 6 in the logarithmic magnitude scale used by astronomers. The brighter an object is, the lower its magnitude number. From a dark location in the countryside, people with normal vision can see stars slightly fainter than magnitude 6. That means the afterglow would have been dim, but visible to the naked eye!

Minutes later, when the rapidly fading afterglow became invisible to our detector, about a dozen ground- and space-based telescopes took over and followed it in various parts of the electromagnetic spectrum for many days. Later in the evening of March 19th, other telescopes measured the burst's redshift at 0.94. Redshift is a measure of the distance to an object. A redshift of 0.94 translates into a distance of 7.5 billion light years. This is more than halfway across the visible universe, meaning the explosion took place 7.5 billion years ago, when the universe was less than half its current age and the Earth had not yet come into existence!

GRB 080319B's optical afterglow was 2.5 million times more luminous than the most luminous supernova ever recorded, making it the most intrinsically bright object ever observed by humans in the universe. (Previously, the most distant object visible to the naked eye was the nearby galaxy M33, a relatively short 2.9 million light-years from Earth.) Its observations covered almost completely all times, from seconds to days, and all wavelengths, from radio to gamma. Preliminary theoretical analysis of this vast amount of data has revealed, perhaps not surprisingly, that the new data will force us to reconsider our understanding of the gamma ray burst radiation mechanism, although final conclusions were not yet reached by the time this note was written.

This is not our last word. The final detector, consisting of 32 cameras on 8 mounts, is just being finished. Such a number of cameras will allow it to observe simultaneously almost the whole sky, at least 2 steradians. With such equipment, we will be able to detect short-lived optical transients on our own, without support of the satellite network.

It was in the morning of Wednesday, March 19th, around 7 am. I was just preparing breakfast in order not to be late for our weekly seminar. As usual, chopping tomatoes and cucumbers for a vegetable salad, I looked with one eye on my laptop where

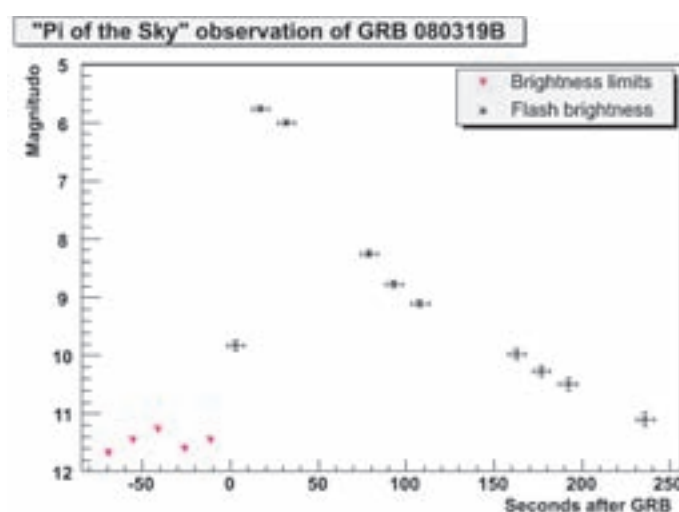


Fig. 2. Light curve of the burst GRB080319B. Data points above magnitude 6 should be visible to the naked eye

the computer in Chile, via Internet, displayed status information concerning our robotic telescope, “Pi of the Sky.” The telescope was collecting images of a section of the sky where a gamma ray burst had been detected by a Swift satellite just minutes before. “There is something strange happening,” my PhD student, Cathy, complained in the communicator window. “Looks like we just got the second alert.” She was right, seconds later my mobile phone signaled another SMS sent from the Swift satellite – an unusual situation when a second burst has been registered in space within an hour after the first one. I agreed with Cathy that she would initialize the downloading of images of the second burst and hurried to the Center for the seminar. Later on, I had a lecture as so I did not learn about the burst before later in the afternoon. Our team, however, acted in coherence as usual. Another PhD student, Lech Piotrowski from the Warsaw University Physics Department, examined the images and localized the bright spot. A while later we put a gif loop composed of our images on the web, the world's first movie of a black hole's birth.

Race for the burst

During the night of 2008.03.18/19 the “Swift” satellite was hunting for GRBs, as usual. The “Pi of the Sky” telescope was routinely monitoring the sky, looking in the same direction as “Swift” and taking 10s long images. The image begun at 6:12:47 UT showed a new object, automatically detected by the burst recognition algorithm. At 6:12:49 UT “Swift”

received the first gamma rays. This moment marked as $T=0$ stands for the beginning of the burst. Only two seconds, later ($T0+2s$) another robotic telescope “RAPTOR” took an image of the object. At $T0+16s$ the object became visible to the “TORTORA” camera, which made a beautiful movie of the peak of the burst. At $T0+17s$ “Swift” sent out the alert about the burst and many telescopes on the ground turned towards the target. The “UVOT” telescope on board “Swift” began observation at $T0+51s$. One hour later the Very Large Telescope in Chile measured

the distance to the burst, which was confirmed by the Hobby-Eberly Telescope in Texas.

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Banach-Mazur distances and projections on random subgaussian polytopes

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The structure of ± 1 polytopes, i.e. the convex hulls of subsets of the combinatorial cube $\{-1, 1\}^n$, is a much studied subject in several areas of combinatorics. Our asymptotic geometric analysis investigated the volumes, mean widths, inradii, and other related geometric parameters of *random* ± 1 polytopes.

The obtained results suggest that random ± 1 polytopes typically display an extremal or “almost” extremal behavior of many geometric parameters of interest. For polytopes spanned by independent Gaussian (or spherical) vectors in \mathbb{R}^n , studied in the asymptotic geometric analysis, a similar phenomenon is well known since a major result by Gluskin (1981) on the diameter of Minkowski compactum.

We have studied symmetric polytopes spanned by random vectors with independent, subgaussian coordinates. This class includes both random ± 1 polytopes and polytopes spanned by Gaussian vectors. More precisely, let $(\xi_{i,j})_{i \leq n, j \leq N}$ be a matrix of independent, β -subgaussian r.v.'s, that is $\Pr(|\xi_{i,j}| \geq t) \leq 2 \exp(-\beta^2 t^2)$ for some constant $\beta > 0$. We also assume that $\text{Var}(\xi_{i,j}) \geq 1$. Let $\xi_j = (\xi_{1,j}, \dots, \xi_{n,j})$ and $B_N = \text{conv} \{\pm \xi^1, \dots, \pm \xi^N\}$. By \tilde{B}_N we denote an independent copy of B_N .

The Banach–Mazur distance of two symmetric polytopes K, L in \mathbb{R}^n is defined as

$$d_{\text{BM}}(K, L) = \inf \{b/a : aK \subset TL \subset bK\},$$

where the infimum runs over all linear transformations T of \mathbb{R}^n and positive numbers a, b . It is well known that $d_{\text{BM}}(K, L) \leq n$. Our first result shows that for N proportional to n , the distance between random polytopes B_N and \tilde{B}_N with high probability is of maximal order.

There exist μ_1, μ_2, μ_3 depending only on β and absolute positive constant c_1 such that for $N > \mu_1 n$ with probability larger or equal to $1 - 5N \exp(-\mu_2 n)$,

$$d_{\text{BM}}(B_N, \tilde{B}_N) \geq (c_1 \ln(N/n))^{-\mu_3} n.$$

Another geometric property of a random polytope which we have investigated is the relation between the projection of the polytope onto a linear subspace E and its section by E . The next result states that with high probability for every projection P onto E with $n/4 \leq \dim E \leq 3n/4$, the image $P(B_N)$ of the polytope sticks out of the multiple of the section $\alpha(B \cap E)$ for α as much as \sqrt{n} (up to a logarithmic factor).

There exist μ_4, μ_5 depending only on β such that for $N \geq \mu_4 n^2 \ln n$, with probability larger or equal to $1 - (N+1) \exp(-n)$, we have for every projection $P: \mathbb{R}^n \mapsto \mathbb{R}^n$ with $n/4 \leq \text{rank } P \leq 3n/4$,

$$\|P\|_{B_N \rightarrow B_N} \geq (c_2 \ln(N/n))^{-\mu_5} \sqrt{n}.$$

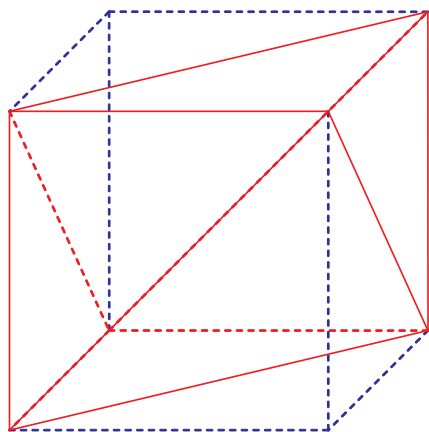


Fig. 1. Example of ± 1 polytope

The crucial new ingredient in the proof of both results is the following small balls probability estimate for subgaussian vectors.

Let A be a nonzero $n \times n$ matrix and let $\xi = (\xi_1, \dots, \xi_n)$, where ξ_i are independent β -subgaussian random variables with $\text{Var}(\xi_i) \geq 1$. Then for any $y \in \mathbb{R}^n$,

$$\Pr(|A\xi - y| \leq \|A\|_{\text{HS}}/2) \leq 2 \exp(-\mu_0(\|A\|_{\text{HS}}/\|A\|_{\text{op}})^2),$$

where μ_0 depends only on β .

Typical use of the above estimate is for A being a projection of rank m . Then $\|A\|_{\text{op}} = 1$ and $\|A\|_{\text{HS}} = \sqrt{m}$ and we get a probability bound of $2 \exp(-\mu_0 m)$. This bound cannot be essentially improved. For example if ξ_i are symmetric taking only values $0, \pm 2$, each of them with probability $1/3$, and A is a projection on the first m coordinates, then $\Pr(A\xi = 0) = 3^{-m}$.

References

- Latała R., Mankiewicz P., Oleszkiewicz K., Tomczak-Jaegermann N. (2007). Banach-Mazur distances and projections on random subgaussian polytopes. *Discrete Comput. Geom.*, 38, 29-50.

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Venturing into asymmetric reactions in water

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Asymmetric reactions to produce enantiomerically pure compounds is one of the most important subjects in current synthetic chemistry. The research of the Młynarski group focuses in broad terms on organic synthesis and the discovery of new reaction methodology, in particular stereoselective and catalytic asymmetric reactions. Inventing new strategies for the development of *perfect chemical reactions*, being a part of the green chemistry concept, is the ultimate goal of the project.

Asymmetric aldol reaction: Nature has perfected the stereospecific aldol reactions by using aldolase enzymes. In all living organisms, type I and type II aldolases catalyze aldol reaction in aqueous environment with perfect enantiocontrol by way of an enamine mechanism and by using a zinc cofactor, respectively. While virtually all the enzyme-catalyzed biochemical aldol reactions use unmodified donor

and acceptor carbonyls and take place under catalytic control in aqua-environment (direct aldol reaction), the chemical domain of this reaction has mostly relied on prior transformation of carbonyl substrates into more reactive species, and the whole process is traditionally carried out in anhydrous solvents.

Although many researchers have developed synthetic mimics of active sites of enzymes to realize enzymatic activity, our research focuses on the medium of enzymatic reactions: water. From a green chemistry perspective, the use of water instead of organic solvent is preferred to decrease environmental contamination. Water is a safe, harmless, and environmentally benign solvent. Now, searching for simple catalysts that mimic the high selectivity of enzymes in water yet offer more general substrate acceptance is a subject of our intense research.

Non-direct methodologies – water-compatible chiral Lewis acids concept: While virtually all the biochemical aldol reactions use unmodified donor and acceptor carbonyls and take place under catalytic control in nature, most chemical methods required the conversion of donor substrates into more reactive species using no less than stoichiometric amounts of metal containing reagents on extra steps. Chiral Lewis acid-mediated asymmetric aldol reactions of aldehydes with silicon enolates (asymmetric Mukaiyama aldol reaction) have been elaborated into a most convenient asymmetric aldol methodology starting from achiral substrates to create asymmetric centers in the aldol adducts. (Fig. 1)

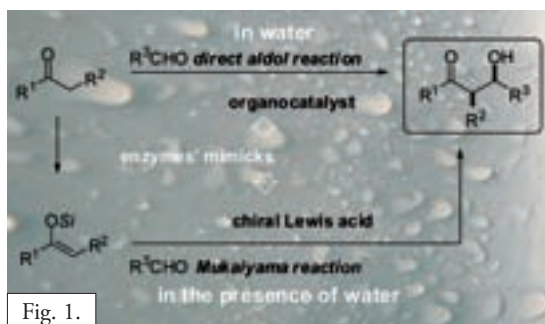


Fig. 1.

This powerful methodology inspired the design of new water-compatible chiral Lewis acids. Thus, we have presented chiral iron and zinc complex with efficiently designed new *pybox*-type ligands for the Mukaiyama aldol reactions which proceed in aqueous organic solvent. (Fig. 2) Application of

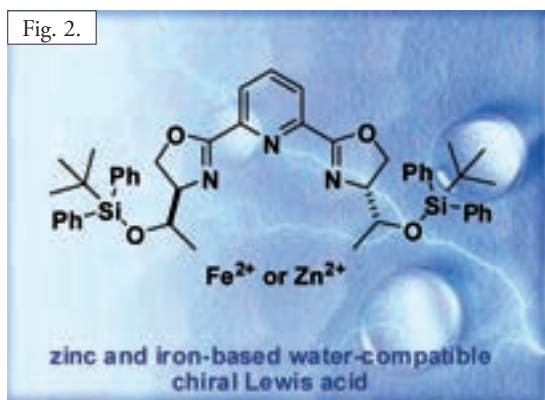


Fig. 2.

iron-based Lewis acids to asymmetric synthesis seems to be particularly exciting as iron is one of the most abundant metals on earth and consequently one of the cheapest and most environmentally acceptable.

Direct aldol reaction in water: Mimicking the mode of action of class II aldolases, chiral the homo- and heterometallic complexes developed recently are reported to be water-sensitive and thus the reactions have been carried out under anhydrous conditions in organic solvents. Nevertheless, continuous exploration of zinc complexes seems appropriate as most aldolases contain an active site Zn cofactor facilitating the enolate formation in water.

Recently, we have succeeded in carrying out the metal-assisted direct asymmetric aldol reaction in aqueous media. A combination of zinc salts and chiral C₂-symmetrical prolinamide ligand leads to high enantioselectivities in direct aldol reactions essentially assisted by water. Similar valine-containing ligand is found to catalyze the aldol reactions in neat water with excellent stereocontrol. (Fig. 3) For demonstrated catalytic systems organic solvent-free conditions are applied.

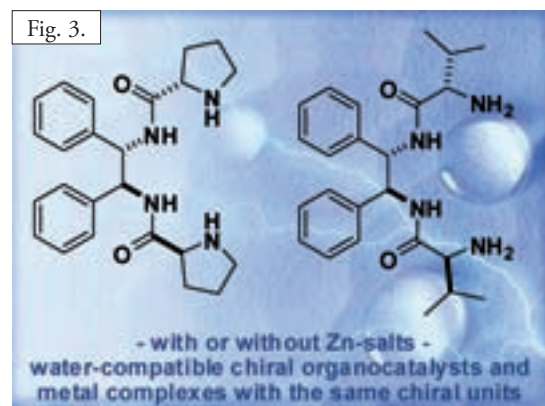


Fig. 3.

As the chiral backbone of the catalyst can be easily modified, the finding reported presents a new and flexible departure. We have also demonstrated that the same ligands (acting as metal-free catalysts) can promote the direct aldol reactions of ketones with various aldehydes without organic co-solvent in the presence of water or in water (organocatalysis).

Our aim will be to develop an efficient catalyst which can mimic the mode of action of type I and type II aldolases. The presented study reveals an interesting area of aqueous asymmetric aldol reaction between application of *metal complexes* and *organocatalysis*.

References

- Jankowska J., Paradowska J., Rakiel B., Młynarski J. (2007). Iron(II) and Zinc(II) Complexes with Designed pybox Ligands for the Asymmetric Aqueous Mukaiyama-Aldol Reactions. *Journal of Organic Chemistry*, 72, 2228-2231.
- Paradowska J., Stodulski M., Młynarski J. (2007). Direct Catalytic Asymmetric Aldol Reactions Assisted by Zinc Complex in the Presence of Water. *Advanced Synthesis & Catalysis*, 239, 1041-1046.

Młynarski J., Paradowska J. (2008). Catalytic Asymmetric Aldol Reactions in Aqueous Media Tutorial Review. *Chemical Society Review* (in press).

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Technical Sciences

Division IV – Technical Sciences covers all the disciplines of technical sciences, including acoustics, automatics, biocybernetics, biomedical engineering, civil engineering, chemical and process engineering, computer science, geotechnology, laser technology, materials science, mechatronics, mechanical engineering, robotics, mechanics of fluids and solids. The Division has 67 national members (36 of whom are full members, 31 corresponding members) and 29 foreign members.

The Division supervises the work of 9 research institutes. These institutes publish scientific journals mostly in Polish. Seven institutes publish journals in English: *Control and Cybernetics*, *Biocybernetics and Biomedical Engineering*, *Archives of Hydroengineering and Environmental Mechanics*, *Theoretical and Applied Informatics*, *Transactions of the Institute of Fluid-Flow Machinery*, *Archives of Metallurgy and Materials*, *Ma-*



Prof. Władysław Włosiński and Prof. Michał Kleiber, Polish Academy of Sciences President, here opening the ceremony of granting the Division's scientific awards (14 December 2007). In the background: Ewa Kiczko and Prof. Andrzej Styczek

chine Graphics and Vision, *Archives of Acoustics*, *Archives of Civil Engineering*, *Archives of Mechanics*, *Computer Assisted Mechanics and Engineering Sciences*, *Engineering Transactions*, *Evolutionary Optimization* (on-line), and *Journal of Technical Physics*.

There are 16 scientific committees affiliated with the Division, composed of 498 elected scientists involved in technical research. In 2007 the committees' activity concentrated on supporting research and the popularization of science by organizing conferences and scientific symposiums (the overall number of such meetings was 146) and by maintaining contact with foreign scientific centers, organizations, and associations. The committees also continued their publishing activity in 2007, editing 26 titles, including 18 quarterlies, 14 of them financially supported by the Polish Academy Sciences. An election of committee members took place in 2007, discussion concerning consolidation was also launched.

The Division continues to edit its own scientific quarterly – *Bulletin of the Polish Academy of Sciences: Technical Sciences*. In 2007 particular issues focused on the following themes: analysis of dynamics systems and mechanical engineering, micro and nano-scale mechanics and electronics.

On behalf of the Academy, Prof. Władysław Włosiński, chairman of Division IV, continued efforts under a consortium of nine European and national institutions responsible for research. This consortium was established to coordinate research in Europe and China within the framework of the European program CO-REACH. Professor Włosiński leads the Polish contribution to this program.

Two plenary sessions were held in 2007. The first session held on 28 March was devoted to cooperation between universities and the institutes of the Polish Academy of Sciences. Participants of the discussion – rectors of Polish universities of technology, directors of Polish Academy of Sciences institutes, and Academy members – spoke about joint PhD programs, exchanges of scientific staff, and other possible forms of cooperation. They pointed out both the benefits and the problems that arise from launching and continuing cooperation.

During the second plenary session held on 17 October, seven full and ten corresponding members

of the Academy were elected. The new corresponding members are: Prof. Romuald Będziński and Prof. Adam Janiak from the Wrocław University of Technology, Prof. Tadeusz Burczyński and Prof. Tadeusz Chmieniak from the Silesian University of Technology, Prof. Marian Kaźmierkowski and Prof. Józef Modelski from the Warsaw University of Technology, Prof. Józef Korbicz from the University of Zielona Góra, Prof. Henryk Krawczyk from the Gdańsk University of Technology, Prof. Andrzej Nowicki from the Institute of Fundamental Technological Research, Polish Academy of Sciences, and Prof. Jan Wójcicki from the Institute of Biocybernetics and Biomedical Engineering of the Polish Academy of Sciences. The new full members are: Prof. Daniel J. Bem, Prof. Zbigniew Ciok, Prof. Andrzej Rakowski, Prof. Kazimierz Sobczyk, Prof. Zenon Waszczyszyn, Prof. Władysław Włosiński, and Prof. Wiesław Woliński.

At the end of this meeting, the winners of the annual academic awards were also announced. These awards were bestowed upon: Dr. Jerzy Pamin from the Kraków University of Technology in mechanics, Dr. Stanisław Stupkiewicz from the Institute of



Dr. Dorota Pijanowska, a laureate of the Division's scientific award. In the background: Prof. Wiesław Woliński and Prof. Kazimierz Sobczyk



The ceremony of granting the Division's scientific awards. From left: Dr. Robert Sekret, Dr. Wioletta Podgórska, Prof. Michał Kleiber, Dr. Dorota Pijanowska, Dr. Stanisław Stupkiewicz, Dr. Tadeusz Łagoda, Dr. Jacek Żak, Dr. Jerzy Pamin, Anna Tascher, Prof. Władysław Włosiński

Fundamental Technological Research, Polish Academy of Sciences, in mechanics, Dr. Robert Sekret from the Częstochowa University of Technology in machine exploitation and machine building, Dr. Wioletta Podgórska from the Warsaw University of Technology in chemical engineering, Dr. Dorota Pijanowska from the Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Sciences, Dr. Jacek Żak from the Poznań University of Technology in transport, and Dr. Tadeusz Łagoda from the Opole University of Technology in machine exploitation and machine building.

Furthermore, in 2007 the members of the Division and employees of its institutes frequently received awards and were honored for outstanding achievements in science. In particular: Karolinska Institutet (Sweden) awarded Prof. Andrzej Weryński with the title of Honorary Doctor of Medicine and the title of Foreign Adjunct Professor, the Polish Ministry of Science and Higher Education awarded Prof. Czesław Cempel with the prize in education for the book *Theory and Engineering of Systems*. The Hong-Kong University of Science and Technology awarded Prof. Czesław Strumiłło with the Arun S. Mujumdar Medal in drying excellence, IEEE awarded Prof. Janusz Kacprzyk with the Pioneer Prize for outstanding contributions in granular computing and computing with words. Prof. Janusz Kacprzyk was also elected a foreign corresponding academicalian of the Royal Academy of Economic and Financial Sciences (Spain).

Nanostructural materials for cardiovascular biomedical devices

B. Major | Aleksander Krupkowski Institute of Metallurgy and Materials Science | Polish Academy of Sciences

The inhabitants of many developed countries, especially in Europe, have to take into account the significant probability that they may suffer from one of the most widespread circulatory diseases – heart failure. When standard methods of treatment fail, in acute cases of heart failure the most radical though effective option remains: an external, partially or fully implanted temporary heart support system. From the point of view of materials engineering, the fundamental problem with an artificial heart ventricle is supplying materials which possess strictly specified mechanical and bio-physical properties designed for contact with flowing blood. Moreover, they must meet a specified durability and above all exhibit high biocompatibility. One of the greatest challenges, therefore, is to select materials that fulfill the mechanical requirements imposed by the structure of the implant while having the smallest possible interaction with the aggressive environment inside the body. If the materials used were biologically incompatible, hemostasis would immediately occur.

Titanium occurs in the body in small amounts. Importantly, there is nothing to suggest that its presence causes any defense action. Titanium could therefore be the ideal biomaterial, but its low resistance to abrasion means that its use can cause it to infiltrate the body. Thus titanium nitride (TiN) and titanium carbonitride Ti(C,N) used in coating form seem to be more promising materials, due to their high mechanical properties and good biocompatibility. Nevertheless, the problem here is that titanium nitride is a brittle ceramic. How can it be used as a biocompatible coating if the artificial ventricles, intended to replace the work of the heart, are made of polyurethane, a material characterized by substantial flexibility? Moreover, polyurethane elements are sensitive to the elevated temperatures which are required by the technologies for depositing the coating.

A solution to this seemingly hopeless situation has been found thanks to innovative laser technology. The pulsed laser deposition (PLD) method is a process which takes place at a relatively low temperature, under vacuum or in a low-pressure gas

environment of precisely controlled chemical composition. A polyurethane element to be used as a component for a future artificial heart is placed inside a special vacuum chamber, close to a rotating target of pure titanium. When the coating process begins, laser beams with nano-second pulse duration are focused at the target and evaporate the material. The energy density on the titanium surface is so great that with each pulse material is evaporated in what is called ablation mode, which is generally non-thermal. The emitted plasma, made up of atoms, ions, and atom clusters, becomes deposited on the nearby polyurethane element. The resulting extraordinary thin deposited films of titanium nitride or carbonitride are uniform, have a nanocrystalline structure, adhere very well to the substrate, are flexible, and display high chemical purity and low residual stress.

The research activity is performed in cooperation with the Foundation of Cardiac Surgery Development in Zabrze in Poland, a leading heart prosthesis unit, and the Laser Center in Leoben in Austria, which offers advanced laser technology.

Another direction of research activity focuses on polymer tubes with modified internal surfaces towards blood cell biocompatibility. New blood contacting materials for forced external and internal blood circulation are under development. The internal surfaces of the tube like devices will be covered with anti thrombogenic coatings in order to obtain the biomimetic properties of such surfaces (so they can be covered with endothelial cells and therefore become similar to natural vessel surfaces). Research is in progress on carbon, titanium, and biopolymer based materials for deposition using physical as well as chemical methods, by deposition of selected poly p-xylylenes. Depending on the topography of the vessel inner simulating surface and chemical nature of the cells, a nonthrombogenic bio-surface, termed neointima, would be formed.

The research activity of the Institute of Metallurgy and Materials Science is mostly focused on design and advanced microstructure, mechanical

and bio-physical diagnosis, realized in cooperation with several Polish (Foundation of Cardiac Surgery Development, Technical Universities in Warsaw and Łódź, AGH) and European institutions in Austria and France dealing with materials science, biology, biomechanics, and medicine.

Biocompatible coatings on elements of the artificial heart ventricle are the main objectives of the established “Polish Artificial Heart” project. The polymer tubes with the modified internal surface are proposed to be implemented as part of the “mnt-era.net” international project, now developing a full proposal being accepted by the international commission at the first initial stage.

References

- Major B., Mróz W., Wierzchoń T., Waldhauser W., Lackner J.M., Ebner R. (2004). Pulsed laser deposition of advanced titanium nitride thin layers. *Surface and Coating Technology*, 180-181, 580-584.
- Lackner J.M., Waldhauser W., Ebner R., Major B., Schöberl T. (2004). Structural, mechanical and tribological investigations of pulsed laser deposited titanium nitride coatings. *Thin Solid Films*, 453-454, 195-202.
- Major B., Bonarski J.T., Waldhauser W., Lackner J.M., Ebner R. (2004). Contribution of pulsed laser deposition conditions to texture, morphology and residual stress developed in TiN layers. *Archives of Metallurgy and Materials*, 49, 83-92.
- Lackner J.M., Waldhauser W., Ebner R., Major B., Schöberl T. (2004). Pulsed laser deposition of titanium oxide coatings at room temperature – structural, mechanical and tribological properties. *Surface and Coatings Technology*, 180-181, 585-590.
- Kustos R., Major R., Wierzchoń T., Major B. (2004). Designing a New Heart. *Academia*, 3, 14-17.
- Major R., Czarnowska E., Sowińska A., Kustos R., Lackner J.M., Woźniak M., Wierzchoń T., Major B. (2005). Structure and biocompatibility of TiN coatings on polyurethane produced by laser ablation. *e-Polymer* No. 026, 1-8, (electronic version).
- Major B. (2005). Laser Technology in Generating Microstructure of Functionally Gradient Materials. *Archives of Metallurgy and Materials*, 50, 35-46.
- Major B. (2006). Chapter 7 – Laser processing for surface modification by remelting and alloying of metallic systems. *Materials Surface Processing by Directed Energy Techniques*, Yves Pauleau (ed.), Elsevier.
- Major R., Bonarski J., Morgiel J., Major B., Czarnowska E., Kustos R., Lackner J.M., Waldhauser W. (2006). Elastic TiN coating deposited on polyurethane by pulsed laser. *Surface and Coatings Technology*, 200, 6340-6345.

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The VerICS 2007 model checker

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Automated verification of finite-state real-time systems (RTS) and multi-agent systems (MAS), performed by analysis of their models (model checking), is a very important subject of research. This is highly motivated by an increasing demand to verify safety critical systems, i.e., time-dependent (multi-agent) systems, the failure of which could have dramatic consequences for both people and hardware. These systems include fire alarms, radiation therapy and robotic surgery machines, nuclear reac-

tor control systems, railway signaling and control systems, braking systems, air traffic control systems, flight planning systems, rocket range launch safety systems, etc. Verification of safety critical systems is known to be a difficult problem. Verifying a correctness property of a system amounts to checking whether a logical formula (expressing the property) is valid on a model of the system representing all its possible computations. However, the practical applicability of model checking is strongly limited by

the state explosion problem, which means that the number of model states grows exponentially with the size of the system. For RTS, this problem occurs particularly strongly due to infinity of the time domain. Therefore, existing verification techniques frequently apply compact symbolic representations of the state spaces. Verification methods are implemented in many competing tools such as Kronos, UppAal2k, NuSMV, VerICS, and Tina (the book cited below offers a survey of these techniques and tools).

This paper presents the current stage of development of VerICS, a model checker for RTS and MAS. Depending on the type of system considered, the verifier enables various classes of correctness properties to be tested – from reachability of a state satisfying certain conditions to more complicated features expressed by formulas of (timed) temporal, epistemic, or deontic logics. Three model checking methods have been implemented in VerICS: two symbolic ones and one consisting in generating abstract models. The SAT-based symbolic verification methods involve bounded model checking (BMC) and unbounded model checking (UMC). The BMC module searches for counterexamples to formulas of the universal fragment of a logic exploiting a translation to the SAT-problem and using SAT-solvers (SAT-solver is a program for solving the SAT-problem, i.e. satisfiability of propositional formulas). UMC is capable of handling the whole language of the logic. Timed automata are used to specify RTS and MAS. The models of RTS and MAS enable us to interpret formulas involving temporal (timed) operators – to express time constraints of systems, epistemic operators – to reason about what agents know, and deontic operators – to reason about the correctness of their behavior. Fig. 1 shows

the architecture of VerICS, consisting of the following five main modules:

- **Estelle to Intermediate Language (IL) translator**, which enables handling of specifications written in a subset of Estelle (the standardized language for specifying communicating protocols and distributed systems)
- **IL to timed automata translator**, which, given an IL specification, generates the corresponding network of timed automata or the global timed automaton
- **BMC module**, which implements bounded model checking-based verification for the classes of properties shown in the figure; the SAT-solvers MiniSat or RSat are used
- **UMC module**, which provides implementations of unbounded model checking verification methods. The module is integrated with a modified version of the SAT-solver ZChaff
- **Splitter module**, which performs reachability verification on abstract models generated for timed automata.

VerICS has been implemented in C++; its internal functionalities are available via an interface written in Java. The current distribution can be downloaded from <http://verics.ipipan.waw.pl>. The experimental results prove that in many cases VerICS is able to handle relatively large examples taken from standard scalable benchmarks. This allows us to expect the same in the case of real world systems. A comparison of VerICS to other model checkers shows that in some cases it performs better than the other tools available on the RTS/MAS verification market. The main advantage of VerICS lies in its ability to find counterexamples for false formulas effectively due to its BMC module. Certain false formulas can be verified in scenarios composed of

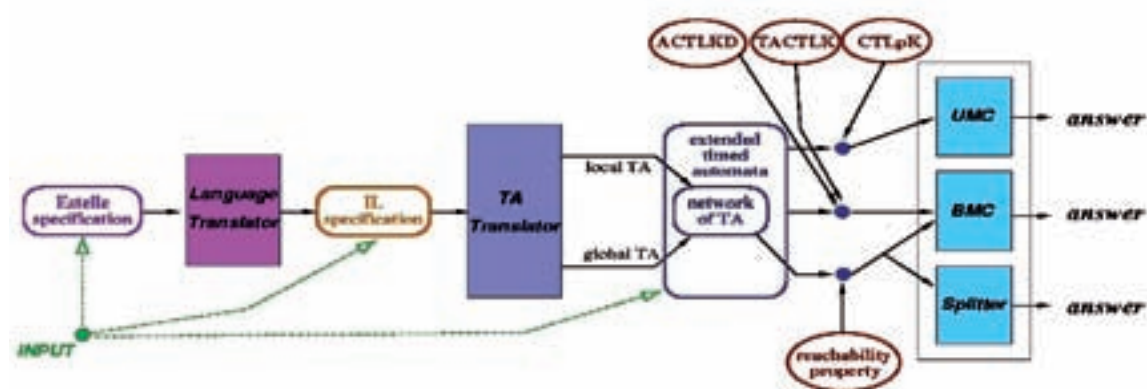
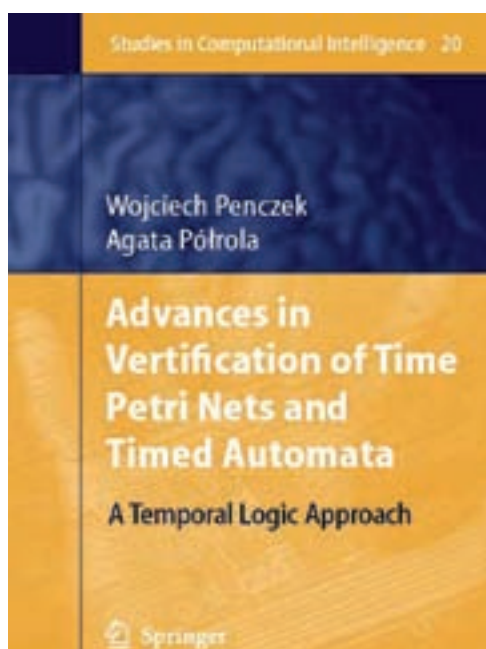


Fig. 1. Architecture of VerICS



up to a thousand modules. No other model checker or other technique can handle this magnitude of state spaces.

References

- Kacprzak M., Lomuscio A., Niewiadomski A., Pęczek W., Raimondi F., Szreter M. (2006). Comparing BDD and SAT based techniques for model checking Chaum's dining cryptographers protocol. *Fundamenta Informaticae*, vol. 72(1-3), 215-234.
- Kacprzak M., Nabałek W., Niewiadomski A., Pęczek W., Półrola A., Szreter M., Zbrzezny A., Woźna B. (2007). VerICS 2006 - A Model Checker for Real-Time and Multi-Agent Systems. *Proc. of CS&P'07*, 345-356.
- Lomuscio A., Pęczek W., Woźna B. (2007). Bounded model checking for knowledge and real time. *Artificial Intelligence*, 171, 1011-1038.

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Effects of crystallization on polymer processing with high deformation rates

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Crystallization is an important structural transformation influencing the dynamics of industrial polymer processing and controlling the physical and mechanical properties of the material. A physically sensible description of the transformation kinetics is needed for the computer modeling of industrial processes, which has become a standard technique in polymer technology. One distinct feature exhibited by polymeric materials is a strong increase in crystallization rate, by several orders of magnitude, caused by the deformation and orientation of the chain molecules. In industrial technologies involving melt processing, the chain deformation and orientation is usually controlled by time-dependent flow deformation and cooling. In fast processing, such as high-speed melt spinning, supersonic melt blowing, electro-spinning of fibers, the polymer fluid is often subjected to elongation rates of sev-

eral hundred times per second. Such fast deformations do not allow for relaxation of the molecular deformation and orientation during the processing time and, in crystallizing polymers, cause rapid stress-induced crystallization resulting in highly oriented texture shown in Fig. 1. The consequence of the high molecular orientation produced in such technologies is the strong enhancement of the mechanical properties of the polymeric products, often by orders of magnitude. Our research on this subject has focused on:

- modeling of the molecular deformation and orientation of polymeric fluids subjected to fast, time-dependent axial deformations (uniaxial, biaxial), as well as the kinetics of stress-induced crystallization,
- flow behavior of the polymer during crystallization (crystallinity-dependent viscosity),

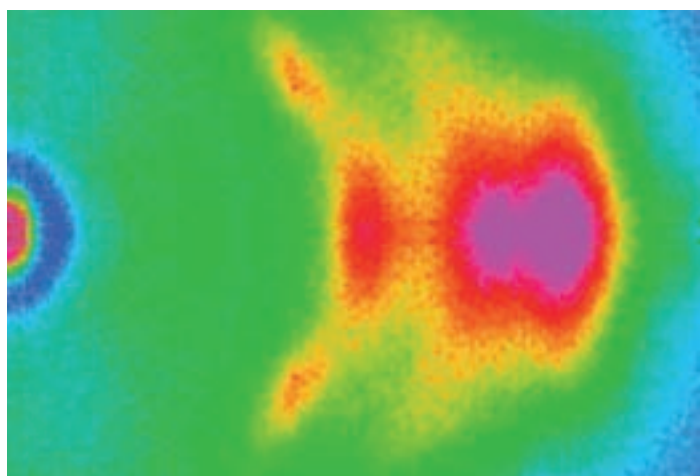


Fig. 1. Wide angle X-ray diffraction pattern illustrating high crystalline orientation of as-spun PET fiber

- effects of stress-induced crystallization in modeling of melt spinning of fibers, in particular the resulting limitation in the spinning speed and fiber thickness.

Molecular orientation and crystallization kinetics

We have proposed a theory of molecular deformation and orientation for fast flow deformations of polymeric fluids considering non-linear stress-orientation behavior and finite extensibility of flexible chain molecules. The approach remains valid in the entire range of the macroscopic deformation rates and deformations of the molecules from statistical coils to fully extended chains. The theory accounts for the molecular thermal motion, chain flexibility and flow convection of the chain molecules under the flow deformation. The time-dependent conformation distribution of the chain molecules,

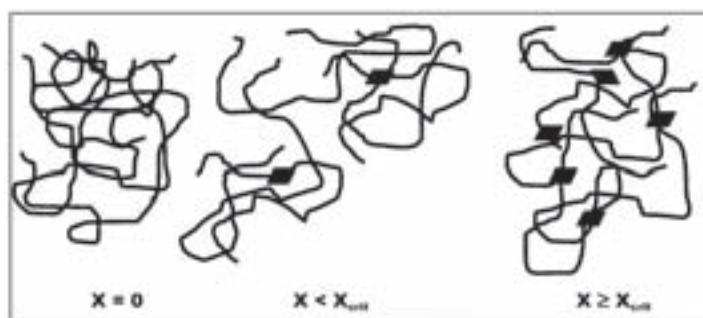


Fig. 2. Molecular model of crystallization affected viscosity. $X=0$ – entangled melt, $X < X_{crit}$ – crystal-bound aggregates, $X > X_{crit}$ – solid rubber-like network

as well as orientation distribution of the chain segments and free energy of the system, have been derived in mathematically tractable terms for time-dependent axial deformation rates. Time evolution of the characteristics is controlled by an instantaneous pseudo-affine molecular deformation with time-dependent axial chain elongation coefficients. The coefficients are given by a formula valid for the entire range of the deformation rates and stresses.

Parallel to the stress-orientation theory, a quasi-stationary kinetic theory of crystal nucleation in such systems has been proposed. The approach is based on an aggregation model proposed earlier by our laboratory for asymmetric particles and accounts for time-dependent segmental orientation and free energy of the system under the flow deformation. The asymmetric particles are identified with statistical chain segments. The kinetic theory predicts strong angular differentiation of the crystal nucleation rate, i.e. enhancement of nucleation rate by orders of magnitude in the orientation direction and reduction in the perpendicular direction. Both the non-linear stress-orientation theory and the quasi-stationary kinetic theory of nucleation are proposed for modeling of structural transformations in processes with high, time-dependent deformation rates.

Rheological behavior of the polymer fluid during crystallization

Rheological properties (viscosity, relaxation time) of polymer fluids are known to be sensitive to crystallization. A small amount of crystalline phase can make viscosity and relaxation time of polymer melts higher by orders of magnitude and convert the fluid into a plastic solid. This is visualized as physical cross-linking of the linear polymer chains by small crystals binding them together. When the number of such inter-chain bonds approaches a critical level in the course of crystallization, the polymer melt is converted into a solid rubber-like network, as illustrated in Fig. 2. The critical crystallinity X_{crit} can be as small as several percent. The abrupt increase in polymer viscosity near the critical crystallinity is represented by a hyperbolic function derived from the cross-linking theory. The hyperbolic, gelation-type formula has been used in modeling the dynamics and structure formation in melt spinning of crystallizing polymers.

Stress-induced crystallization in computer modeling of melt spinning

In the modeling, steady-state melt spinning is considered where the polymer melt is extruded from a spinneret orifice at a constant velocity V_0 and subjected to elongation and cooling along the spinning axis. At a distance L from the extrusion point, solidified filament is collected with a take-up velocity $V_L \gg V_0$. The computer model of the process is based on the mass, momentum, and energy conservation equations determining axial velocity, temperature, and tension profiles. Structure evolution equations account for stress-induced crystallization, and the constitutive equation accounts for polymer viscosity affected by local crystallinity and temperature. In a definite range of spinning conditions, when the stress-induced crystallization leads to rapid solidification of the polymer, bifurcation of the solution of the melt spinning equations is observed. The solution shows bifurcation if the take-up velocity V_L plotted vs. the initial tension force F_0 exhibits a maximum, as illustrated in Fig. 3. No fibers can be spun at speeds higher than the maximum. At the bifurcation, the same take-up velocity V_L leads to different velocity, temperature, and tensile stress profiles, as well as to different structures of the obtained fibers (amorphous or partly crystalline). The bifurcation determines the range of conditions necessary for stable formation of fibers and may be important for the design and optimization of the industrial processes. The practical significance of the predictions concerns limitations of the maximum spinning speed and the minimum of the filament diameter.

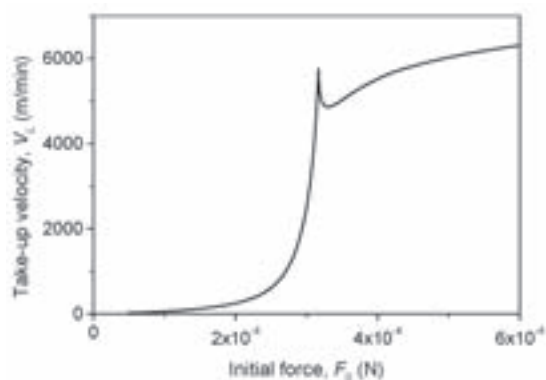


Fig. 3. The velocity-tension relation computed for melt spinning of PET

Critical conditions for bifurcation have been analyzed and the physical mechanism of such behavior has been discussed. The appearance of bifurcation is associated with the onset of crystallization. A necessary condition for bifurcation is the reduction of the polymer deformability along the spinning axis with increasing tension force. The reduction of deformability results from faster crystallization at higher tensile stresses combined with crystallinity-affected viscosity.

Temperature effects seem to be of lower, secondary importance. Bifurcation appears for polymers which crystallize slowly in the absence of the tensile stresses and change the crystallization rate by many orders of magnitude under high stresses. Three regions in the spinning speeds are consequences of bifurcation: spinning of amorphous fibers at low speeds, high-speed spinning of partly crystalline fibers, and the region of inaccessible supercritical speeds. The predicted regions are reasonably consistent with the experimental observations reported by other authors.

Stress-induced crystallization and crystallinity-affected viscosity are primary conditions for bifurcation. The impact of the primary conditions on the bifurcation can be reduced by suppressing the molecular orientation and stress-induced crystallization. This method consists in using immiscible polymer additives, desirably liquid-crystalline, which “take over” the internal stresses. The role of a secondary group of factors in spinline deformability, i.e. the molecular weight of the polymer, thermal conditions of the extrusion, and cooling, have been also discussed. At higher molecular weights the polymer starts to crystallize at lower spinning speeds, the maximum take-up velocity shifts to lower values, and the minimum filament thickness increases. We conclude that the melt spinning of super thin filaments is favored by application of low-molecular-weight polymers. Modification of the temperature of the ambient air provides an alternative important tool for increasing the accessible spinning speed and reducing the filament diameter, e.g. by introducing a hot tube on the spinning axis. We predict that an increase in tube temperature results in increased maximum spinning speeds and admitting much thinner filaments produced at higher speeds, inaccessible in classical high-speed melt spinning (Fig. 4).

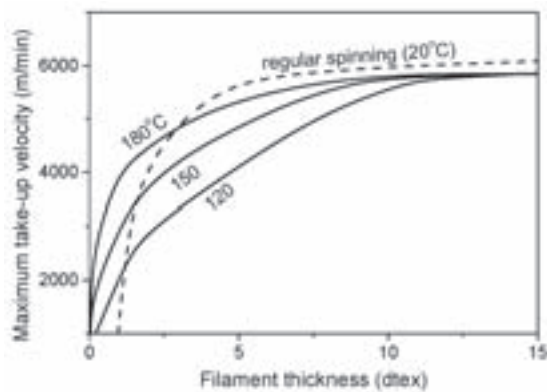


Fig. 4. Maximum take-up velocity vs. filament thickness computed for hot-tube melt spinning of PET at various tube temperatures (solid lines). Dashed line – classical spinning at room temperature

Concluding remarks

The mathematical modeling of structure transformations (orientation, crystallization) during melt processing of polymers with time-dependent, high axial deformation rates provides physically sensible formulations, valid in the entire range of the deformation rates and stresses. The formulations combined with computer modeling of the processing which involves stress-induced crystallization and structure-controlled viscosity can be adopted for other industrial techniques, with the aim of obtain-

ing super thin fibers with an industrial productivity rate. The subject may concern dynamics and structure formation in melt spinning under modified conditions, supersonic melt blowing of super thin fibers, electro-spinning of nano-fibers, etc. Further details of the theory and computer modeling are presented in the publications listed below.

References

- Jarecki L. (2007). In: *Progress in Understanding of Polymer Crystallization. Lecture Notes in Physics*, Reiter G., Strobl G.R. (eds.), Heidelberg, Springer, 65-85.
- Ziabicki A., Jarecki L. (2007). Crystallization-Controlled Limitations of Melt Spinning. *J. Applied Polymer Sci.*, 105, 215-223.
- Ziabicki A., Jarecki L. (2006). Structure-controlled bifurcation in mathematical modelling of fibre spinning. *Archives of Mechanics*, 58, 459-475.

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Modeling of polar ice sheet flows

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Polar ice caps cover approximately 15 million sq. km of the Earth's surface in Antarctica and Greenland. The presence of such huge masses of ice has a significant impact on the global climate. Therefore, analyzing the thermo-mechanical processes taking place in polar regions is essential for understanding the dynamics of global warming.

A schematic cross-section of a large polar ice sheet is sketched in Fig. 1. An ice cap is typically up to 3-4 km thick and extends thousands of kilometers in lateral directions. During the passage from the glacier free surface, when the ice is formed in the accumulation zone, the material undergoes different

stress and deformation conditions. As a consequence, the initially isotropic free-surface ice gradually transforms into strongly anisotropic material in which the mechanical properties depend on the direction in space. Polar ice is a polycrystalline material and deforms mainly by viscous creep. The development of anisotropic structure (called *fabric*) in the highly deformed material results in the ice viscosities decreasing 5 to 10 times compared to the initial, isotropic ice values. For this reason, the anisotropy of ice, and its evolution, are important factors that must be taken into account when analyzing the overall flow of a glacier.

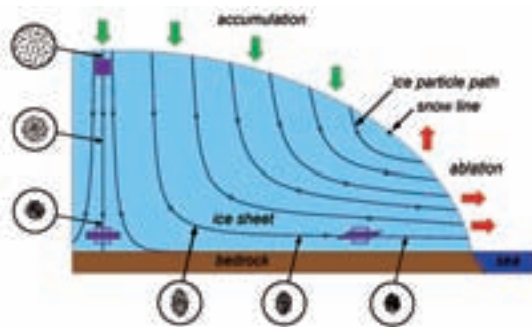


Fig. 1. Schematic polar ice sheet cross-section. Ice enters the glacier on the free surface in the accumulation zone, and leaves it either in the ablation zone, or at the base when ice melts. In the central region of the glacier ice mainly undergoes compression, while further from the glacier center it undergoes shearing. The diagrams to the left and under the plot illustrate ice fabric (anisotropic microstructure). Each point in these diagrams represents the intersection of the axis of symmetry (c -axis) of one crystal with the surface of a hemisphere when each c -axis passes through the center of the sphere. Higher concentration of c -axes in a certain direction indicates stronger anisotropy of ice

The macroscopic anisotropy of ice is due to underlying processes which occur on the microscopic level. In natural conditions, ice is composed of hexagonal crystals (Fig. 2) which are axially symmetric about their c -axes; the spatial orientation of the c -axis defines the directional properties of a single crystal. The crystals of similar orientations constitute grains of a typical size of several millimeters. These grains form polycrystals which – when viewed in polarized light – reveal a pattern shown in Fig. 2c, where different colors indicate different grain orientations.

In order to describe the microscopic viscous properties of a single crystal and how these properties affect the macroscopic behavior of ice, a micro-mechanical model has been constructed (Staroszczyk 2002, 2004). This model, correlated with laboratory data and the results from phenomenological models (Staroszczyk and Morland 2000, 2001; Morland and Staroszczyk 2003), defines a set of macroscopic viscosities in axial compression and simple shear along different directions. Moreover, the model is able to predict the ice fabric resulting from a given macroscopic deformation. The values of macroscopic viscosities, the functions of macroscopic deformations and their rates, have been used to model a creep flow of a large polar ice glacier (Staroszczyk 2006; Morland and Staroszczyk 2006). Accordingly, a complete flow problem has for the first time been solved for an anisotropic ice sheet in which there is a full coupling between the flow variables (velocities and stresses) and the ice fabric, i.e. between the macroscopic variables and the microstructure of ice – in earlier attempts the fabric had been assumed to be independent of the flow. The problem involving the mass and momentum balances, supplemented with the relations describing the mass fluxes across the glacier boundaries due to the ice accumulation, ablation and basal melting, and accompanied by a sliding law at the ice base, has been solved numerically for a radially symmetric flow.

Fig. 3. illustrates a free surface profile (the position of which is not known *a priori* and thus has to be calculated) predicted by the numerical simulations. Also shown are paths A, B, C, D, etc., along

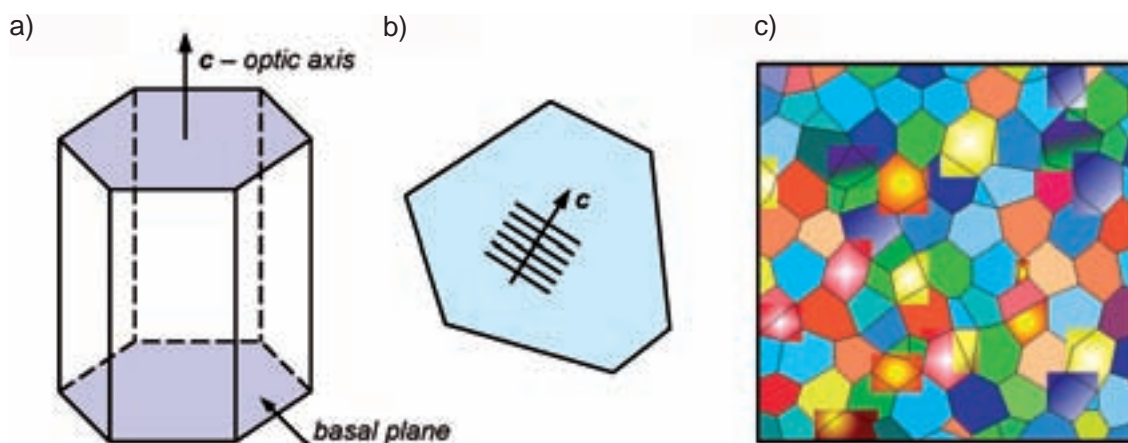


Fig. 2. (a) A single hexagonal ice crystal, (b) A typical grain, comprising of crystals of similar orientations, and (c) An anisotropic polycrystal viewed in polarized light

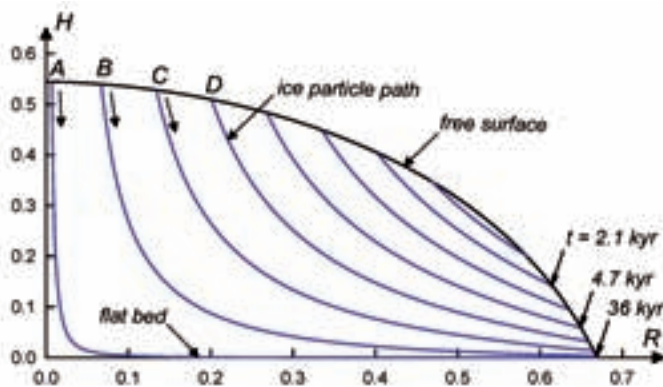


Fig. 3. Free surface profile of a radially symmetric ice sheet. Blue lines show ice particle paths. The units are: 1200 km for the radius R and 2 km for the ice thickness H . 1 kyr = 1000 years

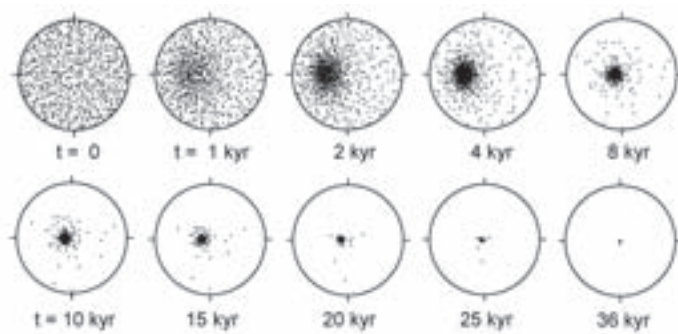


Fig. 4. Evolution of ice anisotropic fabric along the path A shown in Fig. 3, from the initially isotropic fabric for $t = 0$ (with random distribution of crystal c -axes) to very strong fabric for $t = 36$ kyr (with all c -axes aligned nearly in the same, vertical, direction). 1 kyr = 1000 years

which ice particles move from the free surface at the accumulation zone to either the free surface at the ablation zone, or to the glacier base if ice melting occurs. The numbers at the right of the plot indicate the times (in thousands of years) needed by ice particles to move along corresponding paths. Fig. 4. demonstrates the evolution of microscopic fabric as an ice element moves along the path A (which requires about 36,000 years). The diagrams in the upper row correspond to the part of a path when

ice descends nearly vertically, while those in the lower row illustrate the fabric evolution when ice moves mainly in the lateral direction, before leaving the sheet at its margin near the glacier base.

These results are in good agreement with observations, though the full verification of the model will be possible only when detailed empirical data obtained from ice cores drilled in polar glaciers are available.

References

- Morland L.W., Staroszczyk R. (2003). Stress and strain-rate formulations for fabric evolution in polar ice. *Continuum Mech. Thermodyn.*, 15, 55-71.
- Morland L.W., Staroszczyk R. (2006). Steady radial ice sheet flow with fabric evolution. *J. Glaciol.*, 52, 267-280.
- Staroszczyk R. (2002). A uniform strain, discrete grain model for evolving anisotropy of polycrystalline ice. *Arch. Mech.*, 54, 103-126.
- Staroszczyk R. (2004). *Constitutive Modelling of Creep Induced Anisotropy of Ice*. IBW PAN Publishing House, Gdańsk, 1-201.
- Staroszczyk R. (2006). Axi-symmetric ice sheet flow with evolving anisotropic fabric. *Bull. Pol. Ac.: Tech.*, 54, 77-94.
- Staroszczyk R., Morland L.W. (2000). Orthotropic viscous response of polar ice. *J. Eng. Math.*, 37, 191-209.
- Staroszczyk R., Morland L.W. (2001). Strengthening and weakening of induced anisotropy in polar ice. *Proc. Royal. Soc. Lond. A*, 457, 2419-2440.

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Electrospraying and electrospinning – A new route to nanotechnology

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Electrospraying (or electrohydrodynamic spraying) of liquids is a physical process governed by electrical force imposed to a liquid jet. These forces disintegrate the jet into small droplets. An example of an electrospayed plume is shown in Fig. 1. Electrospinning is a process similar to electro-spraying but occurring for liquids of high viscosity. This viscosity prevents jet disintegration but thin fibers ($<1 \mu\text{m}$) are formed due to electrical shear stress on the jet surface.

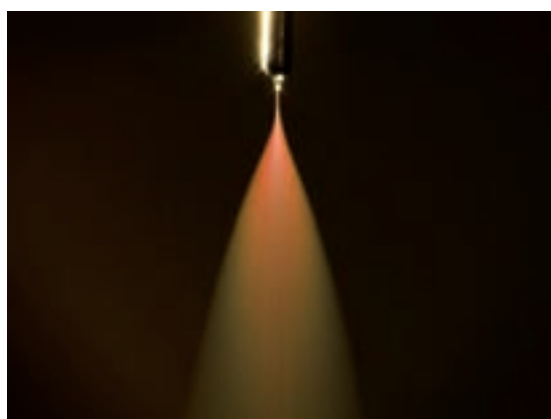


Fig. 1. Spray plume of distilled water electrospayed in the cone-jet mode. Capillary: 0.45 mm o.d., 0.25 mm i.d., flow rate 0.1 ml/h, voltage 8 kV, distance to plate electrode 30 mm, exposure 1/50 s

Nanoscience and nanotechnology can be briefly characterized as studying and working with objects of linear dimensions smaller than 100 nm. Nanoscience includes the investigation of physical phenomena at supra-atomic levels, such as atomic and molecular clusters, compounds built of thousands of molecules (e.g. polymers) or multiatomic structures (crystallites, self-assembled monolayers). Nanotechnology, in turn, refers to the processing, production, or application of materials and structures at the same size scale, and includes generation of nanoparticles, deposition of nanothin films, production of nanofibers, and fabrication of nanostructured materials (nanocomposites). Nanotechnology straddles traditional disciplines such as physics, engineering, chemistry, microelectronics, and mo-

lecular biology. In recent years, it was discovered that electrospaying and electrospinning may be effectively used for nanotechnology processes.

Experimental research on electrospaying and electrospinning, launched at the Institute of Fluid-Flow Machinery in 2006, has aimed to develop new methods for the fabrication of nanostructures such as nanothin layers, nanoparticles, nanofibers, and nanocomposites.

There are two main approaches to nanotechnology: “top-down” and “bottom-up.” Electrospaying and electrospinning can be placed among the “bottom-up” technologies, because these techniques allow various nanostructures to be built from elementary components via nanoparticle-by-nanoparticle deposition from fine electrospayed droplets after solvent evaporation, or via the processing of nanofibers made from a fine electrospun jet. Nanocomposite materials can be produced using these techniques by electrospaying and/or electrospinning of various materials of different physical and chemical properties. These methods can, for exam-

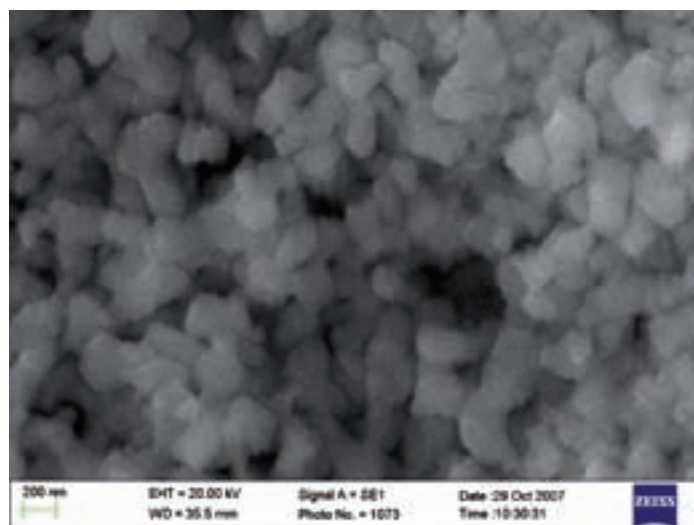


Fig. 2. SEM image of Al_2O_3 α particle layer deposited by electrospaying on a stainless steel substrate. Al_2O_3 α suspension in methanol, voltage = 17 kV_{DC}, capillary 0.45 mm o.d., 0.25 mm i.d., deposition time 10 min, volume of sprayed solution 2 ml, distance between the capillary nozzle and substrate plate 25 mm

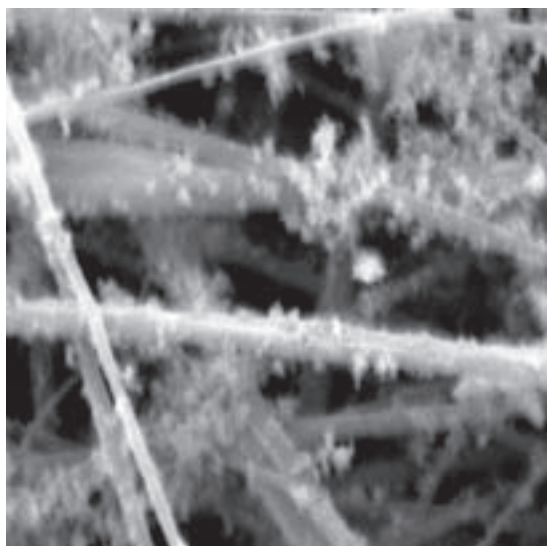


Fig. 3. SEM photograph of poly vinyl chloride nanofiber yarn with incorporated ZrO_2 nanoparticles produced via simultaneous electrospinning and electrospaying from separate nozzles

ple, produce composite nanofilms via electrospaying of nanoparticles of different kinds, yarns made from different electrospun nanofibers, or nanofibers blended with nanoparticles via simultaneous electrospinning of nanofibers and electrospaying of nanoparticles. Electro-coextrusion, a method of two liquid spraying from two co-axial capillary nozzles, provides micro- or nanocapsules as a feedstock for multi-component nanocomposites. Since 2006 these technologies have been tested and developed at the Institute of Fluid-Flow Machinery, and this research is still in progress. The Institute of Fluid-Flow Machinery has years of tradition in investigating electrospaying and research findings have been published in more than 30 peer-reviewed papers in journals of international circulation.

Experiments with micro- and nanothin film production via electrospaying were conducted for various metal oxides such as Al_2O_3 , ZnO , TiO_2 , and MgO . The layer morphology depends on the kind

of material to be deposited, the kind of solvent, the deposition rate, and the substrate temperature. The process was optimized with respect to uniformity of the layer. An example of a Al_2O_3 layer on stainless steel substrate, composed of nanoparticles of about 200 nm, is shown in Fig. 2.

Experiments in nanocomposite yarn formation by simultaneous electrospinning and electrospaying were carried out in cooperation with the National University of Singapore, Nanoscience & Nanotechnology Initiative. By this method, polymer nanofibers (made for example from PVC, polyamide, cellulose acetate, or polysulphonate) of diameter smaller than 200 nm were blended with metal oxide nanoparticles (e.g. TiO_2 , ZrO_2 , Fe_2O_3 , MgO , or Al_2O_3) of a size ranging from 20 to 100 nm. An example of a PVC yarn with ZrO_2 nanoparticles is shown in Fig. 3. This type of yarn could be used for the production of masks, filters, or scaffolds in biotechnology.

References

- Jaworek A. (2007). Electrospay droplet sources for thin film deposition. A review. *Journal of Materials Science*, 42(1), 266-297.
- Jaworek A. (2007). Micro- and nanoparticle production by electrospaying. *Powder Technology*, 176(1), 18-35.
- Jaworek A., Sobczyk A.T. (2008). Electrospaying route to nanotechnology. An overview. *Journal of Electrostatics*, 66(3-4), 197-219.

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Agricultural, Forestry, and Veterinary Sciences

The year 2007 marked the beginning of the Division V management's activities under the new term of office of Academy officials (2007-2010); the Division's Chairman is Prof. Andrzej Grzywacz and its Deputy Chairman Prof. Zygmunt Reklewski. At the end of 2007, Division V – Agricultural, Forestry and Veterinary Sciences – included 37 national members of the Academy (21 full members and 16 corresponding members) plus 25 foreign members.

In 2007 the following persons were elected to become full members of the Academy: Andrzej Grzywacz, Zygmunt Reklewski, Franciszek Tomczak, and Teresa Żebrowska. The newly elected corresponding members were Włodzimierz Bednarski, Małgorzata Mańka, Zdzisław Smorağ, Wojciech Święcicki, Marek Świtoński, and Jan Żmudziński.

There were 16 Committees affiliated with the Division, embracing a total of 466 members: the Committee on Agricultural Economics, the Committee on Agricultural Engineering, the Committee on Agrophysics, the Committee on Animal Sciences, the Committee on the Biology of Animal Reproduction, the Committee on Food Sciences, the Committee on Forestry Sciences, the Committee on Horticultural Sciences, the Committee on Land Reclamation and Agricultural Environment Engineering, the Committee on Management of Mountain Regions, the Committee on Physiology, Genetics and Plant Breeding, the Committee on Plant Cultivation, the Committee on Plant Protection, the Committee on Soil Science and Agricultural Chemistry, the Committee on Veterinary Sciences, and the Committee on Wood Technology.

Two Division council meetings (on 15 February and 12 November) discussed the preparation of plenary sessions and the current activities of the Division.

At the spring plenary session held in Olsztyn on 7-8 May, the activities of the Institute of Animal Reproduction and Food Research in Olsztyn were evaluated over the period 2003-2006. The candidates for the Oczapowski Medal were approved, and members were appointed to various bodies for the new term of office (e.g. the Standing Competitive Commission for the Election of Scientific Unit Directors, the Competitive Commissions for the

Election of Directors of the Institute of Plant Genetics, Poznań, and the Research Center for Agricultural and Forest Environment, Poznań). Matters connected with the new election of the Division V scientific committees were discussed. Reports were presented on the initiation of new election procedures for full and corresponding members of the Academy, on elections to the scientific councils at the Academy establishments, and on the procedures for electing unit directors. Also presented were a framework plan of activities for 2007 and the budget for the Division's scientific activity in 2007.

In the autumn, two plenary sessions were organized in Warsaw: one on 24 October to elect candidates to become full and corresponding members of the Academy, and one on 20 November to evaluate the activities of the Franciszek Górski Institute of Plant Physiology, Kraków, over the period 2003-2006. Elections to the scientific committees were reported on and candidates to become honorary chairmen and honorary members of the committees were also elected. Information was



Participants of an outdoor session of Division V of the Academy, held in Olsztyn on 13-14 May 2007. En route to the session itself, participants visited the historic Church of St. Catherine in Brąswałd. The church boasts numerous frescos (including a gallery of Polish saints) attesting to Warmia's ties to the Polish motherland. The history of the church and its frescoes was related by parish prelate Fr. Anicenty Murawski

presented on the appointment of new unit directors through competitive procedures. Plans to transform the Research Center for Agricultural and Forest Environment into an Institute were outlined and information on the restructuring of the Research Station for Ecological Agriculture and Preservation of Native Breeds (Popielno) was discussed. The Division's representatives to competitive commissions for the election of scientific unit directors (Kraków, Olsztyn, Powsin near Warsaw) were appointed, and a set of "Criteria for Evaluating the Division V Scientific Units for the 4 year Period" were accepted. A resolution was passed concerning the Division's scientific awards in 2007, and information was presented on the conferral of the M. Oczapowski Medals and Division V Laurel statuettes. Moreover, election procedures for full and corre-



Ceremony for conferring the 2007 research awards and diplomas to honorary committee members, held on 3 December 2007. From left: Jerzy Ważny, Full Member of the Academy, Andrzej Szujecki, Full Member of the Academy, member of a team honored with the Michał Oczapowski prize, and winner of the Oczapowski Medal, Antoni Rutkowski, Full Member of the Academy and chairman of the Oczapowski Medal Chapter Committee, and Andrzej Grzywacz, Full Member of the Academy and chairman of Division V of the Academy

sponding members of the Academy in 2007 were summarized.

The Michał Oczapowski scientific prize was granted for the book *Zooindication based monitoring of anthropogenic transformations in Białowieża Primeval Forest* to the research team of Prof. Andrzej Szujecki, including Prof. Sławomir Mazur, Prof. Henryk Tracz, Assist. Prof. Jarosław Skłodowski, Assist. Prof. Małgorzata Sławska, Assist. Prof. Marcin Smoleński, Dr. Marek Sławski, Dr. Tomasz Mokrzycki, Dr. Adam Byk, Dr. Dariusz Łęgowski, Dr. Artur Rutkiewicz, and Stanisław Perliński MSc. (recommended by the Committee of Forestry Sciences).

Research projects were commended as follows: (1) "Isolation and identification of genes with expression connected with the tolerance of cultivated potato cultivars and the wild species of *Solanum sogarandinum* to stresses caused by cold, drought and salinity" earned a prize and diploma for the research team of Assist. Prof. Tadeusz Rorat, Dr. Agnieszka Kielbowicz-Matuk, Dr. Zhimin Yin, and Bartosz Sabała MSc. (the Institute of Plant Genetics, Poznań, as recommended by the Committee on Physiology, Genetics and Plant Breeding), (2) "Selection indices considering the milk production traits of milk goats and a proposed selection index for functional traits" earned a diploma for Assist. Prof. Emilia Bagnicka (the Institute of Genetics and Animal Breeding, Jastrzębiec, as recommended by the Committee on Animal Sciences), (3) "Biological activity and its attendant processes in organic soils irrigated with purified municipal sewage (field and model experiments)" earned a diploma for Assist. Prof. Małgorzata Brzezińska (the Bogdan Dobrzański Institute of Agrophysics, Lublin, as recommended by the Committee on Soil Science and Agricultural Chemistry), (4) "Technical progress and the efficiency of substituting objectified work for live work in agriculture" earned a diploma for Assist. Prof. Sylwester Tabor (Hugo Kołłątaj Agricultural University, Kraków, as recommended by the Committee on Agricultural Engineering).

The highest scientific awards of Division – the M. Oczapowski Medals – were granted to full Academy member Jan Gliński (Bogdan Dobrzański Institute of Agrophysics, Lublin), Prof. Wacław Leszczyński (University of Environmental and Life Sciences, Wrocław), and Prof. Czesław Tarkowski (University of Life Sciences, Lublin).

The Division V Laurel, an award established in 2005, was conferred upon Prof. Jan Kowalczyk (Jan

Kielanowski Institute of Animal Physiology and Nutrition, Jabłonna) for outstanding contributions to the development of zootechnical sciences; upon Prof. Stanisław Kostrzewa (University of Environmental and Life Sciences, Wrocław) for his outstanding contributions to the development of agricultural sciences; upon Prof. Andrzej Libik (Hugo Kołłątaj Agricultural University, Kraków) for outstanding contributions to the development of horticultural sciences; and upon the Hugo Kołłątaj Agricultural University of Kraków for distinguished contributions to the development of agricultural, forestry and food sciences.

On the basis of materials prepared by the scientific committees of Division V, a special issue of *Postępy Nauk Rolniczych* (Advances of Agricultural Sciences) was published under the title “Evaluation of achievements in scientific disciplines for years 1994-2003 including agricultural, forestry, veterinary, and food sciences as well as the main fields and directions of future research activity attending to scientific progress, education, Polish agriculture, forestry, veterinary and the food processing industry.”

A scientific conference of Division V was held on 22 October, on “Studying the safety of food and feeds of animal origin – current status and prospects,” organized by the Committee on Veterinary Sciences.

A ceremony for awarding the Division’s Scientific prizes, distinctions and appointments was organized on 3 December. The “*Pro Scientia et Vita*” foundation, established by Division V members, provided financial support for young scientists for the sixth year.

The scientific activities of the Division, its research units, and its committees resulted in the publication of 23 scientific journal titles, including: *Acta Agrophysica*, *Acta Physiologiae Plantarum*, *Animal Science Papers and Reports*, *Annual Review of Agricultural Engineering*, *Folia Forestalia Polonica (Series A and B)*, *International Agrophysics*, *Inżynieria Rolnicza (Agricultural Engineering)*, *Journal of Animal and Feed Sciences*, *Journal of Applied Genetics*, *Journal of Plant Protection Research*, *Journal of Water and Land Development*, *Polish Journal of Food and Nutrition Sciences*, *Polish Journal of Soil Science*, *Polish Journal of Veterinary Sciences*, *Prace i Materiały Zootechniczne (Livestock Research Papers and Communications)*, *Problemy Inżynierii Rolniczej (Problems of Agricultural Engineering)*, *Problemy Zagospodarowania Ziemi Górskich (Problems of Management of Mountain Areas)*, *Reproductive Biology*, *Roczniki Nauk Rolni-*

czych – Seria G (Annals of Agricultural Sciences – Series G), and *Zagadnienia Ekonomiki Rolnej (Problems of Agricultural Economics)*.

The Division published 8 titles issued by the committees as well as “*Postępy Nauk Rolniczych (Advances of Agricultural Sciences)*”, the bimonthly publication of Division V – Agricultural, Forestry and Veterinary Sciences. Issues 516-523 of the non-periodic series *Zeszyty Problemowe Postępów Nauk Rolniczych (Advances in Agricultural Sciences – Problem Issues)* were published in 2007, financed by different Polish scientific units, as well as issues 11 and 12 of *Biuletyn Informacyjny Wydziału Nauk Rolniczych, Leśnych i Weterynaryjnych PAN* (Information Bulletin of Division V – Agricultural, Forestry and Veterinary Sciences, Polish Academy of Sciences).



Ceremony for conferring the 2007 research awards and diplomas to honorary committee members, held on 3 December 2007. From left: Zygmunt Reklewski, Full Member of the Academy and deputy chairman of Division V, Prof. Henryk Skąpski, honorary member of the Committee on Horticultural Sciences, Antoni Rutkowski, Full Member of the Academy and chairman of the Oczapowski Medal Chapter Committee, Andrzej Grzywacz, Full Member of the Academy and chairman of Division V of the Academy, Prof. Edward Żurawicz, chairman of the Committee on Horticultural Sciences, Adolf Horubała, Full Member of the Academy and chairman of the Division V award committee

Biological activity and nutrient removal in organic soils irrigated with wastewater

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As demand for fresh water intensifies all over the world, wastewater is frequently being seen as a valuable resource. Globally, around 20 million ha of land are irrigated with wastewater, and this is likely to increase markedly during the next few decades. The rationale for this practice differs between the developing and developed worlds. In developing countries, the prime drivers are livelihood dependence and food security, whereas environmental agendas appear to be significant in the developed world. Compared with other European countries, Poland can be regarded as a country of poor water resources, with the water exploitation rate exceeding 20% of existing reserves. At present, in Poland about 7000 on-site systems for individual farms are in operation and more than 100 constructed wetlands composed of vegetation filters with reed or willow have been installed.

Wastewater irrigation on land is among the ancient anthropogenic activities that affect soil quality (for Poland the first record dates back to 1559). This practice can resolve certain environmental

problems related to an excessive or unbalanced supply of nutrients and the introduction of pollutants into ground water. Equally importantly, wastewater can secure the supply of water to crops. However, an accumulation of undesirable or toxic elements has the potential to restrict some soil functions and cause plant toxicity and food chain contamination. Soil irrigated with wastewater acts as a filter that purifies wastewater through several physical, chemical, and biological processes. Soil microorganisms play a key role in maintaining ecosystem functions through their contribution to a wide range of essential alterations. Thus, the changes in soil microbial activity are considered to constitute an early warning for decreasing soil quality.

This research looked at the impact of wastewater irrigation of muck soils (Terric Histosol, Histi-Mollic Gleysol) on their biological activity and some physico-chemical properties and processes essential under flooding conditions. As the results of field experiments were difficult to interpret in clear-cut fashion, model studies were performed under controlled laboratory conditions with soil monoliths and soil samples.

The study evidenced the suitability of muck soils for the elimination of excess nutrients from wastewater. Higher effectiveness of the soil-root filter was obtained for phosphates (>80%), somewhat lower for ammonia (62-77%) and nitrates (43-72%).

Four-year periodic irrigation with treated municipal wastewater (600 or 1200 mm per year) significantly affected soil biological status. The intensity and trend of these changes strongly depended on soil type, soil depth, plant cover, and wastewater dose. Under field conditions, soil dehydrogenase and catalase activities were inhibited in peat-muck soil under poplar (*Populus* spp.) and in mineral-muck soil with grass cover (with domination of *Alopecurus pratensis*, *Phalaris arundinacea* i *Festuca pratensis*), while they were stimulated in peat-muck soil planted with willow (*Salix* spp.).

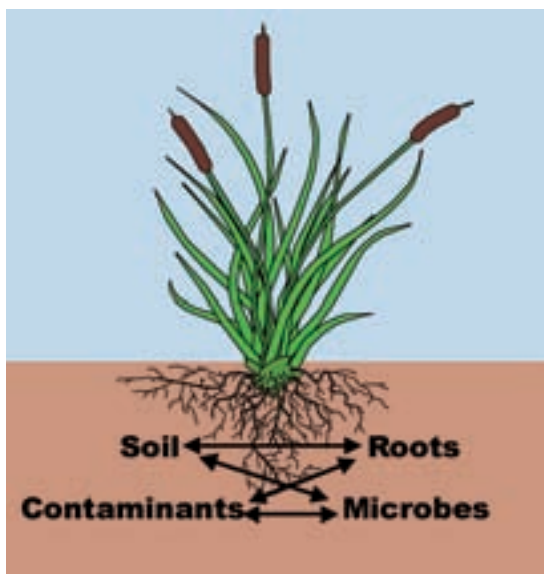


Fig. 1. Wastewater purification in soil – possible interactions in the root zone

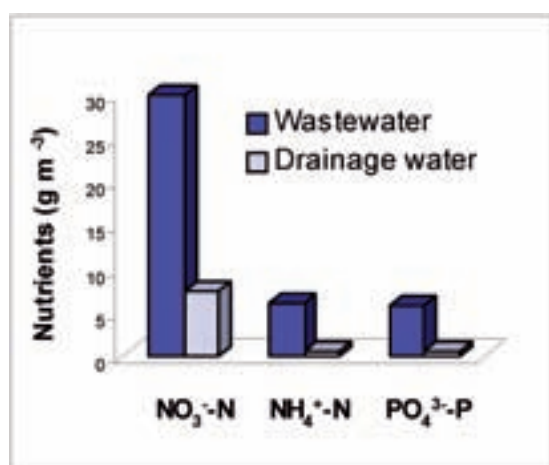


Fig. 2. Nutrient elimination in tested soils – nitrogen and phosphorus concentrations in wastewater used for irrigation, and in drainage water (at soil depth of 150 cm)

microbial populations of previously irrigated soil took place. By contrast, the irrigation of soil planted with willow improved its microbial status as measured by an increase in C availability (C_{mic} -to- C_{org} ratio), microbial biomass and actual activity, as well as by lower qCO_2 . In meadow surface soil, some beneficial alterations were observed (increased microbial biomass, dehydrogenase activity, N_2O formation) with no changes in C_{mic} -to- C_{org} , qCO_2 index, and glucose-stimulated activities. Despite a relatively high level of biochemical activity, the soils tested showed very high redox resistance. Intensive redox processes were observed only in glucose amended soils (N_2O , Fe^{2+} , H_2 , and CH_4 detected at $Eh < 400$, < 300 , < 200 , and < -50 mV, respectively).

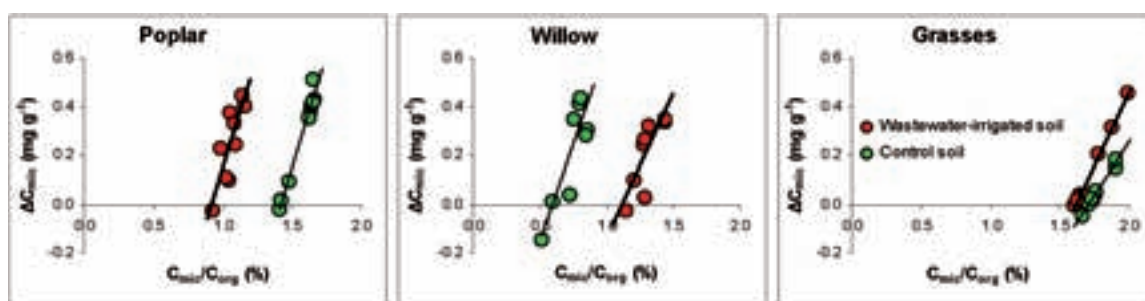


Fig. 3. Changes in soil microbial biomass (ΔC_{mic}) versus index of soil carbon availability (C_{mic}/C_{org} ratio) in organic soils planted with poplar, willow and grasses (non-irrigated controls and soils irrigated with wastewater)

The persistence of the changes over time, as determined in the laboratory 3 years after irrigation was ceased, depended significantly on the previous soil-plant system. The inhibition was still observed in soil under poplar, while it was unstable in meadow soil. The stimulation of enzyme activity in soil under willow, in turn, was maintained in the surface layer only, not in deeper layers.

Various indicators used to study surface soils (0-10 cm) under laboratory conditions revealed a strong alteration in the physiological status of irrigated soils' microbial communities. The deterioration of soil biological properties under poplar was evidenced by a decrease in microbial biomass and biochemical activities related to the native organic matter utilization ability (dehydrogenase and catalase activities, N_2O formation) and by an increase in metabolic quotient (qCO_2) and a decrease in C_{mic} -to- C_{org} ratio. However, a high level of potential activity (mineralization of the added glucose) indicated that no detrimental effects in

All soils irrigated with wastewater showed lower pH, higher contents of C_{org} , NH_4^+ , NO_3^- , higher C:N ratio, and greater respiration and methanotrophic activities than the control soils. Despite some disadvantageous alterations, all soils maintained their potential ability for methanotrophic activity, complete denitrification to N_2 , and redox resistance. These properties emphasized the adaptability of the organic soils tested to irrigation with wastewater, albeit supporting proper soil air-water conditions.

References

- Brzezińska M. (2006). Impact of treated wastewater on biological activity and accompanying processes in organic soils (field and model experiments). *Acta Agrophysica*, 131, 3-164.
- Brzezińska M., Tiwari S.C., Stepnińska Z., Nosalewicz M., Bennicelli R.P., Samborska A. (2006). Variation

of enzyme activities, CO₂ evolution and redox potential in an Eutric Histosol irrigated with wastewater and tap water. *Biology and Fertility of Soils*, 43, 131-135.

Kotowska U., Włodarczyk T., Brzezińska M. (2007). Transformations of nitrogen and phosphorus in soil planted with willow irrigated with wastewater. *Archives of Environmental Protection*, 33, 67-78.

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Influence of environmental pollutants on the function of bovine reproductive processes

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Polychlorinated biphenyls (PCBs) are a group of 209 congeners that were manufactured for industrial use, while dichlorodiphenyltrichloroethane (DDT) is an insecticide. As both of these compounds were widely used in industry and in agriculture they have penetrated into the environment and become present in almost every component of the global ecosystem involving air, water, and soil. The production and use of PCBs and DDT has been banned in Europe and the US since they were recognized as potential factors of health risk. PCBs and DDT are known as teratogenic, embryotoxic, neurotoxic and purportedly carcinogenic factors. Their resistance to degradation and affinity to adipose tissue allow them to be accumulated in the lipid tissue, and subsequently to influence the vital processes in living bodies.

The aim of the current study was to investigate the effect of PCB 77 (recognized as an estrogen and dioxin-like congener), DDT, and DDE (the metabolite of DDT) on the function of the bovine reproductive.

Ovaries (days 5-10 of the estrous cycle) and uterine horns (days 1-5 and 8-12) were collected from a slaughterhouse. Luteal, endometrial, and myometrial cells were isolated by enzymatic dispersion. Granulosa cells were obtained from follicles by flushing with own follicular fluid. All cells were cultured at 38°C, in humidified atmosphere (95% air and 5% CO₂). Ovarian cells were pre-incubated for 24h, endometrial and myometrial cells for 72 and 96h respectively, to allow them to attach to the well bottom. Next, cells were incubated for 6, 24, or

72h with PCB 77, DDT, or DDE (1 and 10 ng/ml). Longitudinal strips of myometrium were dissected and immersed in aerated (95% air and 5% CO₂) physiological salt solution (4°C) for 24-72h with PCB 77 and for 48h with indomethacin (INDO, 10⁻⁴M), blocker of cyclooxygenase (COX), jointly or separately with PCB 77 (1; 10; 100 ng/ml). The viability of cells treated (72-96h) with these xenobiotics was also investigated. Oxytocin, PGFM (metabolite of PGF2 α) and PGE2 concentration in the medium was estimated by EIA. RNA was isolated from the studied cells and subjected to RT-PCR. cDNA obtained from luteal and granulosa cells was amplified by PCR using primers for genes of NP-I/OT (oxytocin precursor) and PGA (peptidyl-glycine- α -amidating-monooxygenase). G3PDH was used as reference gene. cDNA obtained from endometrial and myometrial cells was amplified by PCR using primers for COX and PGFS genes, i.e. genes involved in PGF2 α synthesis. 18S RNA was used as reference gene. The spontaneous and OT (10⁻⁷M) stimulated myometrial contractility was measured with an HSE Schuler Organbath apparatus. All experiments were performed in n=4-8 repetitions.

Each the compounds applied affected (p>0.05) the viability of used cells, thus we assume that the data were obtained from living cells. PCB 77 and DDE increased (p<0.05) OT secretion from luteal and granulosa cells, but DDT increased (p<0.05) OT secretion from luteal cells only (Fig. 1). PCB 77 and DDE also increased (p<0.05) gene expression for NP-I/OT and PGA in luteal cells (data not

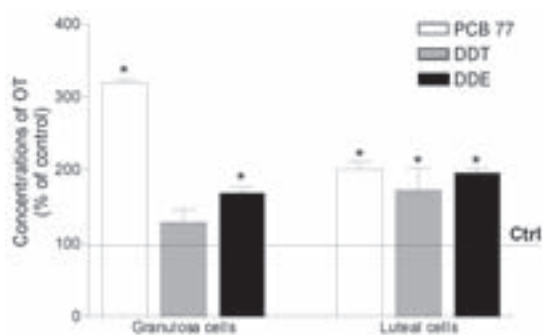


Fig. 1. Effect of PCB 77, DDT and DDE (10 ng/ml) on mean (\pm SEM) secretion of OT from granulosa and luteal cells. * ($p < 0.05$)

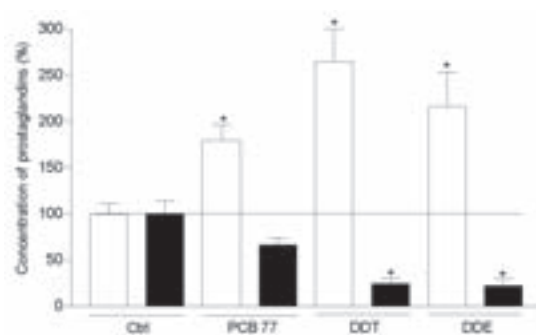


Fig. 3. Effect of PCB 77, DDT, and DDE (10 ng/ml) on mean (\pm SEM) PGF2 α (white bar) and PGE2 (black bar) secretion from endometrial cells. * ($p < 0.05$)

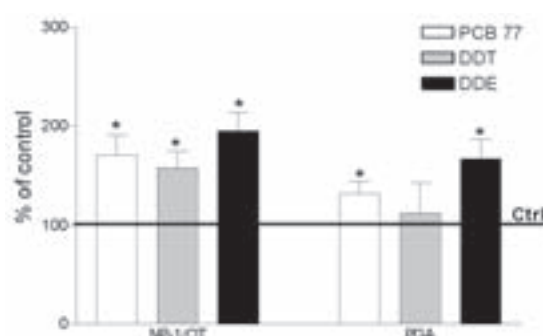


Fig. 2. Effect of PCB 77, DDT, and DDE (10 ng/ml) on mean (\pm SEM) gene expression of NP-I/OT and PGA in granulosa cells. * ($p < 0.05$)

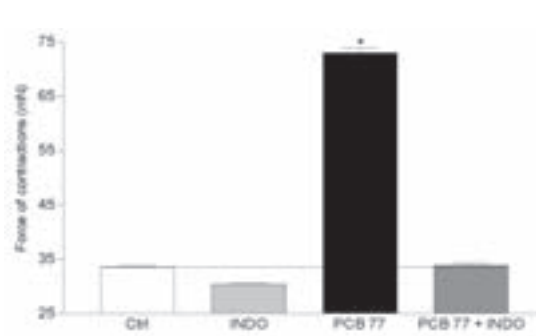


Fig. 4. Effect of PCB 77 (10 ng/ml) compared with indomethacin (INDO) on mean (\pm SEM) force of myometrial contractions. * ($p < 0.05$)

shown). Moreover, PCB 77, DDT, and DDE increased ($p < 0.05$) gene expression of NP-I/OT in granulosa cells (Fig. 2). However, only PCB 77 and DDE increased ($p < 0.05$) gene expression for PGA (Fig. 2). PCB 77, DDT, and DDE increased ($p < 0.05$) PGF2 α secretion from endometrial cells (Fig. 3). However, PCB 77 had no effect on the expression of genes involved in PGF2 α synthesis (data not shown). Endometrial secretion of PGE2 was not affected ($p > 0.05$) by PCB 77, while DDT and DDE even reduced ($p < 0.05$) PGE2 release (Fig. 3). Thus PCB 77, DDT, and DDE may disrupt the ratio PGF2 α : PGE2 in endometrial cells, which is crucial for the maintenance of early pregnancy. PCB 77 increased ($p < 0.05$) both PGF2 α secretion from myometrium (data not shown) and the force of myometrial contractions (Fig. 4). However, INDO markedly ($p < 0.05$) reduced this effect by PCB 77 (Fig. 4).

Ovarian OT and PGF2 α are released concomitantly as a positive feedback loop effect. Since the compounds used can increase OT and PGF2 α secretion during the whole estrous cycle, they can also

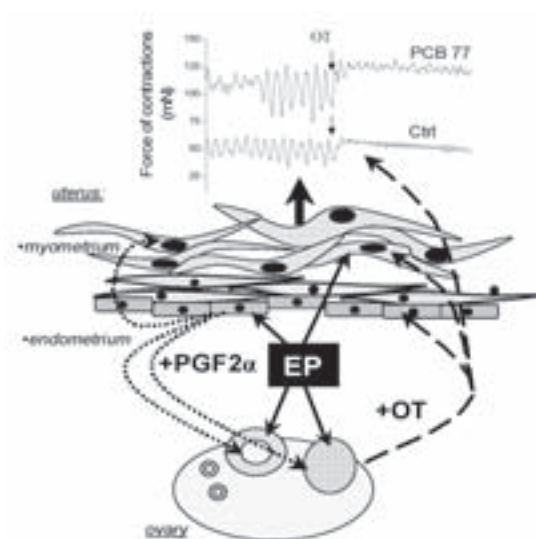


Fig. 5. Effect of PCBs, DDT, and DDE (EP) on ovary and uterus function – mechanism of action. Above, exemplary chart of contractions of two individual myometrial strips (control and pretreated with PCB 77; 10 ng/ml; before and after OT challenge, arrows). Strips were collected from a single cow

elicit premature luteolysis and affect the length of the estrous cycle. It is noteworthy that the metabolite of DDT has a much more adverse effect on OT synthesis and secretion than DDT itself. Both OT and PGF2 α are also involved in the stimulation of uterine contractions. PCBs may also increase uterine contraction, thus they may be responsible for the impairment of fertilization, blastocyst implantation, and even abortion (Fig. 5). All treatments stimulated endometrial PGF2 α secretion. Although PCB 77 did not affect PGF2 α synthesis, we assume it is involved in the effect of PCBs on uterine contractions, since INDO reduced the contraction force increase evoked by PCBs. We conclude that PCBs and DDT may impair bovine reproductive processes by influencing ovary and uterus secretory function, and this is followed by increased force of uterine contractions.

References

Młynarczuk J., Kotwica J. (2006). Effect of polychlorinated biphenyls on the secretion of oxytocin from

luteal and granulosa cells in cow: possible involvement of glucocorticoid receptors. *Veterinarni Medicina*, 51, 391-398.

Młynarczuk J., Wróbel M., Kotwica J. (2008). The effect of DDT and its metabolites on the expression of the NP-I/OT and PGA genes in luteal and granulosa cells and LIF factor in endometrium of cow. *Medycyna Weterynaryjna* (in press).

Wróbel M., Kotwica J. (2007). Phytoestrogens reduce the effect of polychlorinated biphenyls on the contractility of bovine myometrium in vitro. *Veterinarni Medicina*, 52, 55-62.

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Canine olfactory detection of human cancer odor markers

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This research aimed to validate methods of canine training and olfactory detection of human cancer odor markers carried in exhaled breath. Since no good image-based screening method is yet available for primary lung cancer, new methods of early-stage cancer detection are being sought via microanalysis of volatile organic compounds (VOCs) produced by changed metabolism in cancer disease and exhaled in the breath. Several candidate VOC biomarkers of cancer disease (e.g. alkanes, alkane derivatives, benzene derivatives) may be identified using gas chromatography / mass spectrometry and colorimetric sensor array or quartz microbalance gas sensors. Yet as these technologies are sophisticated and involve the use of mathematical models to reduce the abundance of breath biomarkers and to lower breath collection time, they appear to be impractical.

Sniffer dogs are known for their olfactory acuity which enables them to detect odorous molecules

as low as in ppt (parts per trillion) concentrations and to distinguish specific odor molecules in a mixture of different odors. Although dogs are widely used for different forms of detection (e.g. narcotics, explosives, human body and remains, identification of perpetrators on the base of scent) the reliability of such detection has not been sufficiently assessed using scientific methods. Due to their trainability (responding to operant conditioning), dogs are good candidates for the simple, non-invasive detection of VOCs as odor markers of cancer disease. This notion was supported by reports carried in the prestigious medical journal *The Lancet* on cases of spontaneous detection of melanoma by untrained dogs.

In our research project we trained dogs to detect lung and breast cancers, as the major malignancies in men and women respectively, and melanoma, as a malignancy spontaneously detected by untrained



Odor samples being sniffed by the dog Gromit (M. Walczak)

dogs according to literature reports. Our laboratory is one of four laboratories in the world where canine detection of cancer is being investigated using a scientific approach. Six dogs were trained to distinguish pattern breath samples taken from donors diagnosed with lung cancer (78 donors), breast cancer (55 donors) or melanoma (46 donors) from those taken from “healthy” controls (400 samples, 350 individuals). Data on age, sex, kind and stage of cancer, diet, smoking and health status of donors were taken into consideration as variables.

Three adult dogs out of six completed all stages of the training and have been deemed ready for detection, while three younger dogs are at the final training stage. Altogether, 6800 trials of different kinds with 3 adult dogs were conducted, including “active” trials where the dog has to indicate the pattern odor, “zero” trials where no pattern odor was in the lineup and the dog should refrain from indicating randomly, and “double-blind” trials where the status of the tested sample was unknown to the experimenter and had to be ascertained on



The dog Cygun indicates an appropriate sample to Prof. Tadeusz Jezierski (M. Walczak)

the basis of dog indications. Two kinds of criteria for correct indication were used: (1) a yes/no reaction in relation to each sniffed sample and (2) correct choice of the pattern sample in a lineup of four controls and one pattern sample. Using criterion (1) the trained dogs were able to distinguish pattern breath samples from control samples with detection sensitivity 84.9%, 76.8%, and 84.8% (at 50% of correct indication by chance) and with specificity 84.3%, 72.0% and 82.0% for lung cancer, breast cancer and melanoma respectively. Particular dogs did not differ significantly in terms of detection indices, which ranged from 68.0% to 89.2% for sensitivity and from 76.7% to 87.7% for specificity. Using criterion (2) an average sensitivity of 60% was achieved (at 20% of correct indications by chance). No significant differences in correct indications depending on the cancer stage were observed. Various causes for dog errors (false positive indications and misses) were analyzed, e.g. poor motivation for reward, discouragement caused by a lack of success, unconscious dog-handler communication, the effect of sample position within the lineup, duration of sample storage before testing, and contamination of samples by other odor molecules. At present we are investigating the possibility of canine detection in relation to samples from donors with very early stages of cancer before confirmation by medical diagnosis. Canine olfactory detection can be regarded as a step towards developing a simple, reliable, non-invasive, low-cost pre-screening method of cancer disease in humans which would be applicable especially in countries where access to medical cancer screening is difficult.

References

McCulloch M., Jezierski T., Broffman M., Hubbard A., Turner K., Janecki T. (2006). Diagnostic accuracy of canine scent detection in early – and late – stage lung and breast cancers. *Integrative Cancer Therapies*, 5(1), 1-10.

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Association of the polymorphism and expression of certain genes with the occurrence of mastitis in dairy cattle

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Traditionally, breeding goals for dairy cattle have mainly focused on increasing productivity, yet the intense selection for production traits has led to an increase in disease frequency in the dairy cow population. One of the traits affected by this selection pressure is *mastitis*. Considered the most important dairy cow disease in terms of economic impact, mastitis reduces milk yield and lowers the quality of milk and milk products in all dairy-producing countries of the world. It affects not only animal production effectiveness but also animal welfare issues.

Introducing resistance to mastitis into dairy cattle breeding programs seems to be one of the possible methods for curbing the increasing number of clinical and sub-clinical cases of udder inflammation and thus a method of improving the economic results of cattle husbandry and breeding. Looking for candidate genes is one of the strategies for introducing mastitis resistance into breeding programs. The *BoLA-DRB3* alleles and lactoferrin alleles show considerable promise as potential mastitis markers.

The overall aim of the study was to examine if alleles of the genes lactoferrin and *BoLA-DRB3* (among the major histocompatibility complex genes) could be proposed as candidate genes for resistance to mastitis in dairy cattle. To answer this general question several objectives were examined, i.e.:

- To explore the interrelation between mastitis caused by different bacterial species and genotypes for *BoLA-DRB3 locus* (*BoLA-DRB3.2*16* and *BoLA-DRB3.2*23*),
- To identify the relationship between genotypes of the lactoferrin gene and sub-clinical mastitis caused by *Staphylococcus aureus*, other staphylococci, and *Streptococcus dysgalactiae*,
- To evaluate the PCR method in identifying *Staphylococcus aureus* from the milk of infected cows,
- To identify associations between somatic cell count as a measure of mastitis and genotypes for *BoLA-DRB3 locus* (*BoLA-DRB3.2*16* and *BoLA-*

*DRB3.2*23*) and the lactoferrin gene in Polish dairy cattle,

- To examine the expression of *BoLA-DRB3* genes in different stages of lactation.

The methods used to fulfill these objectives combine the techniques of molecular biology and population genetics. The material for the study was 525 Polish Black-and-White Holstein dairy cows from the experimental farm of the Institute of Genetics and Animal Breeding. The experiment was carried out over three years from 2004 to 2006. DNA from the blood of all cows was collected prior to genotyping *BoLA-DRB3.2*16* and *BoLA-DRB3.2*23* alleles by the MPT-PCR method (Fig. 1) and lactoferrin alleles by the RFLP-PCR method. Milk samples were collected for mastitis diagnosis on the basis of bacteriological examination and somatic cell count in milk. To diagnose *Staphylococcus aureus mastitis* the PCR protocol (Fig. 2) was established. To test differences between alleles in *BoLA-DRB3* and lactoferrin *locus* and different measures of mastitis (test-day somatic cell count, estimating breeding value of somatic cell count, latent and sub-clinical mastitis caused by all examined bacterial species) different methods of population genetics were used: GLM (general linear model), REML (restricted maximum likelihood) and BLUP (best linear unbiased prediction).

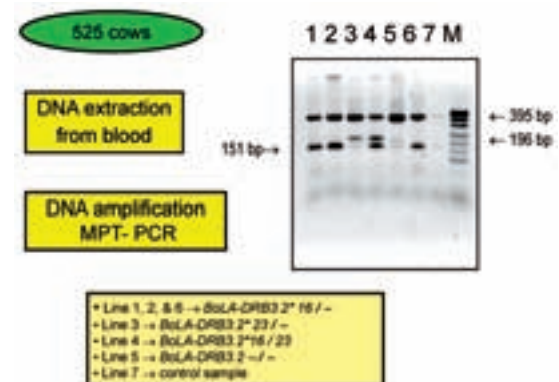


Fig. 1. Identification of *BoLA-DRB3.2* alleles by the MPT-PCR method

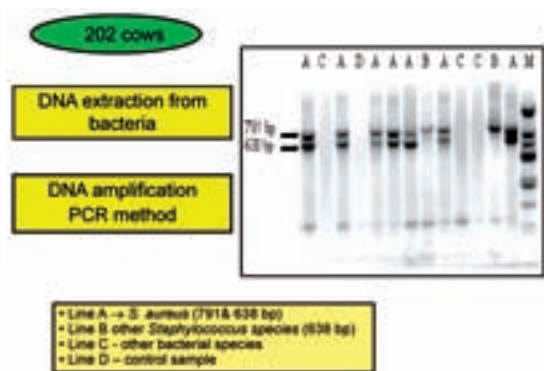


Fig. 2. Identification of *Staphylococcus aureus* (*S. aureus*) in the milk of infected cows using the PCR method

The most important results of the project are presented below. The first result to be used in the experiment was to establish PCR protocol for the identification of *Staphylococcus aureus*, the most common bacteria causing cow udder infections (Fig. 2). The PCR method for identifying *Staphylococcus aureus* bacteria in milk appears to be objective, sensitive, and specific when compared to conventional methods of recording mammary gland infection status. It can be used not only for unambiguous identification of *Staphylococcus aureus* but also for the identification of other *Staphylococcal* species found in bovine milk culture from infected cows.

Cows carrying *BoLA-DRB3.2*23* allele were found to develop sub-clinical mastitis caused by *Streptococcus dysgalactiae* significantly more often when compared against cows carrying *BoLA-DRB3.2*16* and against heterozygous (*BoLA-DRB3.2*16/23*) animals (Fig. 3). There was no association between cows carrying *BoLA-DRB3.2*16* and *BoLA-DRB3.2*23* allele with susceptibility or resistance to *Staphylococcus aureus* mastitis or sub-

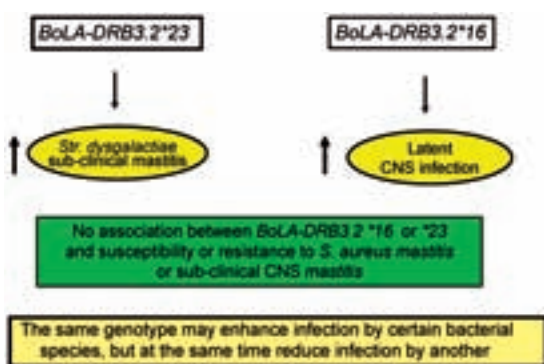


Fig. 3. Association between *BoLA-DRB3.2* alleles and mastitis caused by different bacterial species

clinical mastitis caused by coagulase-negative staphylococci (CNS), but *BoLA-DRB3.2*16* was significantly associated with increased susceptibility to the latent CNS infection. Alleles may thus be related to resistance or susceptibility of mastitis according to environmental conditions (pathogens causing mastitis), which may differ by population. The present study suggested that one genotype may enhance infection by certain bacterial species, but at the same time resist infection by another. No relationship was found between lactoferrin polymorphism and mastitis caused by any of the bacteria examined.

The study found that expressions of *BoLA-DRB3* alleles in milk macrophages and lymphocyte at 2-3 months of lactation was two times higher than at the onset of lactation. This can explain the decrease in cow resistance to mastitis pathogens after calving.

A significant decrease was observed in the somatic cell count (phenotypic value – PV) of cows carrying *BoLA-DRB3.2*16* allele, compared to cows carrying *BoLA-DRB3.2*23*. A significant decrease was also found in the somatic cell count (phenotypic value – PV) in the milk of cows of lactoferrin genotype BB, compared to cows of genotype AA and AB.

In the examined population cows carrying *BoLA-DRB3.2*23* allele had a higher estimated breeding value (EBV) for somatic cell count in milk as compared to cows carrying *BoLA-DRB3.2*16* or other alleles (Fig. 4) but there were no differences between estimated breeding value (EBV) of somatic cell count and lactoferrin polymorphism.

It can be concluded that *BoLA-DRB3.2*16* allele may indicate greater mastitis resistance, whereas

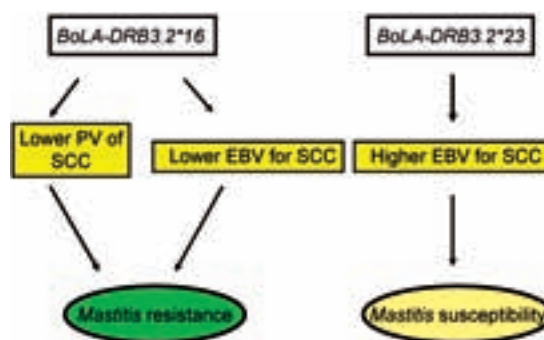


Fig. 4. Association between *BoLA-DRB3.2* alleles and somatic cell count (SCC) phenotypic value (PV) or estimated breeding value (EBV)

*BoLA-DRB3.2*23* may indicate greater mastitis susceptibility. The *BoLA-DRB3* gene can be proposed as a candidate for mastitis resistance and used in breeding programs as a genetic marker of mastitis. The lactoferrin gene polymorphism examined here is not a functional one and other polymorphisms must be sought for this gene in order to propose it as a candidate for mastitis resistance.

References

- Galal Abdel Hameed K., Sender G., Korwin-Kossakowska A. (2007). Public health hazard due to mastitis. *Animal Sciences and Reports*, 25(2), 73-85.
- Sender G., Galal Abdel Hameed K., Korwin-Kossakowska A. (2008) Association of the *BoLA-DRB3* alleles with estimated breeding value for somatic

cell count in Polish dairy cattle. *Archiv für Tierzucht*, 51(2), 111-119.

- Galal Abdel Hameed K., Sender G., Korwin-Kossakowska A. (2008). An association of BoLA alleles *DRB3.2*16* and *DRB3.2*23* with occurrence of mastitis caused by different bacterial species in two herds of dairy cows. *Animal Sciences and Reports*, 26(1) (in press).

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Medical Sciences

Division VI – Medical Sciences represents the medical scientific and academic community in Poland (including universities, institutes, and respective academic schools), promotes research in medicine, pharmacy, physical training, and health education, and supervises research activity at the Academy institutes affiliated with the Division. The Division's Chairman is Prof. Wojciech Kostowski (corresponding member of the Academy), a psycho- and neuropharmacologist. His Deputy Chairmen are Prof. Sławomir Majewski (corresponding member of the Academy), a dermatologist and immunologist, and Prof. Jacek Zaremba (corresponding member of the Academy), a specialist in clinical genetics and neurology.

The Division has been successfully meeting the difficult challenge of adapting research activity at the institutes to the competitive European and global scientific environment and, at the same time, adjusting scientific policy to the economic situation in Poland. The Division believes that medical research has to focus on the most promising trends in medicine, including those of potential application.

As of the end of 2007 there were 21 full members, 18 corresponding members, and 22 foreign members of the Division. Three new full members and three new corresponding members of the Academy were elected to the Division in December 2007.

During the year the Division members actively participated in preparing opinions and expert reports for the government and Ministry of Health with regard to various regulations, laws, and acts. A new form of activity of the Division was also initiated, known as the *Internet Medical University*. Three scientific press conferences were organized at the initiative of the Chairman of the division: 1) *Sepsis – diagnosis, treatment and prognosis*, 2) *Bifalpine – hope for the treatment of pain*, and 3) *Medical and sociological aspects of resistance to antibiotics*. Prof. Jerzy Nowak was selected via a competitive procedure to become head of the Institute of Human Genetics in Poznań. Moreover, the Division launched official procedures for establishing an Institute of Medical Biology in Łódź.

Two plenary sessions of the Division took place in 2007. At the session on 22 March, Prof. Grzegorz

Opolski from the Medical University of Warsaw presented a lecture on *Cardiology – new perspectives*. Division members drew up a statement on the protection of physicians in a view of current unjustified attacks. An Advisory Committee to the head of the Division was also elected.

The session on 25 October, in turn, focused on the election of new full and corresponding members of the Academy. Three new full members (Prof. Janusz Komender, Prof. Olgierd Narkiewicz, and Prof. Jan Ryżewski) and three new corresponding members (Prof. Jan Albrecht, Prof. Marek Krawczyk, and Prof. Jerzy Vetulani) were elected.

The Division granted awards to the following scientists: the Jędrzej Śniadecki Medal went to Prof. Joanna Strosznajder from the Mirosław Mossa-



Ceremony at which the Division VI Awards were conferred

kowski Medical Research Center (Warsaw) for her achievements in studying the neurotransmission and pathogenesis of neurological disorders and in the popularization of medical sciences. The Division's Individual Scientific Prize went to Dr. Małgorzata Lewandowska-Szumieł from the Department of Biophysics and Human Physiology (Medical University of Warsaw) for a series of studies on *Interactions between human cells and implanted biomaterials*. Two collective awards went to: 1) Prof. Jolanta Zakrzewska-Czerwińska, Dr. Dag-



Award-granting ceremony for Dr. Waclaw Mayzel Medical Laurel

mara Jakimowicz, and Dr. Anna Pawlik from the Ludwik Hirszfeld Institute of Immunology and Experimental Therapy in Wrocław for a series of studies on *Basic steps of the cell cycle in bacteria: replication and segregation of bacterial chromosomes*; 2) Prof. Kalina Kawecka-Jaszcz, Prof. Tomasz Grodzicki, Dr. Katarzyna Stolarz-Skrzypek, Dr. Wiktoria Wojciechowska, and Dr. Marcin Cwynar from Collegium Medicum at Jagiellonian University in Kraków for a series of studies on *The impact of genetic and environmental factors on properties of large arterial vessels and the activity of the sympathetic system*. In addition, a special prize – the Doctor Waclaw Mayzel Medical Laurel – was conferred upon medical students from the Medical Academy in Wrocław (Barbara Koza, Marta Kubina, and Ewa Żygadło) and from the Technical University in Wrocław (Paweł Grycko).



The Jędrzej Śniadecki Medal (left) and the Mayzel Laurel (right)

In 2007 the members of the Division published 289 papers in total, chiefly in international journals, as well as actively participating at various conferences and symposia.

There are five research institutes affiliated with the Medical Division: the Mirosław Mossakowski Medical Research Center in Warsaw, the Institute of Pharmacology in Kraków, the Institute of Human Genetics in Poznań, and the Center for Medical Biology in Łódź (since 1 April 2008 Institute of Medical Biology).

Four scientific journals are published by the medical institutes: *Archivum Immunologiae et Therapiae Experimentalis*, *Folia Neuropathologica*, *Pharmacological Reports*, and *Postępy Higieny i Medycyny Doświadczalnej (Advances in Hygiene and Experimental Medicine)*. The Division also supports the *Polish Journal of Food and Nutrition Sciences*, co-edited by the Scientific Committee on Human Nutrition affiliated with the Division.

The Division supervises the activity of 11 scientific committees (330 members) and 76 subcommittees (1150 members) which represent the medical sciences in Poland. The chairpersons of these committees, mostly non-members of the Academy, participate in the Division's plenary sessions and enjoy equal rights with the Academy's members except with regards to electing candidates to become new Academy members. Each committee establishes special commissions focused on various specific fields of medical research, with the members of these commissions in large part drawn from outside the committee body itself.

Moreover, in 2007 the Division supported 23 national and international scientific conferences organized by its affiliated scientific committees and research institutes, as well as the publication of several monographs.

The Division facilitates the international representation of Poland's medical and biomedical disciplines via national committees of the Polish Academy of Sciences interacting with international bodies. Prof. Wojciech Kostowski, Chairman of the Division, represents the Academy to the Council of International Organizations of Medical Sciences (CIOMS), while Prof. Jacek Zaremba represents the Academy to the European Academies Science Advisory Council (EASAC). Prof. Andrzej Trzebski, in turn, represents the Polish Academy of Sciences to the Standing Committee of the European Medical Research Councils of the Euro-

pean Science Foundation (EMRC ESF). There are 7 Polish national committees affiliated with the Division: the National Committee for Cooperation with the International Union of Physiological Sciences (IUPS), the National Committee for Cooperation with the International Union of Pharmacology (IUPHAR), the National Committee for Cooperation with the International Union of Immunological Societies (IUIS), the Na-

tional Committee for Cooperation with the International Union of Nutrition Sciences (IUNS), and the National Committee for Cooperation with the International Council of Medical Societies (ICOMS), the National Committee for Cooperation with the International Council on Laboratory Animal Science (ICLAS), and the International Federation of Societies of Electron Microscopy (IFSEM).

Is heterozygous I171V mutation of the NBS1 gene a risk factor for cancer?

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Homozygous mutations within the NBS1 gene are responsible for the high incidence of neoplasms in Nijmegen breakage syndrome (NBS). Heterozygous NBS1 mutations lead to increased susceptibility to malignancies, mainly of lymphoid origin. It has been postulated that heterozygous carriers of 657del5 NBS1 mutation are at higher risk of developing cancer. In addition to the most common 657del5 mutation several other alternations in NBS1 gene have been described. We have found a high frequency of heterozygous missense I171V mutation of the NBS1 gene in acute lymphoblastic leukemia (1). The aim of this study was to analyze the frequency of I171V mutation in the NBS1 gene in 270 women with breast cancer, 131 with colorectal carcinoma, 175 patients with larynx cancer, 81 with second primary head and neck tumors, and in 1174 control individuals. DNA samples were analyzed by PCR-single strand conformation polymorphisms for exon 5 of the NBS1 gene and by restriction analysis of PCR product using the MndI (MfeI) enzyme. Those samples which showed shifts on nondenaturing polyacrylamide gels or yielding an additional band after MndI digestion were directly sequenced (ABI PRISM 377 DNA Sequencer, Applied Biosystems) (2).

I171V mutation was present in 17 out of 657 cancer patients, compared with 8 out of the 1174

control individuals, constituting 2.59% in the studied patients with malignancies and 0.68% of the control group ($p=0.0001$; relative risk 2.126; odds ratio 4.519; 95% confidence interval 1.613-2.803). The highest I171V mutation prevalence (6.17%) was found in second primary head and neck tumors. Detailed incidence of I171V mutation in 4 groups of patients with various malignancies is showed in table 1. The incidence of NBS1 gene I171V mutation in breast cancer, larynx cancer and second primary tumors of head and neck groups differed



Fig. 1. Laboratory work on cancer risk genes at the Institute's Department of Molecular Pathology (M. Kęsikiewicz)

Table 1. Analysis of I171V mutation incidence in various cancers and in a control group. Fisher's exact test was used for statistical analysis (GraphPad Prism, ver. 4.03), and the groups studied were compared against the control

	Breast cancer n=270	Colorectal cancer n=131	Larynx cancer n=175	Second primary tumors of head and neck localization n=81	Control n=1369
number	5	3	4	5	8
percentage	1.85	2.29	2.28	6.17	0.58
p value		0.0638	0.038	0.0004	
relative risk	2.36	3.173	2.986	7.272	
odds ratio	3.21	3.987	3.98	11.192	
95% confidence interval	1.176-4.736	1.191-8.448	1.325-6.731	3.534-14.967	

significantly in comparison to the control. For the colon cancer group the difference was not quite significant as compared to the control. In a previous paper we reported a significant difference, yet the control group was much smaller, constituting 600 cases (3).

Since DNA was isolated from non malignant cells, all mutations found in cancer patients appeared to be of germinal origin. In both patients and healthy individuals, only heterozygous I171V mutation was identified.

The high incidence of NBS1 gene I171V mutation found in patients strongly suggests that it is etiologically related to cancer development (4). The I171V alternation occurs in the breast cancer carboxyl-terminal (BRCT) nibrin domain. This domain is highly conserved in proteins involved in DNA repair and cell-cycle checkpoints playing a significant role in double-strand DNA breaks. It is very likely that the I171V alternation of the BRCT domain changes the function of nibrin.

The high frequency of NBS1 gene I171V mutation found in the studied cancer patients strongly suggests the involvement of this mutation in carcinogenesis. Very interestingly, this mutation is characteristic for many types of malignancies, and it can therefore be postulated that that I171V mutation of the NBS1 gene contributes to cancer predisposition.

References

Mosor M., Ziółkowska I., Pernak-Schwarz M., Januszkiewicz-Lewandowska D., Nowak J. (2006). Association of the heterozygous germline I171V

mutation of the NBS1 gene with childhood acute lymphoblastic leukemia. *Leukemia*, 20(8), 1454-1456.

Ziółkowska I., Mosor M., Wierzbicka M., Rydzanicz M., Pernak-Schwarz M., Nowak J. (2007). Increased risk of larynx cancer in heterozygous carriers of the I171V mutation of the NBS1 gene. *Cancer Sci.*, 98(11), 1701-1705.

Nowak J., Mosor M., Ziółkowska I., Wierzbicka M., Pernak-Schwarz M., Przyborska M., Roźnowski K., Pławski A., Słomski R., Januszkiewicz D. (2008). Heterozygous carriers of the I171V mutation of the NBS1 gene have a significantly increased risk of solid malignant tumours. *Eur. J. Cancer*, 44(4), 627-30.

Roźnowski K., Januszkiewicz-Lewandowska D., Mosor M., Pernak M., Litwiniuk M., Nowak J. (2007). I171V germline mutation in the NBS1 gene significantly increases risk of breast cancer. *Breast Cancer Res Treat.*, doi:10.1007/10549-007-9734-1.

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An electrochemical DNA-oligonucleotide label based on the carborane structure – A hybridization study using magnetic beads and carbon paste electrode

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Electrochemical detection of DNA and DNA-based biosensors is one of the fastest developing fields of contemporary biological research and practice. Electrochemical methods offer an attractive alternative to established fluorescence and other optical coding technologies, with advantages in terms of cost, sensitivity, and direct electronic read-out.

Boron clusters used as redox active tags provide another option to the metal complexes that have so far been in use as electrochemical labels. The advantage of boron clusters lies in their versatility, allowing an array of labels with different electrochemical properties to be included into a nucleic acid and its components, as well as in their chemical and biological stability, tunable redox potential, and susceptibility to chemical modification and derivatization.

We have recently developed several chemical approaches for synthesizing boron clusters bearing DNA-oligonucleotides containing carborane cages in different locations of the oligomer. Preliminary observation under HPLC conditions using a standard electrochemical detector Coulochem II (Esa, USA) has shown that the oligonucleotide probe labeled with 7,8-dikarba-*nido*-undekaborate (CBM) (Fig. 1, 1) group, complementary to a fragment of the US14 gene of human cytomegalovirus (HCMV),

provided an intense diagnostic peak at potential +0.9 V at carbon electrode (vs Pd/H₂). For metal-lacarborane (BEMC) monomer (Fig. 1, 2), a peak at potential +1.7 V at platinum electrode (vs. palladium electrode) was detected. This finding prompted us to study the 7,8-dikarba-*nido*-undekaborate cluster as a redox label in more detail.

In this study, performed in collaboration with colleagues from the Institute of Biophysics, Academy of Sciences of the Czech Republic (Frantisek Jelen, Emil Paleček and Alena Kourilova), we utilized differential-pulse or square-wave voltammetry in combination with an adsorptive transfer stripping technique for measuring ODN hybridization. The whole procedure involves ODN hybridization at superparamagnetic Dynabeads (DB) with subsequent detection at the surface of a carbon paste electrode.



Fig. 2. Hybrid of unmodified DNA and DNA labeled carborane cluster and voltammogram of 2'-(7,8-dikarba-*nido*-undekaborane-7-yl)methyluridine label

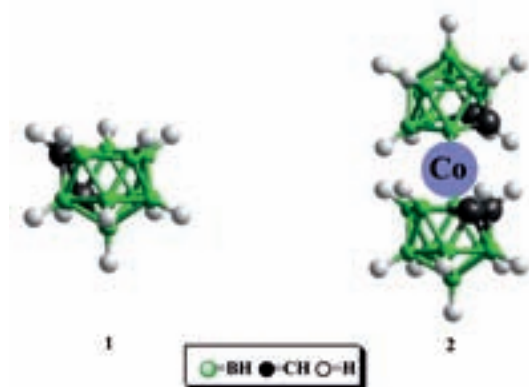


Fig. 1. Example structure of carborane cluster – C₂B₈H₁₀ (1) and metallocarborane complex – [(C₂B₉H₁₁)₂Co]⁻ (2)

We used commercial superparamagnetic DB containing an oligonucleotide track of 25 thymines as a surface suitable for oligonucleotide (ODN) hybridization. The method involved two hybridization steps: (a) hybridization of 43-mer ODN containing a track of 25 adenines, (b) hybridization with the second target, which was either complementary or non-complementary to the first target ODN and was labeled by carborane label.

We believe that the development of electrochemically distinguishable polyhedral boron cluster labels, as shown here, may pave the way to the more widespread use of redox labeled nucleic acid probes in a variety of applications.

References

- Olejniczak A.B., Plešek J., Leśnikowski Z.J. (2007). Nucleoside-Metallacarborane Conjugates for Base-Specific Metal Labeling of DNA. *Chemistry – A European Journal*, 13, 311-318.
- Olejniczak A.B., Corsini M., Fedi S., Zanello P., Leśnikowski Z.J. (2007). Nucleoside-metallacarborane conjugates for multipotential electrochemical coding of DNA. *Electrochemistry Communications*, 9, 1007-1011.

Jelen F., Olejniczak A.B., Kourilova A., Leśnikowski Z.J., Paleček E. (2008), in preparation.

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Guanosine 3', 5'-cyclic monophosphate (cGMP) signaling in inflammation

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Inflammation is a complex protective response to infection or injury. It involves the cooperation of a variety of cells and soluble factors. The whole process must be precisely controlled at different levels to avoid undesired tissue damage or lethal effects. At the cellular level, cell activity is regulated by various signaling pathways, including those dependent on adenosine 3',5'-cyclic monophosphate (cAMP) and guanosine 3',5'-cyclic monophosphate (cGMP). These are messenger molecules of intracellular signal transduction pathways important in many biological processes. It is well known that cAMP may act as an inhibitor of inflammation mediator synthesis, but less information is available about cGMP action. Guanosine 3',5'-cyclic monophosphate, synthesized from GTP by guanylyl cyclases (GC) located either on the cell membranes (pGC) or in the cytoplasm (sGC), acts further through activation of effector proteins including cGMP-dependent protein kinases (PKG) and cGMP-regulated phosphodiesterases (PDE). The action of cGMP is terminated with its degradation by cGMP-specific PDE (Fig. 1). The available data on the role of the cGMP pathways show that the particular enzyme expression changes during cell maturation. We hypothesize that similar changes may also tune the response of a cell to varying environmental stimuli.

The aim of our study was to analyze the cGMP-dependent signaling pathway in resting and activated macrophages and neutrophils in the process

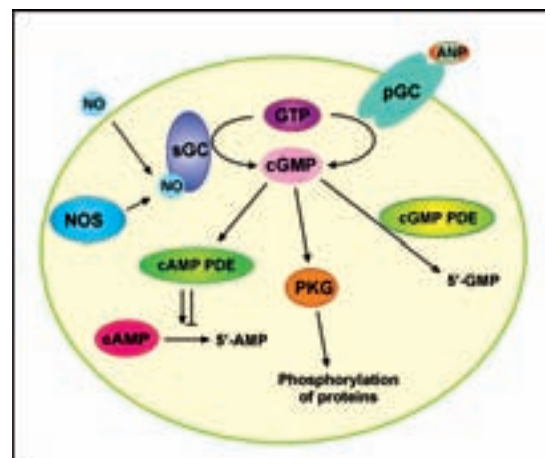


Fig. 1. Intracellular signaling by cGMP. Cyclic GMP (cGMP) is synthesized from GTP by guanylyl cyclases and is hydrolyzed to GMP by phosphodiesterases (cGMP PDE). Guanylyl cyclases exist as cytosolic (sGC) or membrane-bound (pGC) enzymes. All sGC are activated by nitric oxide (NO), which is synthesized by nitric oxide synthases (NOS). Among seven isoforms of pGC, the most ubiquitous is GC-A which is activated by atrial natriuretic peptide (ANP). The cGMP signal is in turn transmitted to other proteins including cGMP-dependent protein kinases (PKG) and cAMP phosphodiesterases regulated by cGMP.

of inflammation. Neutrophils are the first line host defense cells against microbial infections. They are recruited in response to activating factors, migrate to the site of inflammation, secrete microbicidal agents, and phagocytize microorganisms. Activation prolongs neutrophils' lifespan, delaying their spontaneous apoptosis. Macrophages are key cells in the inflammatory process. They secrete mediators of inflammation, present foreign antigens to T lymphocytes, and phagocytize invading microorganisms as well as apoptotic and necrotic cells.

We observed that sGC and PKG, present in blood neutrophils of control rats, disappeared from the inflammatory cells of animals with experimental peritonitis induced by peptone or bacterial endotoxin, LPS. Instead, inflammatory neutrophils showed elevated expression of inducible nitric oxide synthase (iNOS) and synthesized large amounts of nitric oxide (NO) at a level several times higher than in resting cells. High concentrations of NO exert an inhibitory effect on the expression and activity of various cellular proteins. It could be hypothesized that disappearance of PKG and sGC in rat neutrophils was a consequence of high iNOS activity. This implies that inflammation disrupts NO/sGC/cGMP/PKG signaling in neutrophils in response to increased concentrations of NO. Considering recent data on the role of PKG in spontaneous apoptosis of neutrophils, one can speculate that a lack of the enzyme in activated cells is favorable for their survival in the site of inflammation.

Disappearance of PKG was also observed in inflammatory rat peritoneal macrophages. Therefore, its down-regulation may have a more general character. In macrophages, high cGMP-dependent hydrolytic activity of PDE against cGMP and cAMP was detected. Analysis of substrate specificity, sensitivity to inhibitors, and subcellular localization showed that the main cGMP-regulated PDE in peritoneal exudate macrophages are PDE2 and PDE3. PDE2 hydrolyzes cGMP and cAMP and is stimulated by cGMP, while PDE3 activity against cAMP is inhibited by cGMP. In the absence of PKG, the cGMP-regulated phosphodiesterases could act as the effectors of cGMP in peritoneal exudate macrophages (PEM). PDE2 was most efficient in hydrolyzing cGMP in peritoneal exudate macrophages, indicating its role in preventing excessive cGMP accumulation. The significant finding of our studies was that expression and activity of PDE3 correlated with macrophage activation level. Freshly isolated

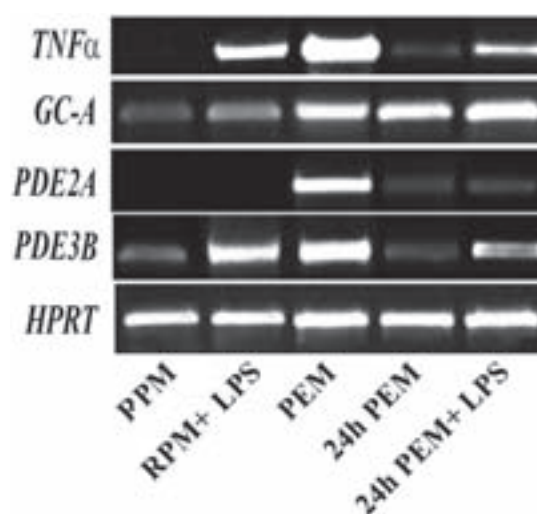


Fig. 2. Expression of TNF α correlates with expression of PDE3B in macrophages. The mRNA of TNF α , GC-A, PDE2A, and PDE3B was detected using RT-PCR. The lanes contain material from rat resident peritoneal macrophages (RPM), RPM cultured for 3h in the presence of LPS, freshly isolated rat peritoneal exudate macrophages (PEM), PEM cultured for 24h (24h PEM), and 24h PEM cultured an additional 3h in the presence of LPS. HPRT is a control

PEM exhibited the highest expression of PDE3 and proinflammatory cytokine TNF α (Fig. 2). When PEM were kept for 24h in culture, their activation level decreased, as indicated by lower TNF α expression, and there was a parallel decrease in the expression of PDE3. The cells were then reactivated by LPS treatment, again demonstrating significantly elevated expression of PDE3 and TNF α . Up-regulated expression of TNF α and PDE3 was also observed in resident peritoneal macrophages. The LPS-induced expression of phosphodiesterases suggests that they could accelerate the development of an inflammatory response by suppressing the anti-inflammatory effects of cAMP and cGMP. However, the role of PDE3 appears to be biphasic, because activated macrophages also synthesize atrial natriuretic peptide (ANP), which is an autocrine/paracrine activator of the pGC isoform GC-A. Increased cGMP may elevate the cAMP concentration through inhibition of its hydrolysis by PDE3 (Fig. 3). Indeed, we observed that stimulation of GC-A with ANP inhibited activity of transcription factor NF- κ B induced by LPS in U937 and THP-1 human monocytic cells, which express GC-A and PDE3 but not PKG. The effect of ANP was abolished in the presence of an inhibitor of cAMP-dependent protein kinase (PKA). Based on these

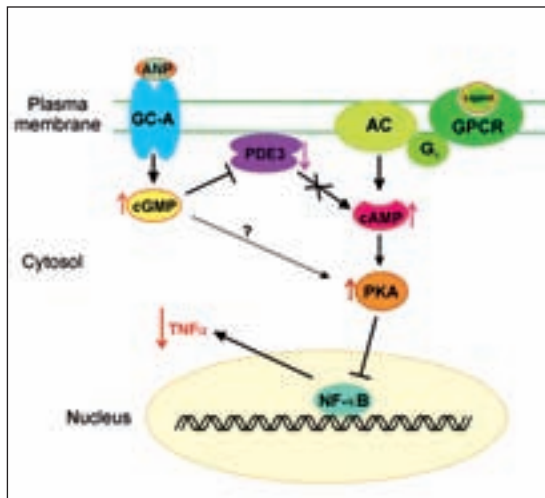


Fig. 3. Putative mechanism of TNF α inhibition by cGMP in macrophages. Concentration of cAMP increases after stimulation of adenyl cyclase (AC) by a G-protein (G_s) as a result of activation of a G protein-coupled receptor (GPCR). Synthesis of cGMP by GC-A in response to ANP prevents hydrolysis of cAMP by PDE3. Elevated concentration of cAMP activates the cAMP-dependent protein kinase (PKA), which is involved in inhibition of transcription factor NF- κ B and ultimately synthesis of TNF α . The alternative mechanism involves direct cross-activation of PKA by cGMP

observations, the inhibitory effect of cGMP on TNF α synthesis can be explained in terms of a cAMP inhibitory effect.

References

- Ciuman M., Siednienko J., Czyżyk R., Witwicka H., Kołosionek E., Kobińska M., Gorczyca W.A. (2006). Cyclic GMP-dependent protein kinase and soluble guanylyl cyclase disappear in elicited rat neutrophils. *Biochimica Biophysica Acta*, 1760, 1618-1623.
- Witwicka H., Kobińska M., Siednienko J., Mitkiewicz M., Gorczyca W.A. (2007). Expression and activity of cGMP-dependent phosphodiesterases is up-regulated by lipopolysaccharide (LPS) in rat peritoneal macrophages. *Biochimica Biophysica Acta*, 1773, 209-218.

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10 years of experience with teleimaging in clinical practice

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The most important issue in modern emergency medicine is how to avoid delays in initiating definitive medical care. The clinical factors adversely influencing the outcome of care include: admission to an inappropriate hospital, delayed or inappropriate interhospital transfer, and delay in surgical treatment. The above factors are indeed critical in rural/remote areas due to isolation and distance.

In response to such challenges, a telemedical system based on the DICOM standard has been developed and applied by the Department of Neurosurgery, Medical Research Center, Polish Academy of Sciences. It connects 5 hospitals in the Mazowsze region, serving a population of 2 million people. Modern radiological workstations were established at expert centers and the digitalization of

all kinds of medical imaging was introduced at all the hospitals. Workstations are equipped with PCs, 2 medical monitors (Eizo Nanao), and special tele-radiological software (PAX machine[®] system, CompArt Medical Systems).

All radiological examinations are transmitted to a central server and different specialists can load data from the server to their workstation over a secure virtual private network (VPN). Integration of the Radiology Information System (RIS) and Hospital Information System (HIS) makes full medical and demographical data easily available to the consultant. A special Q-and-A form developed by our department is attached to the sent examination, to select the most important medical information and to facilitate consultation. Voice

communication between centers over Skype™ (Skype Ltd.) has been introduced, but still requires evaluation. The system currently enables consultations among neurosurgeons, radiologists, cranio-facial surgeons, orthopedic surgeons, vascular surgeons, general surgeons, and neurologists, and the system is also used by interventional cardiologists.

Our analysis encompassed patient data collected from December 1996 to March 2002. Most neurosurgical teleconsultations 235 (26%) consisted of control examinations in the postoperative period for treatments performed outside of the Department of Neurosurgery, Polish Academy of Sciences, or conservative treatment performed in remote hospitals. Most of the control examinations were related to patients operated on by our department due to traumatic brain injury, brain tumor, or treatment with CSF shunt (those patients need more detailed follow-up). 35 (4%) unsuccessful teletransmissions were identified, with an insufficient number of scans making teleconsultations impossible. Errors in transmissions involved modem failures, operator mistakes such as accidentally switching off the system or disconnecting communication ports, and for instance unexpected user-caused alterations to the software setup.

40 (4%) of transmitted images did not evidence any visible pathologies. Considering the number of patients admitted to our Department after teleconsultation (excluding control CT examinations), that corresponds to 206 admissions, showing that approximately 70% of the patients consulted avoided unnecessary transportation through the use of our teleconsulting system.

The rate of neurosurgical intervention for admitted patients came to 86% (178). We discovered that contact with the referring physician is needed but that his or her name and telephone number are often missing or misplaced. There were also problems with information about the rate of deterioration and the time and mechanism of injury. There were reported cases when no information was referred about an additional medical condition that could interfere with preparations for a neurosurgical intervention, e.g. a relevant previous medical condition, other medical condition, other medical disease, or non-cerebral injuries. A suggestion involving the execution of basic laboratory blood tests appears to be a very important issue: there were reports of waiting-times of approximately 30 minutes or even

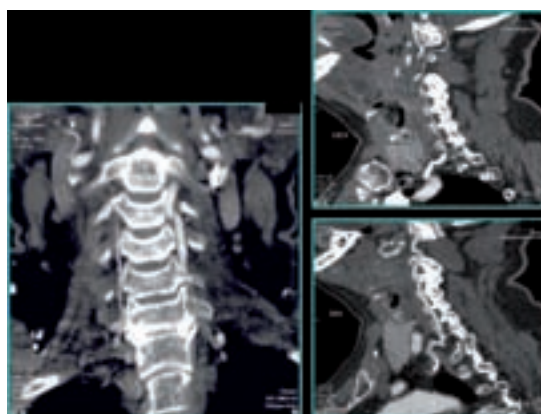


Fig. 1-2 Angio-CT examination of a patient with dissection of the vertebral artery, with a 3D reconstruction. This examination carried out with the support of experts at a teleconsulting center, via a telemedical network

up to 1 hour for blood group, blood morphology, electrolytes and blood clotting test results before a planned surgical procedure could be started. In some cases it was necessary to carry out standard X-rays or ECGs. We found that some problems related to a lack of patient or family permission for neurosurgical treatment, which could give rise to lawsuits. Information on the referring physician is also very important; in some cases we found difficulties in further contact with a remote hospital if additional information about an admitted patient proved necessary.

All these problems were meant to be overcome by a specific, purpose-developed, detailed Q-and-A form, gathering a set of important information based on standard questions. Five years' experience with neurosurgical teleconsulting resulted in further

research on the procedural algorithm comprising image teletransmission and the Q-and-A form for improving telephone consultations with physicians from a remote hospital. The risk of missing any important information is considerably minimized. Future studies will show which of the proposed questions had a particular impact on the quality of neurosurgical teleconsultation. Our very first experience indicated that the amount of data produced by radiological equipment is constantly growing, requiring broadband communication between centers and a potential for expanded capacity. We have found special workflow technology software to be very important for managing such large amounts of data. To facilitate communication during the project, special software based on web technology has been developed and is now under evaluation. It will enable independent web browser access to the server, from the expert's location. The development of new teleradiological and teleconsulting software is one of the most important outcomes of this project.

In future studies this system will be compared against different existing systems and the non DICOM system used at our Department from 1996 to 2004. Clinical and economic evaluation will be published after the project is completed.

Another important issue is testing the telemedical network in different configurations and modalities. The final conclusions of this project may be very helpful for the development of such systems. The existing system requires constant development and updating not only due to the rapid advance of data transmission technology but also because of the rapidly growing amount of data produced by modern medical imaging technology: we are increasingly facing the need for 1Gb file transmission from a CT scanner to a center located 100 km away.

The introduction of this telemedical system connecting different hospitals and involving different medical specialities seems to be very promising and needs further research. Our experience has indicated that such a system can indeed successfully increase the accessibility of consultations with different medical specialists in a short time. It should also help to improve trauma care and patient qualification for emergency neurosurgical treatment. It definitely facilitates remote patient follow-up (repeat

consultations) and remote monitoring of treatment performed by experts. In our previous publications we emphasized the possibility of avoiding unnecessary transportation and considerably reducing transportation costs. The development of a large medical database for scientific, educational, and statistical purposes is a general outcome of all telemedical solutions, and especially important in academic centers.

This system now functions as a local (hospital) and regional network and is prepared to facilitate the global exchange of medical and scientific information. Our experience with teleimaging has enabled us to identify advantages and disadvantages of such systems.

Advantages:

- optimized neurosurgical patient care
- lower transport costs
- better accessibility of consultations with different medical specialists and expert opinions
- proper patient qualification for emergency neurosurgical treatment
- avoidance of unnecessary transportation
- development of a large medical database for scientific, educational, and statistical purposes.

Disadvantages:

- rapid advance of technology
- users are forced to continuously develop and upgrade existing systems
- problems with large data storage
- security
- costs of system upgrade and maintenance.

Our experience has indicated that local authorities should be involved in developing and maintaining such systems, as this helps to encourage better cooperation between hospitals and reduce overall health care costs. In modern clinical practice teleimaging should be treated as a standard procedure.

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Earth and Mining Sciences

Division VII – Earth and Mining Sciences covers the following fields: geology, geophysics, oceanography, geodesy, geography, environmental engineering, and mining sciences. At the end of 2007, the Division consisted of 34 members, including 21 full members and 13 corresponding members of the Academy. There were also 22 foreign members.

The Division is headed by Professor Bogdan Ney (full member of the Academy) as Chairman, with Professor Andrzej Ciołkosz and Professor Ryszard Marcinowski (corresponding member of the Academy) as Deputy Chairmen.

During 2007, the Division coordinated the activities of 7 research institutes plus the Museum of the Earth. Eleven scientific committees with 39 sections or commissions were associated with the Division, assembling 366 members, including 46 members of the Academy. A number of scientific journals and other periodicals belonging to the committees of Division VII were published, including: *Acta Geologica Polonica*, *Acta Geophysica Polonica*, *Archives of Mining Sciences*, *Mineralogical Archives*, *Management of Mineral Resources*, *Geodesy and Cartography*, *Studies of the Committee on Water Management*, *Studia Quaternaria*, and *Oceanology*. The journals *Acta Geologica Polonica* and *Oceanology* are indexed by the Institute for Scientific Information in Philadelphia. In addition, each of the institutes publishes their own, often international or nationwide journals and periodicals.

Two plenary sessions of the Division were held in 2007. The first part of the spring session, held on 4 April 2007, involved a scientific session on “World Mineral Energy Resources – Conclusions for Poland.” The papers delivered during the session were prepared by the following professors of the Division: Prof. R. Ney, full member of the Academy, Prof. J. Siemek, corresponding member of the Academy, and Prof. E. Mokrzycki, director of the Mineral and Energy Economy Research Institute in Kraków.

During the second part of this same session, members were elected to three commissions: a commission for awarding the Division’s scientific prizes for the 2007-2010 term, a commission for electing a new Director of the Institute of the Geological Sciences in Warsaw, and a decisions and motions

committee for the plenary session of the Polish Academy of Sciences on May 2007. There was broad discussion of the notion of transferring the International Institute of Ecohydrology from Division II to Division VII, with the outcome that the members of Division VII rejected such a transfer. The Division took steps to establish the National Planet Earth Committee in connection with the International Year of Planet Earth for the triennium 2007-2009; this Committee elected Prof. Andrzej Żelaźniewicz its chairman. The decision of the Division has been confirmed by the Presidium of the Polish Academy of Sciences.

The autumn session of the Division, held on 15 October 2007, discussed the issue of obligatory assessments of the Mineral and Energy Economy Research Institute and the Strata Mechanics Research Institute, both in Kraków. Commissions were appointed for assessing the Institute of Oceanology and the Institute of Environmental Engineering, as well as for electing a new director of the Institute of Geophysics. The members of the Division approved new elected members of the Scientific Committees affiliated with Division VII. At the same session, Prof. S. Massel, corresponding member of the Academy, Prof. P. Korcelli, corresponding member of the Academy, Prof. M. Lewandowski, and Prof. Cz. Rosik-Dulewska presented information about the preliminary organization of the following new scientific centers within the Polish Academy of Sciences: the *Pomerania Center* (Institute of Oceanology), the *Geobiocentrum* (Institute of Geophysics, Institute of Geological Sciences, the Stanisław Leszczycki Institute of Geography and Spatial Organization in Warsaw), and the *Kraków Center* (Mineral and Energy Economy Research Institute, Strata Mechanics Research Institute, Institute of Environmental Engineering), respectively. The structure and scientific duties of these Centers were then broadly discussed.

Competitions were held to elect directors for two institutes, as a consequence of which the President of the Polish Academy of Sciences appointed the following new directors: Professor Marek Lewandowski at the Institute of Geological Sciences in Warsaw for the 2008-2011 term, and Professor Czesława Rosik-Dulewska as acting direc-

tor at Institute of Environmental Engineering in Zabrze.

In the second part of the session the following candidates were recommended for membership of the Polish Academy of Sciences (by secret ballot): Professor Lubomir W. Baran (geodesy and cartography) and Professor Janusz Kotlarczyk (geology) as full members of the Academy, plus Professor Józef Dubiński (mining sciences) and Professor Andrzej Żelaźniewicz (geology) as corresponding members of the Academy. These candidates were duly elected at the plenary session of the Polish Academy of Sciences held in December, thus becoming full and corresponding members of the Academy.

At both of the sessions in 2007, Prof. B. Ney, head of the Division, reported on current aspects on the Polish government's scientific policies, as well as on important scientific happenings in Poland and other countries. He likewise provided information about the work of the Presidium of the Polish Academy of Sciences.

In 2007 the Division's scientific committees organized 28 plenary sessions, the same number of presidium meetings, and several section meetings. The scientific activities of the committees are documented by their organization last year of 31 national conferences with 11,835 participants and 14 international conferences with 916 participants. The overall number of lectures presented during these conferences was 1116. The members of the committees drew up several expert scientific opinions for the Polish government, industry, and various organizations.

Many members of our Division were commended or honored in 2007. The Hungarian Academy

of Sciences elected Professor Jerzy Jankowski, full member of the Academy, an Honorary Fellow. Professor Czesław Druet, full member of the Academy, was elected Honorary President of the Committee on Maritime Research, as well as of the Sopot Municipal Scientific Society. Professor Roman Ney, full member of the Academy, was elected Honorary President of the Committee of Mineral Economy Sustainable Development. The Minister of Science and Higher Education awarded Professor Lubomir W. Baran, full member of the Academy, a prize for his scientific, organizational, and teaching activity. He also won the "Medal of Merit for Geodesy and Cartography" from the Ukrainian Society of Geodesy and Cartography and the "Gold Laurel University Medal" from the Senate of the University of Warmia and Mazury.

The Rector of the Poznań University of Economics granted Professor Ryszard Domański, full member of the Academy, an award for his textbook *Theoretical Principles of the Spatial Organization*. The Rector of Stanisław Staszic AGH University of Science and Technology granted Professor Jakub Siemek, corresponding member of the Academy, a (first-class) award for his publication activities.

Division VII – Earth and Mining Sciences also awarded its own prizes to scientists for their achievements: Professor Andrzej Manecki from the AGH University of Science and Technology received the Stanisław Staszic Award for his book *Encyclopaedia of Minerals*, and Dr. Adam Porowski from the Institute of Geological Sciences in Warsaw won the Wawrzyniec Teisseyre Award for his paper *Origin of Mineralized Waters in the Central Carpathian Synclinorium, SE Poland*.

Topsoil magnetic and geochemical anomalies caused by technogenic deposition in some regions of Central Europe

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Field measurements of soil surface magnetic susceptibility (κ) and heavy metal content in the uppermost horizons of forest topsoil (Of/Oh) were carried out in south and south-western Poland, the Ostrava and Trinec area, eastern Saxony, and northern Bohemia. Such measurements were taken using

a Bartington MS2 (Magnetic Susceptibility System) with a MS2D loop sensor, fully integrated with an GPS external sensor. Each MS2 measurement value is therefore associated to geographical position with an accuracy better than 10 meters. Ten to fifty measurements were taken at each grid point (2 x 2 m

square), depending on variability of susceptibility in the grid area.

The area of southern and south-western Poland exhibits considerably higher κ values than other regions of the country. Large magnetic anomalies occur in the Upper Silesian Industrial Region (USIR) located in the central part of the Silesia Province. It extends in the south-western direction to the Polish-Czech borderland in the area of Ostrava, Karvina, Jastrzębie, Trinec, and Cieszyn (Fig. 1). Areas of magnetic anomalies over 50×10^{-5} SI units also frequently occur in Lower Silesia (Wrocław, Wałbrzych and Zgorzelec), farther to the west along the German-Czech border, and towards the north-west direction, with maximal values close to Hoyerswerda (the Schwarze Pumpe power plant and coking plant). The geological background in this area, with some local exception in the Sudetes, is poor in natural ferrimagnetic minerals, ruling out a natural (geogenic) origin of this anomaly. The only reason for such abnormal κ values is technogenic magnetic particles contained in industrial and urban dusts which are deposited on the soil surface and then accumulated in the organic horizon of forest topsoil as a result of long-term emissions.

Different kinds of industrial dusts (from iron metallurgy, coal combustion, cement and coking plants) as well as urban dusts collected in city centers usually have very high κ values (Table 1). The mineralogy and geochemistry of magnetic fraction, considered as a potential environmental tracer, have not been previously recognized; such studies are currently being conducted by the Institute of Environmental Engineering, Polish Academy of Sciences. The magnetic particles were separated from both dust and forest topsoil in areas under the influence of anthropogenic influx. Strongly magnetic particles of irregular shape were predominant in the topsoil near the Trinec, Zawiercie and Huta Katowice metallurgical plants and exhibit strong ferromagnetic properties. Such angular shaped grains were identified as characteristic for emissions from iron metallurgy. Mineralogical study shows them to be mostly iron oxides with a considerable amount of Mn and Cr (Fig. 2). Magnetic and mixed magnetic and siliceous spherules are predominant in the magnetic material separated from soils collected close to Hoyerswerda, Łaziska, Jaworzno, and from the fly ashes of the Jaworzno and Opole power plants. They were identified as iron oxides sometimes covered by a sili-

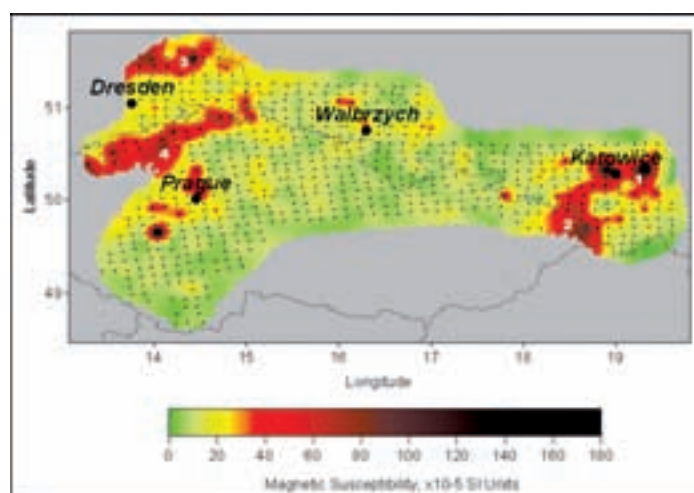


Fig. 1. Magnetic anomalies of forest topsoil in south and south-western Poland, Bohemia and eastern Saxony: 1 – USIR anomaly, 2 – Ostrava – Trinec anomaly, 3 – Hoyerswerda anomaly, 4 – northern Bohemia anomaly

ceous crust enriched with Pb, Cd and Zn. These magnetic spherules are typical for industrial and urban dusts deposited on the soil surface as a result of coal combustion (Fig. 3).

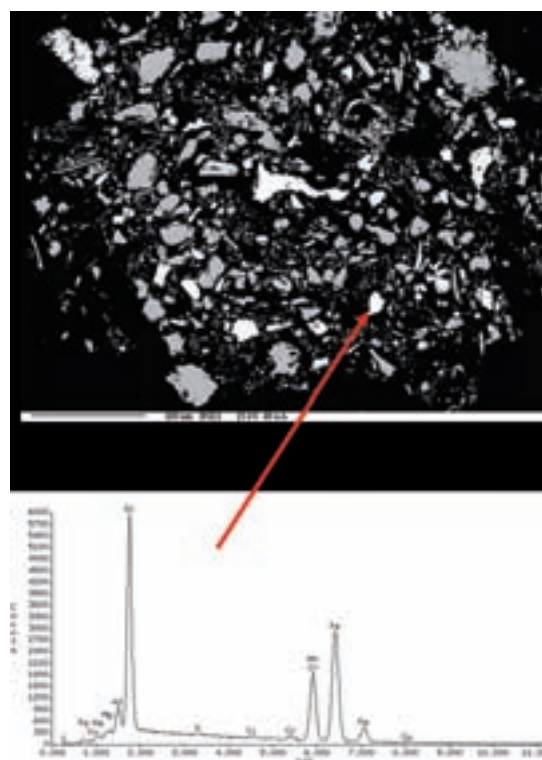


Fig. 2. SEM micrograph of magnetic concentrate separated from a forest topsoil sample collected in the vicinity of Trinec (Czech Rep.), with quantitative results of microchemical analysis

Table 1. Magnetic susceptibility of different kinds of industrial and urban dusts

Dust origin	Number of samples	Magnetic susceptibility ($\times 10^{-8} \text{m}^3 \text{kg}^{-1}$)		
		Minimal	Maximal	Mean
Iron metallurgy	12	20	45,800	13,700
Cement plants	18	10	1600	360
Fly ash after hard coal combustion	35	660	3600	2000
Fly ash after lignite combustion	7	500	1600	1050
Coking plants	43	80	1100	370
Urban dusts collected in city centers	65	15	1500	160

The total dust fall in most the areas of magnetic anomaly is nowadays considerably low, but the emission and deposition of industrial dusts was once much higher, during the intensive post-war development of heavy industry. In Upper Silesia it is well documented by the annual reports of Regional Sanitary and Epidemiological Station in Katowice (SANEPID). Between 1975 and 1985, annual dust fall over 500 gm^{-2} was reported in many Upper Silesian cities. The high amount of total dust fall was accompanied by a high amount of Zn, Pb and Cd (over 1000, 500 and 10 mgm^{-2} , respectively). All dust particles and contaminants deposited over the many years of industrial and urban activity have persisted in the organic horizon of forest soils, which acts as an “irreplaceable environmental filter.” In the areas of magnetic anomalies the concentration of Pb, Cd and in some cases Zn exceeded the national standards, exhibiting large regional geochem-

ical anomalies. Such huge concentrations of heavy metals in a relatively thin layer may pose a true ecological hazard for the food chain.

The κ values measured in the USIR area correlate very well with some heavy metal contents (Zn, Pb, Cd, Cu) in forest topsoil. The Pearson correlation coefficients between κ and content of the aforementioned metals calculated for the USIR area are: 0.72 for Zn, 0.67 for Pb, 0.63 for Cd, and 0.83 for Cu. For the magnetic and geochemical anomaly in Hoyerswerda (Saxony), the calculated correlations were even higher (0.76 for Zn, 0.88 for Pb, 0.76 for Cd, and 0.78 for Cu) because sources of pollution there are not as diverse as in the USIR (only power and coking industries). For the Ostrava – Trinec anomaly, the calculated coefficients are 0.72 for Zn, 0.65 for Pb, and 0.64 for Cu. It is highly characteristic of this area that high correlations between κ and also Mn, Cr and Co content were observed close to the Trinec, Cieszyn and Jablonkov areas as well as in Beskidy Mts, along the Olse valley. This is result of the deposition of these elements by the metallurgical plant in Trinec. In all the areas studied, the range and spatial distribution of magnetic and geochemical anomalies are in most cases very similar.

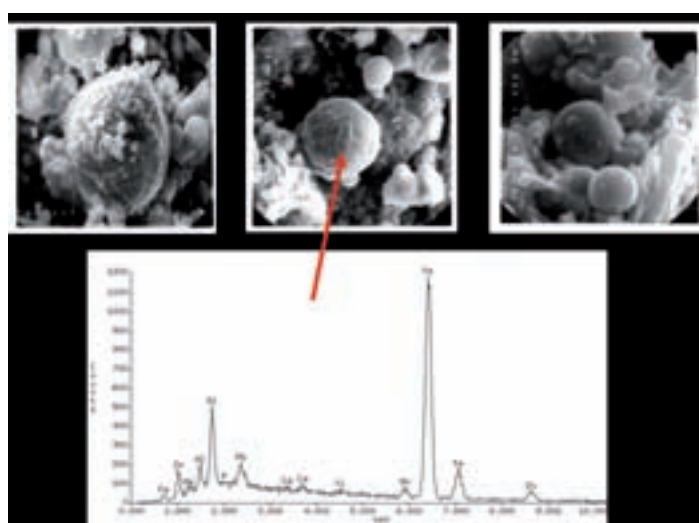


Fig. 3. SEM micrographs of magnetic concentrate separated from forest topsoil and fly ashes collected from different anomaly areas. Quantitative results of microchemical analysis were performed for separated particles from Katowice

References

- Magiera T., Kapička A., Petrovský E., Strzyszczyński Z., Fialová H., Rachwał M. (2008). Magnetic anomalies of forest soils in the Upper Silesia – Northern Moravia region. *Environmental Pollution* (in press).
- Magiera T., Strzyszczyński Z., Rachwał M. (2007). Mapping particulate pollution loads using soil magnetometry in Urban forests in the Upper Silesia Industrial Region, Poland. *Forest Ecology and Management*, 248, 36-42.

Strzyszczyk Z., Ferdyn M. (2005). Magnetic susceptibility and heavy metal content of soil around the coking plants in Silesia. *Mitteilungen der Deutschen Bodenkundlichen Gesellschaft*, vol. 107, no. 1-2, 557-558.

Strzyszczyk Z., Rachwał M. (2008). Changes in Magnetic Susceptibility of forest soils along the west and south border of Poland. *Archives of Environmental Protection*, 34, 71-79.

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Huge contrasts in the lithospheric structure of Central Europe

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Starting in 1997, Central Europe, between the Baltic Sea and Adriatic Sea, has been covered by an unprecedented series of seismic experiments to investigate the Earth's complex lithospheric structure,

down to a depth of about 100 km. These experiments – **POLONAISE'97, CELEBRATION 2000, ALP 2002, SUDETES 2003** – have only been possible due to a massive international cooperative effort. This

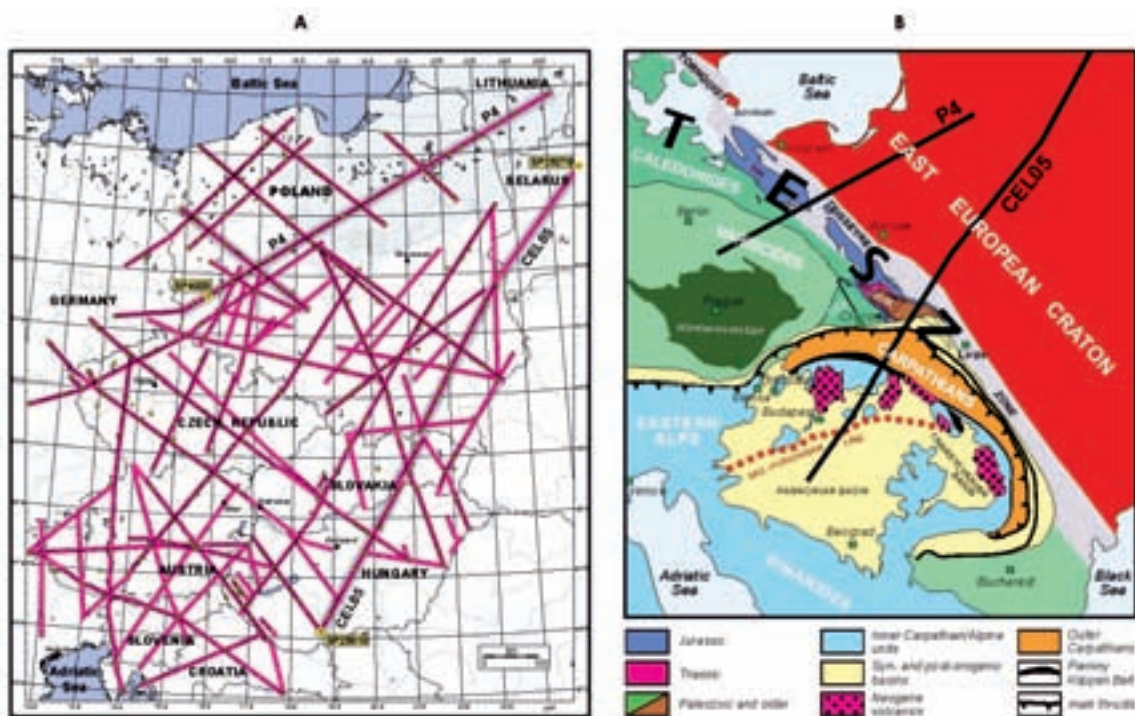


Fig. 1A. Location of seismic profiles recorded in Central Europe during POLONAISE'97, CELEBRATION 2000, ALP 2002, and SUDETES 2003 international experiments.

White circles – locations of 295 big shots for generation of seismic waves. Total length of all profiles is about 20,000 km with ca 7000 seismic receiver positions (small black dots).

Basic seismic profiles for geodynamics of the Central Europe P4 and CEL05.

1B. Simplified tectonic map of the Central Europe. TESZ – Trans-European Suture Zone; HCM – Holy Cross Mountains; MM – Małopolska Massif; USB – Upper Silesian Block

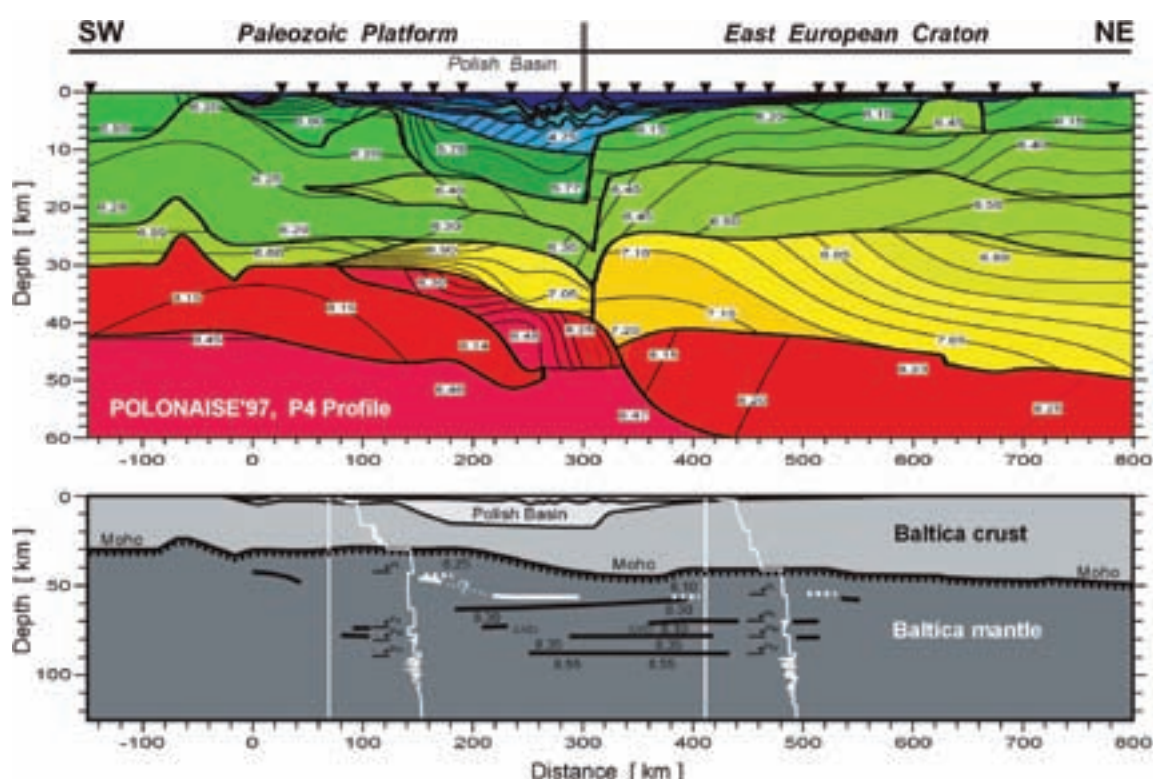


Fig. 2. Seismic structure of the Earth's crust (upper Fig.) and lower lithosphere (bottom Fig.) along POLONAISE'97 profile P4 (location shown in the Fig. 1). The profile P4 runs across the Trans-European Suture Zone almost perpendicularly to the edge of the East European Craton. The thick solid lines – layer boundaries; thin lines – isovelocity contours (in km/s); Moho is crust-mantle boundary; black triangles – shot points along profile; thick black and white lines – seismic reflectors from lower lithosphere (bottom Fig.). Note thin Palaeozoic platform crust (ca 30 km), thick crust of the EEC (ca 45-50 km), and thick sedimentary Polish Basin in the TTZ with P wave velocities lower than 6 km/s down to ca 20 km depth. Vertical exaggeration for the model is ca 5.2

International Consortium consisted of more than 30 institutions from 16 countries in Europe and North America, i.e. Austria, Belarus, Canada, Croatia, the Czech Republic, Denmark, Finland, Germany, Hungary, Lithuania, Poland, Russia, Slovakia, Slovenia, Turkey, and the United States. The majority of the seismic recording instruments were provided by the IRIS/PASSCAL Instrument Center in Washington and the University of Texas at El Paso (USA). As a result of these experiments, a network of seismic profiles (Fig. 1A) now extends from the East European Craton (east of the Baltic Sea), along and across the Trans-European Suture Zone (TESZ) in Poland and the Bohemian Massif, through the Carpathians, Sudetes, and Eastern Alps, to the Pannonian Basin, the Dinarides, and the Adriatic Sea (Fig. 1B). Total length of seismic profiles in all experiments is about 20,000 km (Fig. 1).

As reflected in structures within the Trans-European Suture Zone (TESZ), the Alps and Carpathi-

ans, the Bohemian Massif, and the Pannonian Basin (Fig. 1B), Central Europe has experienced a complex tectonic history that includes three geologically recent periods of mountain building due to accretion of terranes during the Caledonian and Variscan orogenies and the collisional events of the Alpine orogeny. When viewed from a larger perspective, the Palaeozoic tectonic evolution of Europe involved a series of orogenic pulses resulting from the collision and suturing of Baltica, Laurentia (the North American palaeo-continent), Gondwana (Africa/South America), intervening terranes like Avalonia and the Bohemian Massif, and transported crustal blocks from the supercontinent Pangea.

The TESZ region is a broad zone of deformation that extends across Europe from the British Isles to the Black Sea region that formed as Europe was assembled from a complex collage of terranes during the late Palaeozoic. These terranes were accreted along the margin of Baltica (East European Craton),

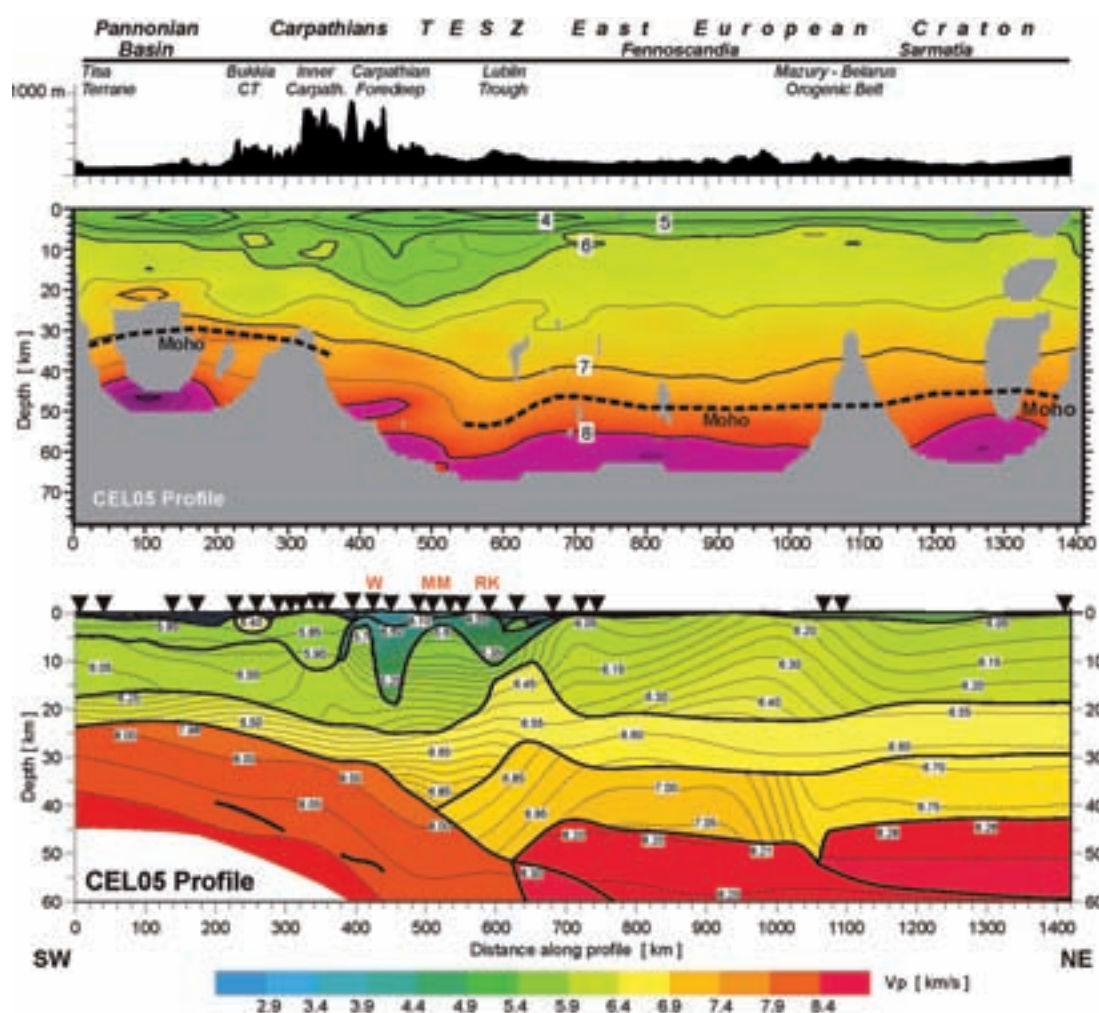


Fig. 3. Two-dimensional P wave velocity model of the Earth's crust for CELEBRATION 2000 profile CEL05 (location in Fig. 1) derived by tomographic inversion of P wave first arrival travel times (upper Fig.) and by ray-tracing modeling (bottom Fig.). Thick solid lines – layer boundaries; thin lines – isovelocity contours in km/s; Moho is crust-mantle boundary; black triangles – shot points. Topography along the profile is shown at the top of the model. Note the very thin Pannonian crust (ca 25 km), thick crust of the EEC (ca 45-50 km), and the thickest crust in the investigated area in the TESZ (ca 52 km depth at a distance of 620 km). Carpathians and TESZ sedimentary basins with P wave velocities lower than 6 km/s down to 10-20 depth were found. Vertical exaggeration for the model is ca 6.8

that was formed during the break-up of Rodinia. The tectonic evolution of this region is of global importance for studies of terrane tectonics and continental evolution.

Examples of results

CELEBRATION 2000 profile CEL05 and POLONAISE'97 profile P4 are most representative for characterizing seismic wave fields in Central Europe because of their length. The 1420 km long CEL05 profile is the longest recorded in the CELEBRATION 2000 experiment (Fig. 1A, B). It

begins in Hungary, crosses the Slovak Republic, Poland, and Belarus, and ends in northwestern Russia. The southwestern part of the profile lies in the Pannonian Basin. The profile crosses a tectonically complex zone that includes the Carpathians and their foredeep, and the TESZ. The northeastern part of the profile crosses the EEC (Fig. 1B). The 800 km long profile P4 is the longest recorded in the POLONAISE'97 experiment (Fig. 1A, B). The profile P4 runs across the Trans-European Suture Zone almost perpendicularly to the edge of the East European Craton. Models of the Earth's crust and lithospheric mantle along profiles P4 and CEL05 are shown

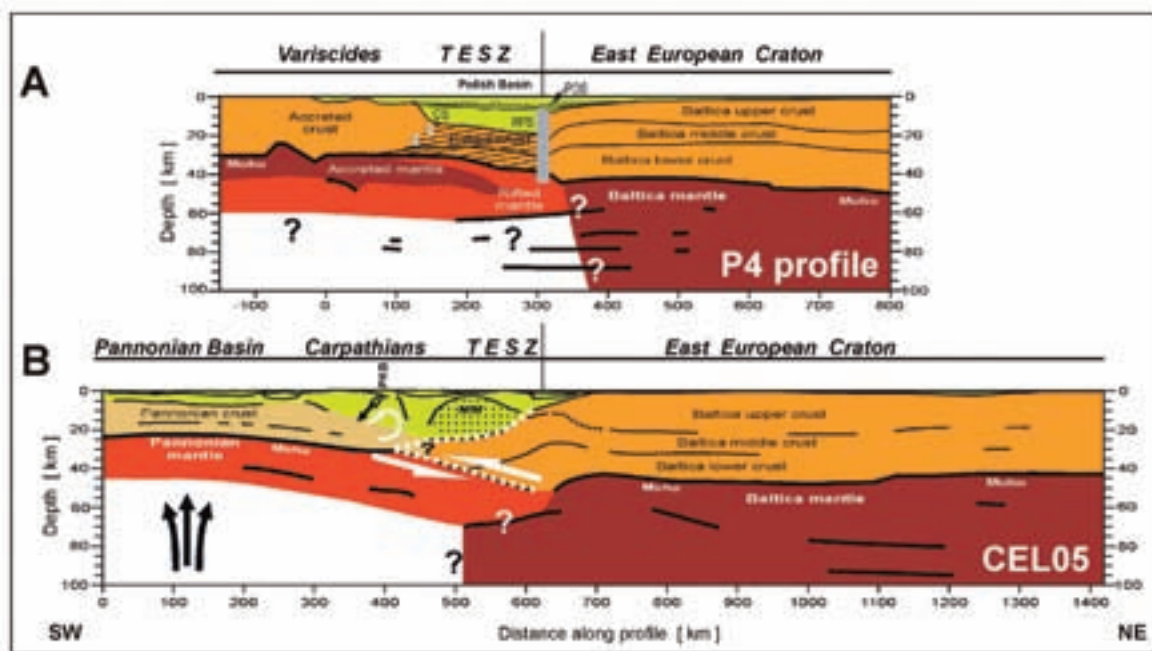


Fig. 4. Tectonic interpretation of the Transition from East European Craton to Trans-European Suture Zone (TESZ) and Variscides along profile P4 (A) and from East European Craton to Carpathians and Pannonian Basin along profile CEL05 (B).

(A) Abrupt transtensional margin (gray bar) where the southwestern extent of Baltica lithosphere is minimal. POS – post-orogenic sedimentary sequence, OS – orogenic sedimentary sequence; RPS (pull-apart) sedimentary sequence.

(B) Collisional model involving “old” northward subduction zone (white arrows) of the Pannonian lithosphere under East European Craton in the Jurassic – Early Cretaceous (Książkiewicz, 1977) or by the end of Jurassic, ca 140 Ma (Golonka et al. 2003), and thinning of the Pannonian lithosphere due to extension and high heat flow (black up-directed arrows), and “young” southward subduction (black down-directed arrow) or rollback (white twisted arrow) in the Tertiary (Miocene) in the Pieniny Klippen Belt (PKB). MM – Małopolska Massif

in Figs. 2 and 3. Geotectonic interpretation of the CEL05 and P4 lithospheric models is shown in Fig. 4.

Conclusion

The POLONAISE’97, CELEBRATION 2000, ALP 2002, and SUDETES 2003 seismic experiments provide significant new data about the structure and tectonic evolution of Central Europe. As is always the case, it takes an integrated geological and geophysical analysis to interpret the velocity models that result from such experiments.

In the case of the P4 profile region, we cannot claim to resolve the debate about how far the thinned crust of the rifted margin of Baltica extends under Germany. However, profile P4 reaches the north-west margin of the Bohemian Massif (Fig. 2), and the velocity models do not require that the remnants of Baltica extend far beyond the Polish Basin. In the

case of profile CEL05, the north-dipping elements of the model in the vicinity of the margin of Baltica indicate a rather sharp termination of the lithosphere of Baltica. We suggest that this geometry is due mostly to Variscan and/or Mesozoic collision along an abrupt margin that formed during the breakup of Rodinia. To the south, it is hard to argue against Moho geometry being primarily due to late Cenozoic extension in the Pannonian Basin region.

When all the individual results are completed and integrated, these experiments will provide an unprecedented 3-D image of the evolution and assembly of a continent.

Acronyms of the seismic experiments:

POLONAISE’97 – **P**olish **L**ithospheric **O**nsets
– **A**n **I**nternational **S**eismic **E**xperiment

CELEBRATION 2000 – **C**entral **E**uropean
Lithospheric **E**xperiment **B**ased on **R**efraction

ALP 2002 – Eastern Alps and adjacent regions
SUDETES 2003 – Sudetes Mountains and adjacent regions

References

Grad M., Guterch A., Keller G.R., and POLONAISE'97 and CELEBRATION 2000 Working Groups. (2007). Variations in lithospheric structure across the margin of Baltica in Central Europe and the role of the Variscan and Carpathian orogenies, in Hatcher R.D., Jr., Carlson M.P., Mc Bride J.H., and Martinez Catalán J.R., (eds.). *4 – D Framework of Continental Crust: Geological Society of America Memoir*, 200, 341-356, DOI: 10.1130/2007. 1200 (17).

Grad M., Guterch A., Keller G.R., Janik T., Hegedüs E., Vozár J., Ślęczka A., Tiira T., and Yliniemi J.

(2006). Lithospheric structure beneath trans-Carpathian transect from Precambrian platform to Pannonian Basin: CELEBRATION 2000 seismic profile CEL 05. *Journal of Geophysical Research*, 111, 23, DOI: 10.1029/2005JB003647.

Guterch A., Grad M., Keller G.R. (2007). Crust and Lithospheric Structure-Long Range Controlled Source Seismic Experiments in Europe, in G. Schubert, ed., *Treatise on Geophysics, Seismology and Structure of the Earth*, vol. 1, 533-558, Elsevier.

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Paleoredox variations, biological productivity and petroleum source bed formation in the Triassic of Svalbard

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The mass extinction at the Paleozoic/Mesozoic boundary, the largest in the Earth's Phanerozoic history, killed off over 90% of marine species and resulted in worldwide oceanic starvation during Early Triassic times. The cause of this severest biological crisis has long been a subject of scientific debate, through it is presumed that euxinic deep marine waters were the primary kill mechanisms for the extinction. These deleterious waters are thought to have abruptly injected into surficial waters and released huge amounts of hydrogen sulfide to the oxic realm. However, several aspects of the Triassic marine environments are inconsistent with a short-term, bottom-up toxic pulse, including evidence of a prolonged nature of the biological crisis, plus enhanced water stagnation and recovery of marine productivity millions of years after the boundary event.

The best record of Triassic productivity and water anoxia is known to occur in the shelf and epicontinental sedimentary basins surrounding the Arctic Ocean, from Alaska N Slope, through the

Sverdrup Basin of Arctic Canada, northern Greenland and the Barents Sea shelf, to west and east Siberia. Thick sequences of black shales deposited in these basins reflect enhanced burial of marine organic matter that in general started from the Smithian/Spathian boundary and increased upwards. This boundary is placed at roughly 249 Ma, dividing the Olenekian Stage (late Early Triassic) into two substages (Smithian – Early Olenekian, and Spathian – Late Olenekian). The black shale sequences clearly parallel each other, suggesting that over-regional control of their formation resulted from transgressive-regressive pulses in the Boreal Ocean. Parts of the sequences are considered important petroleum source units that currently focus exploration interest in the Arctic.

Svalbard (Fig. 1) is a key area for the study of the Arctic Triassic. It shows onland exposures of sedimentary sequence typical of the NW Barents Sea shelf. Recently, geologists from the Institute of Geological Sciences, Polish Academy of Sciences, have started a scientific project aimed at reconstruct-



Fig. 1. (A) Sketch map of Svalbard showing location of the main islands. (B) Geological map of Edgeøya showing outcrops of the Sassendalen Group

ing the paleoproductivity and paleoredox evolution in the Triassic sequence related to preservation of organic carbon and its petroleum potential. Field research concentrates on eastern islands of the archipelago (Edgeøya, Barentsøya and Nordaustlandet), where flat-lying Triassic strata contain maximum organic carbon occurring mostly at the oil window maturity level.

The lower part of the Triassic sequence, classified into the Sassendalen Group (Early Triassic Vikinghøgda Formation and Middle Triassic Botneheia Formation), encompasses black shales and mudrocks with upwards-increasing content of marine organic matter (Fig. 2). The Botneheia Formation contains oil-prone kerogen Type II and I and significant amounts of syngenetic bitumen (up to 12 wt. % organic carbon). It represents a summit

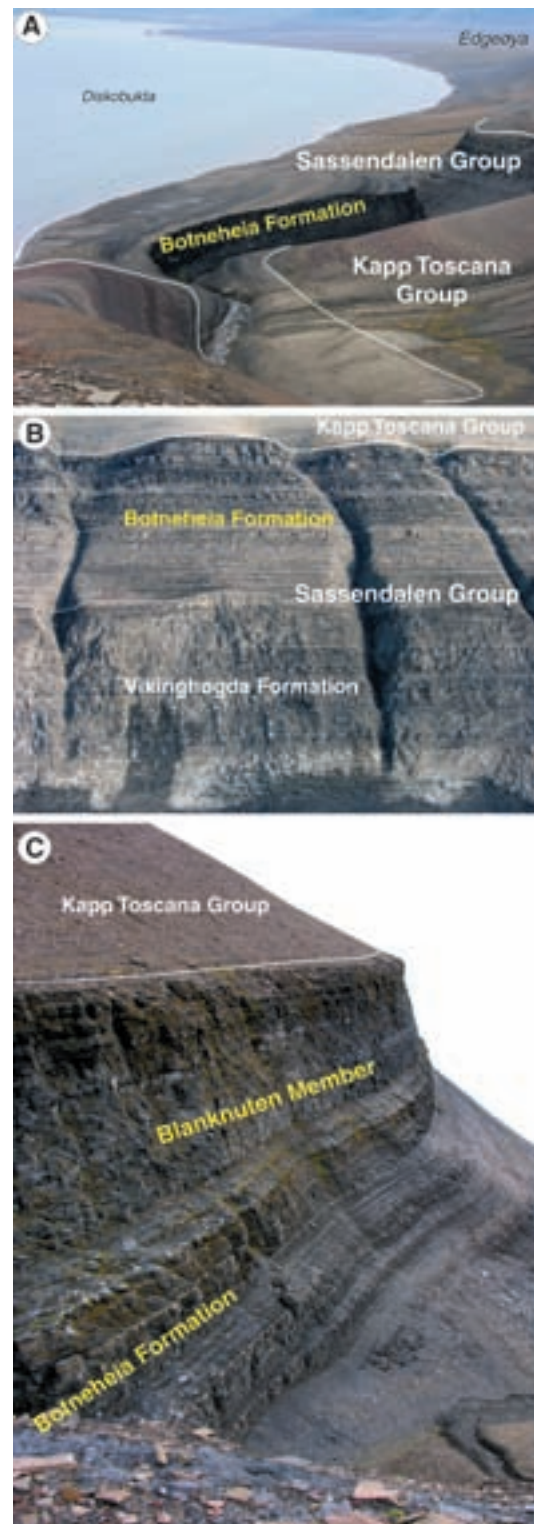


Fig. 2. (A) Outcrops of the Triassic sequence (Sassendalen and Kapp Toscana groups) on the western coast of Edgeøya. (B) Black shale sequence of the Early to Middle Triassic Sassendalen Group (Vikinghøgda and Botneheia formations) in coastal cliff of Muen. (C) Blanknuten Member (Ladinian) in the upper part of the Botneheia Formation at Blanknuten, W Edgeøya records an euxinic event in the Svalbard basin

stage of marine ecosystem recovery that promoted high biological productivity in the Svalbard basin. Biological productivity was allocated in the photic zone and dominated by non-skeletal planktonic unicells (bacteria, algae). *Tasmanites* and radiolaria blooms were important during deposition of the Blanknuten Member (Ladinian). Increased biological productivity upwards in the sequence was associated with enhanced stagnation of bottom water, oxygen consumption and bacterial sulfate reduction that led to the development of basinwide euxinic conditions (Fig. 3). Rain of fresh marine organic matter contributed to phosphate enrichment in surficial sediments and phosphogenesis (Fig. 4). Maximum phosphogenesis occurred under dysoxic bottom conditions and resulted in the formation of nodular and peloidal phosphorite accumulations (up to 25 wt. % P_2O_5). Several stages of bottom environment deterioration can be discerned on the basis of geochemical indices (Fig. 5). The most striking changes are in the content of organic carbon (TOC), in the degree of pyritization of iron (DOP), and in isotopic composition of pyritic and apatitic sulfur ($\delta^{34}S$). Evolution of the bottom environment from oxic through dysoxic/anoxic to euxinic is reflected in the consequent increase of organic carbon content in black shale, from 2-5% through 5-10% to 10-12%, respectively. These stages are characterized by different proportions of reactive iron that was reduced and bound in sedimentary pyrite, with the DOP values ranging from 0.3-0.5 through 0.6-0.8 to nearly 1.0 (all the reactive iron transformed into pyrite). The Blanknuten Member shows a prominent shift of $\delta^{34}S$ values of pyrite, from -30 – 10‰ VCDT in oxic to dysoxic bottoms up to +15‰ VCDT in euxinic environment, suggesting formation from an isotopically heavy, residual sulfate reservoir. This is confirmed by a similar trend in the isotopic composition of sulfate sulfur occurring in the form of lattice substitutions in sedimentary apatite. The association of high biological productivity in the water column, bottom stagnation and euxinia in the Blanknuten Member led to the formation of the best petroleum source bed in Svalbard. Pyrolytic data suggest that up to 70% of kerogen in the member can be transformed into hydrocarbons, with potential production ranging from 40 to 70 kg oil per ton of rock.

The reasons for the development and geological maintenance of euxinic water in the Svalbard basin

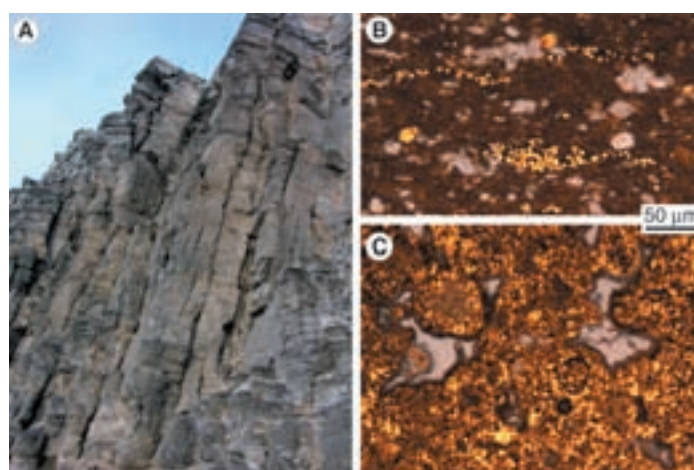


Fig. 3. (A) Organic carbon-rich, phosphatic mudrock of the middle part of the Blanknuten Member deposited under euxinic conditions in the deep shelf environment of the Svalbard basin. (B) Microscopic photograph of the mudrock showing organic carbon-rich matrix (dark brown) and common microgranular and framboidal pyrite (yellow). (C) Microscopic photograph of pyritized (yellow) peloidal phosphate in the mudrock

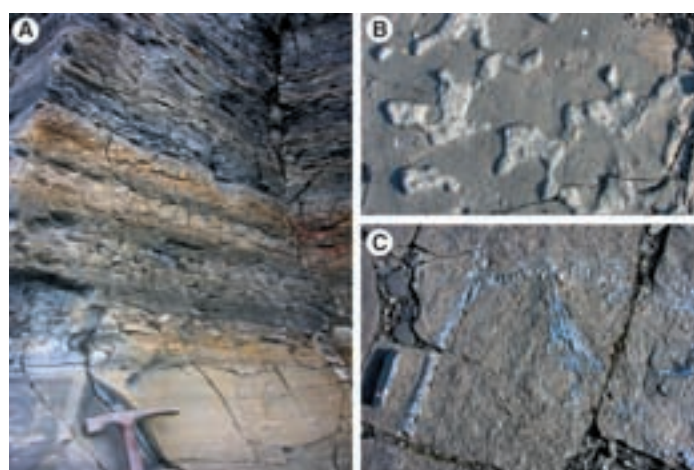


Fig. 4. (A) Recurrent phosphorite conglomerate beds in the lower part of the Blanknuten Member deposited as a result of slumps and debris flow into euxinic depression in the Svalbard basin. (B) Irregular pristine phosphate nodules in the upper part of the Blanknuten Member formed as a result of phosphate authigenesis of organic-rich sediment under dominant dysoxic conditions. (C) Ichthyosaur skeleton in a mass mortality bed in the upper part of the Blanknuten Member

are as yet poorly understood. Most probably this water formed as a result of sluggish circulation and redoxcline stabilization in a wide synsedimentary depression in an open shelf depositional area. The

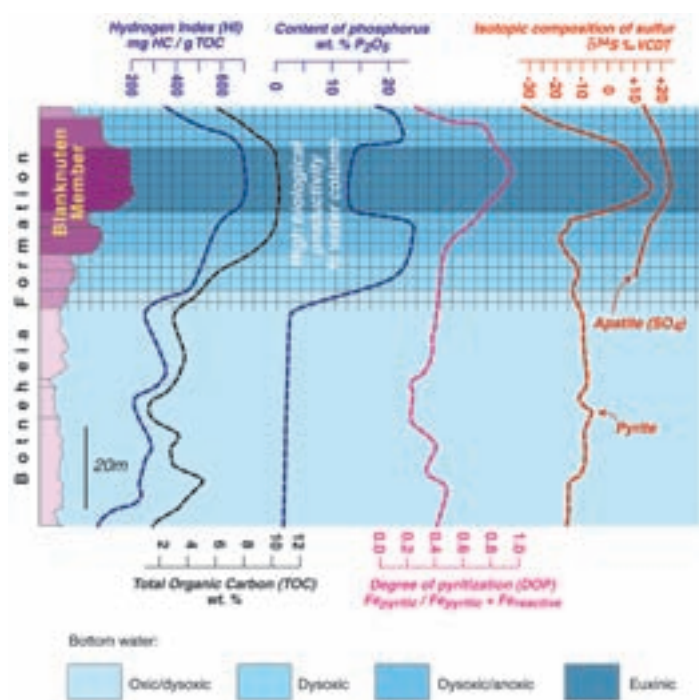


Fig. 5. Profile of the Middle Triassic Botneheia Formation at Edgeøya showing selected geochemical indices and paleoredox and paleoproductivity interpretation

euxinic event in the Triassic of Svalbard developed 6 Ma after the boundary biological crisis. Biostratigraphic data suggest that it lasted approximately 4 Ma. Shallowing of the environment led to mixing episodes that caused expulsions of euxinic water to the surface and recurrent deposition of mass mortal-

ity beds in the upper part of the Blanknuten Member. Consequent shallowing, increased environment dynamics, and a decline in productivity terminated the Svalbard euxinia.

References

- Krajewski K.P. (2005). The Arctic phosphogenic province: its origin and phosphorus reservoir. EOI No. 229 for the 4th International Polar Year 2007/2008. <http://www.ipy.org>.
- Krajewski K.P. (2006). Geological processes in the formation of the Arctic phosphogenic province. Project No. 15. Change and Variability of the Arctic Systems – Nordaustlandet. http://www.eld.geo.uu.se/IPY/letters_n_grants/index.htm.
- Krajewski K.P., Karcz P., Woźny E., Mørk A. (2007). Type section of the Bravaisberget Formation (Middle Triassic) at Bravaisberget, W Nathorst Land, Spitsbergen, Svalbard. *Polish Polar Research*. 28(2), 79-122.

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Reconstruction of lake evolution at Rzeciono (NW Poland) during the Eemian Interglacial and early Vistulian on the basis of stable isotope analysis

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Introduction

Numerous localities with lacustrine successions dating from the Eemian Interglacial have been discovered in Poland. These sediments have been documented very well in palynological terms; some of them have been analyzed in terms of stable oxygen and carbon isotopes. Combining isotopic data with palaeontological results helps to reconstruct

environmental conditions and lake evolution in greater detail.

The oxygen isotope composition of lacustrine carbonates is controlled by the isotopic composition of the host water and the water temperature at which carbonate precipitation took place. The oxygen isotopic composition of lake water is determined by the atmospheric component of the global hydrological cycle and reflects the mean oxygen isotopic

composition of catchment precipitation, which is primarily a function of latitude, modified by orography and continentality (Fig. 1).

Carbon isotope composition of authigenic carbonates is determined by the isotopic composition of bicarbonate (HCO_3^-). The ^{13}C content in sediments is mainly influenced by water-atmosphere CO_2 exchange, by the volume of incoming groundwater and the influx of dissolved carbonates, by plankton photosynthesis and by CO_2 production during the decay of organic matter (Fig. 2).

Isotopic studies of Eemian deposits have been conducted in Poland by Mirosław-Grabowska since 2001 (Mirosław-Grabowska, Niska 2005; Mirosław-Grabowska, Niska 2007a; Mirosław-Grabowska, Niska 2007b).

The palaeolake at Rzecino

The palaeolake at Rzecino is located near Połczyn-Zdrój (NW Poland). Sediments about 3.5 m thick were analyzed. Sandy silts occur on the bottom (below 39.6 m), followed by calcareous gyttja (depth: 39.6-35.0 m) (Fig. 3). Organic silts appear at a depth of 36.4-37.6 m. The upper part (above 35.0 m) of this succession contains organic sands. Palynological data indicate these sediments accumulated during the Eemian Interglacial and the subsequent part of the Vistulian Glaciation.

Stable isotope carbon and oxygen analyses were carried out on 52 samples of calcareous sediments from the depth intervals 34.60-36.40 m and 37.60-40.40 m using the classical phosphoric acid method. The isotopic composition was measured with a Finnigan MAT Delta⁺ gas spectrometer at the Institute of Geological Sciences in Warsaw. The concentrations of ^{13}C and ^{18}O isotopes are presented as $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ isotope ratios versus the V-PDB standard ($\delta^{13}\text{C}$, $\delta^{18}\text{O}$).

Results

The final phase of the Wartanian is characterized initially by values of $\delta^{18}\text{O}$ ca. -5‰ and $\delta^{13}\text{C}$ from -0.4 to +0.1‰ (isotopic horizon – Is 1, Fig. 3). The high $\delta^{18}\text{O}$ values are associated with the presence of dispersed allochthonous carbonates from the underlying morainic till. The CaCO_3 content of these sediments, mainly sandy silts, is low. At that time reservoir formation took place. Then a decrease

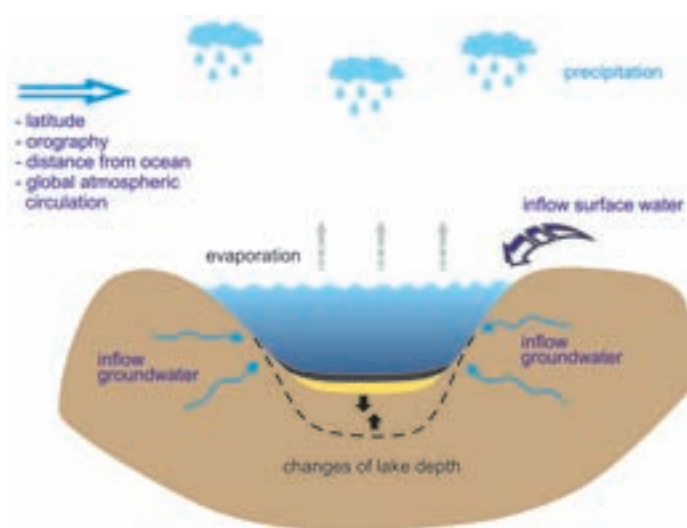


Fig. 1. Processes influencing the oxygen isotopic composition

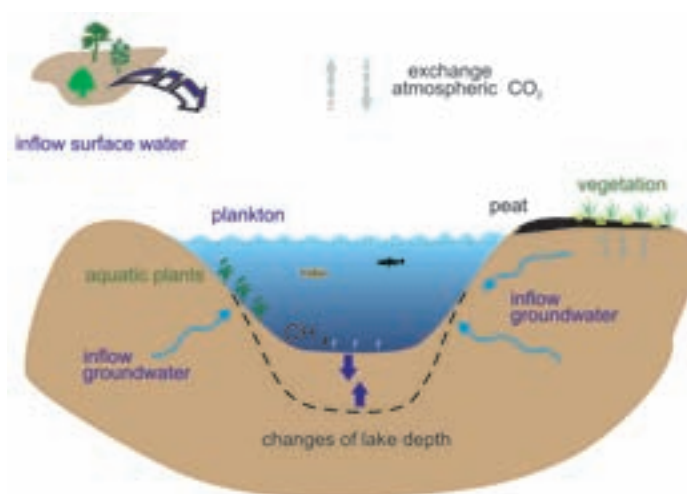


Fig. 2. Factors influencing the carbon isotopic composition

of $\delta^{18}\text{O}$ values is observed. After reaching a minimum of -7.2‰, these values rise to ca. -5‰. The $\delta^{13}\text{C}$ values change from -0.2 to +0.1‰ (lower part of Is 2). The lower $\delta^{18}\text{O}$ values are connected with a change in the isotopic composition of lake water, caused by an inflow of water enriched in the lighter isotope ^{16}O .

At the beginning of the Eemian Interglacial (pollen zones E1-E2) the environmental conditions in the lake studied are constant. The isotopic values of $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ are on the same level (upper part of Is 2). At the end of pollen zone E2, the $\delta^{18}\text{O}$ values rise (to -3.1‰). High $\delta^{18}\text{O}$ values are probably connected with increased evaporation and

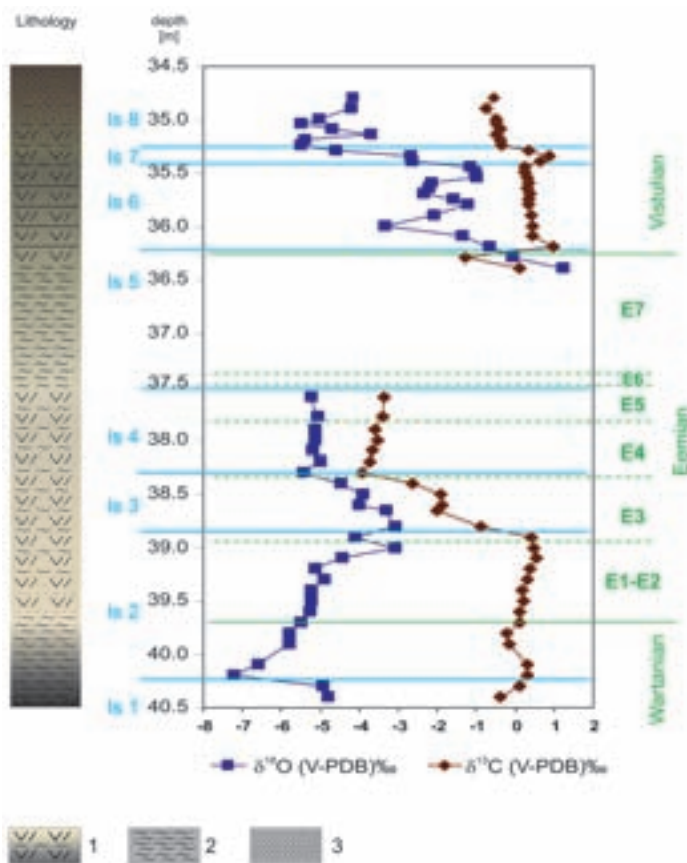


Fig. 3. Isotopic data of sediments at Rzecino. Lithology: 1 – gyttja, 2 – silts, 3 – organic sands; Is 1-8 – isotopic horizons; E1-E7 – regional pollen assemblage zones (stratigraphy based on palynological data)

lower water level in this reservoir, the low-carbonate silts gradually being replaced by authigenic gyttja.

During the pollen zone E3 a gradual decrease in $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values is observed (Is 3). The $\delta^{18}\text{O}$ values drop to ca. -5.4‰ and the $\delta^{13}\text{C}$ values reach their minimum (-3.9‰). This decrease was likely caused by an increase of precipitation. The greatest lake depth probably occurred at this time.

During the pollen zones E4 and E5, constant values of $\delta^{18}\text{O}$ (ca. -5‰) and of $\delta^{13}\text{C}$ (ca. -3.6‰) are noted (Is 4). This isotopic composition shows the stable climatic and hydrological conditions and/or the fast rate of sedimentation. The end of pollen zone E5 (from depth 36.45 m) evidences a lithologic change, in which calcareous gyttja are replaced by carbonate-free sediments: silts and peaty silts. This phenomenon might have been caused by a shallowing of the lake through its being filled up with sediments.

At the end of pollen zone E7 the carbonate sediments occur again. The $\delta^{18}\text{O}$ values are very high and change from -0.7 to $+1.2\text{‰}$ and the $\delta^{13}\text{C}$ values oscillate from -1.3 to $+1\text{‰}$ (Is 5). The restoration of the Rzecino reservoir took place at that time.

Based on palynostratigraphy, the end of the Eemian Interglacial occurs at a depth of 36.25 m. During the Early Vistulian, broad fluctuations of $\delta^{18}\text{O}$ values (from -3.4 to -1‰) and constant values of $\delta^{13}\text{C}$ (ca. $+0.4\text{‰}$) are observed (Is 6). This isotopic record points to frequent changes of water volume and bioproduction on the same level in this lake. Next a decrease in $\delta^{18}\text{O}$ values proceeds continuously (to -4.6‰), and a rise of ca. 0.5‰ in $\delta^{13}\text{C}$ values is noted. Such a trend might have coincided with climatic cooling. On the top of the succession $\delta^{18}\text{O}$ values oscillate from -5.5 to -3.1‰ while $\delta^{13}\text{C}$ values equalize on the level of ca. -0.7‰ . The isotope composition reflects a small rise in lake level or an influx of water enriched in light isotopes. Then organic sands occur, suggesting the decline of the palaeolake at Rzecino.

References

- Mirosław-Grabowska J., Niska M. (2005). Isotopic and Cladocera records of climate changes of Early Eemian at Besiekierz (Central Poland). *Geological Quarterly*, 49(1), 67-74.
- Mirosław-Grabowska J., Niska M. (2007a). Reconstruction of environmental conditions of Eemian palaeolake at Studzieniec (Central Poland) on the basis of stable isotope and Cladocera analyses. *Quaternary International*, 162-163, 195-204.
- Mirosław-Grabowska J., Niska M. (2007b). Isotope and Cladocera data and interpretation from the Eemian optimum and postoptimum deposits, Kalliska palaeolake (Central Poland). *Quaternary International*, 175(1), 155-167.

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Studies on vegetation response to a topographical-soil gradient

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We present an assessment of topography-soil-vegetation relationships along three catenal sequences representative of the Wigierski (Lake Wigry) National Park. The main aim of the work was to determine whether a sequence of changes in soil indicators is reflected in a sequence of changes in plant communities (e.g. species richness and quantitative or qualitative indices of species composition, as well as the role of indicative species).

The selected catenas represented the most characteristic sequences of soils and plant communities in the young glacial landscape (Fig. 1). Catena 1 goes along the slope of a kame tableland, from its edge to a depression without outflow. Meadow vegetation prevails (Fig. 2). Catena 2 is forested and runs in the Czarna Hańcza valley, from the edge of a morainic hill to the valley terraces. Catena 3 is representative of soil and vegetation conditions of a morainic plateau with grassy communities. It extends from a denuded area that is more or less flat, downslope to a former lake basin which is now a peatland.

After field studies, laboratory work, and statistical and GIS-based data processing and calculations

a total of 25 variables were compiled for each site (Table 1).

The relationships between soil indicators and plant communities are complex. The three catenal sequences differed in their species richness, but little in terms of soil. An intermediate position is occupied by the weighted means of indicator values. The lower sections of the three catenae were more similar to each other than the upper parts. This may be explained by the stronger similarity in soil moisture conditions at lower altitudes. Fig. 3 presents these relations for catena number 3.

A number of statistically significant correlation relationships between soil and vegetation variables were found. The most important are the following (Table 2):

- A negative correlation relationship between C:N and the mean of Ellenberg's acidity index (RIND). This points to the moderate ecological requirements of the patches of vegetation studied where soil reaction was concerned.
- A relation between soil carbon content (C) and the share of species number with indicator soil mois-

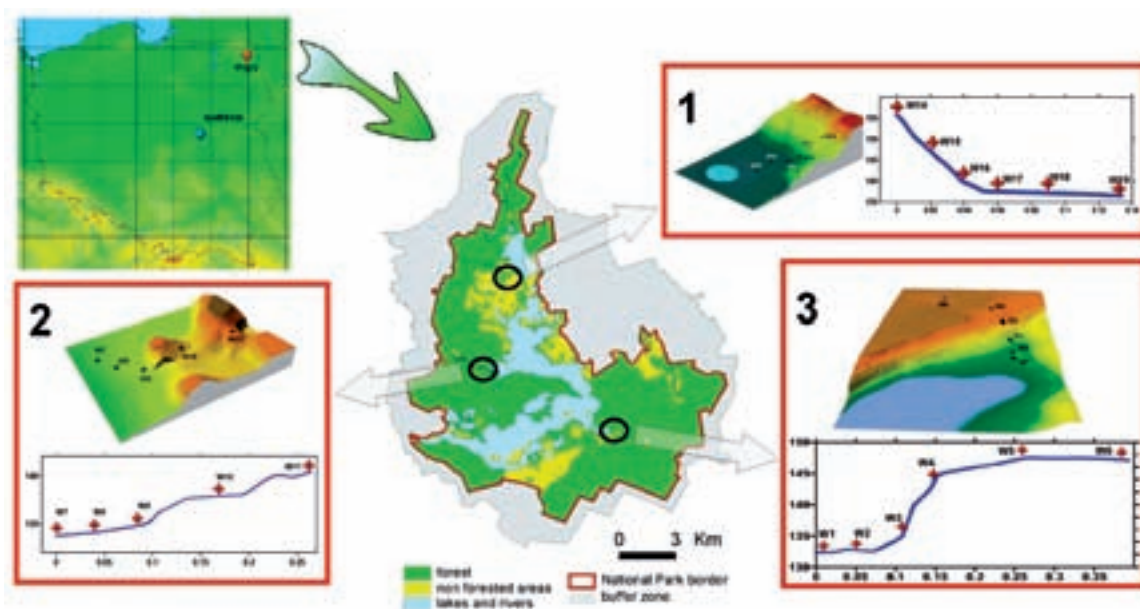


Fig. 1. Locations of study sites within Wigierski National Park



Fig. 2. General view of the area where the first transect was located (J. Solon)

ture value F4 (FIND4). In conditions of low organic carbon content (of up to 8%), there is a much greater decline in the proportion of these species. Where the content of organic carbon is greater than 10%, this relationship became indistinct.

- A relation between soil conductivity (K) and the share of dry-conditions species (FIND3). Where K was $< 70 \mu S$, the share of these species was greater, while where K was $> 70 \mu S$ FIND3 species were not present at all. This result indirectly reflects the relationship between conductivity and moisture.

- A relation between soil moisture (W) and the weighted means of Ellenberg's F indicator describing the water requirements of plant communities (FIND). An increase in soil moisture to 35% corresponded to an increase in the weighted mean FIND value, while greater moisture levels ($>35\%$) were associated with a flattening out of the curve, with no significant relationship between the features being indicated.

- A relation showing that higher shares of base-loving species (RIND 8) were associated with higher elevations (WYS2), which is the result of brown soils' prevalence on higher altitudes.

- A relation between the number of species (L_GAT) and the total nitrogen content in soils (N), showing that very fertile soils are associated with plant communities poor in species (Fig. 4).

Generally, relationship between the number of species and soil properties are of a non-linear character. For plots where the soil pH was 6-7, the

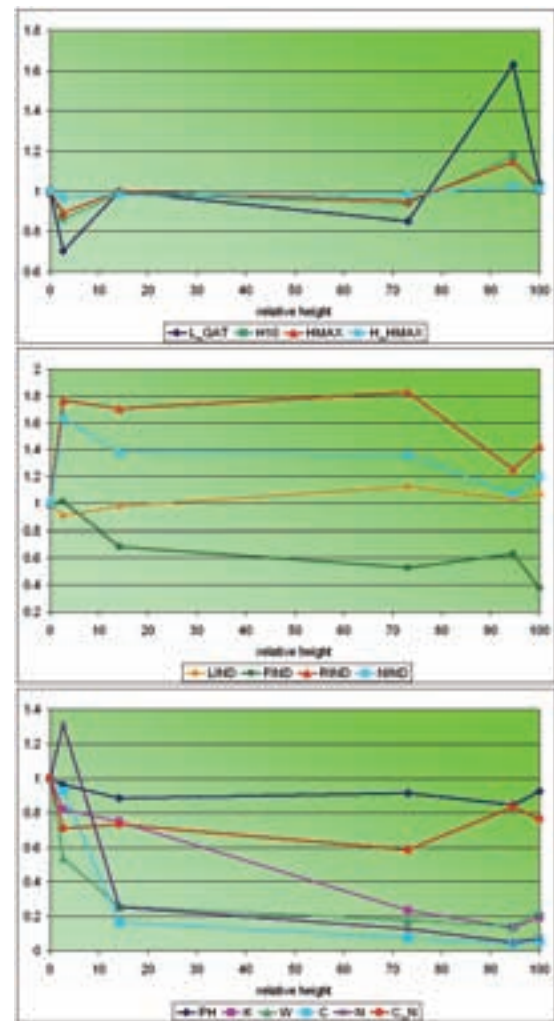


Fig. 3. Variability of diversity indices, mean Ellenberg's indices, and soil properties on catena no 3. Relative values are presented (the value for a given site divided by that of the lowest site)

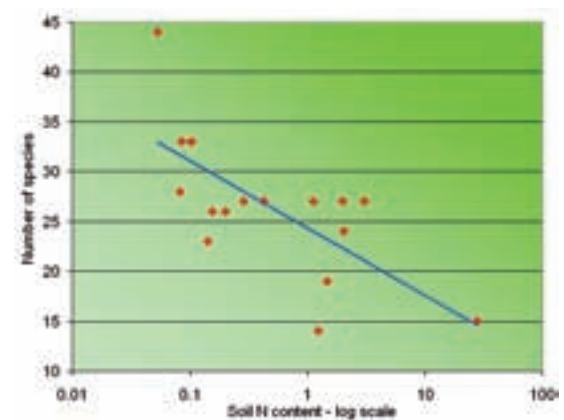


Fig. 4. Relationship between number of species (dependent variable) and nitrogen content in soil (independent variable). $y = -2.9293 \cdot \ln(x) + 24.329$; $R^2 = 0.4972$

Table 1. Acronyms and definitions of variables

Acronym	Definition
L_GAT	Number of vascular plant species on a study site (20m ²)
H10	Herb layer diversity index, calculated according to the formula: $H10 = -\sum p_i \log_{10} p_i$; p_i – the share of i -species in total cover
HMAX	The index of maximal diversity calculated according to the formula $HMAX = \log_{10} n$; n – number of plant species
H_HMAX	The evenness index calculated according to the formula $H_HMAX = H10/HMAX$
WYS	Absolute height of the site (meters above sea level)
WYS2	Relative location of the site on the catena (for the lowest site WYS2 = 0; for the highest site WYS2 = 100)
PH	pH of the upper soil horizon measured in fresh samples
K	Soil conductivity
W	Soil moisture
C	Organic carbon content
N	Total nitrogen content
C_N	Total nitrogen to organic carbon ratio
LIND	Mean indicator light value (L) based on species cover
FIND	Mean indicator soil moisture value (F) based on species cover
FIND3	The percentage share of species number with indicator soil moisture value F3 (in total number of species) – indicators of relatively dry soils
FIND4	The percentage share of species number with indicator soil moisture value F4 (in total number of species) – indicators of slightly moist soils
FIND34	The percentage share of species number with indicator soil moisture value F3 and F4 (in total number of species)
RIND	Mean indicator soil reaction value (R) based on species cover
RIND7	The percentage share of species number with indicator soil reaction value R7 (in total number of species) – indicators of weakly-acid or weakly-alkaline soils
RIND8	The percentage share of species number with indicator soil reaction value R8 (in total number of species) – indicators of alkaline soils
RIND78	The percentage share of species number with indicator soil reaction value R7 and R8 (in total number of species)
NIND	Mean indicator soil nitrogen value (N) based on species cover
NIND2	The percentage share of species number with indicator soil nitrogen value N2 (in total number of species) – indicators of extremely oligotrophic soils
NIND3	The percentage share of species number with indicator soil nitrogen value N3 (in total number of species) – indicators of oligotrophic soils
NIND23	The percentage share of species number with indicator soil nitrogen value N2 and N3 (in total number of species)

Table 2. Results of dependence modeling. Shown are only results with R either higher than 0.6 or higher than absolute value of Pearson's Product-moment Correlations

X	Y	model	parameters				R
			a	b	c	d	
C/N	RIND	$y=a+bx$	9.821	-0.307			0.6826
K	FIND3	$y=a+b/x$	-0.0419	211.1673			0.6458
W	FIND	$y=a/(1+b*\exp(-cx))$	6.6586	3.5553	0.1135		0.7841
W	FIND4	$y=a/(1+b*\exp(-cx))$	-22351135	-270209.8700	-0.0549		0.8979
C	FIND4	$y=(a*b+c*x^d)/(b+x^d)$	1.1812	0.0645	43.9877	-1.7720	0.9416
wys2	RIND8	$y=a+bx+cx^2$	6.0649	-0.0552	0.0014		0.7242

number of species was not significantly affected by differences in soil moisture, while the number of species was markedly lower with either higher pH and moisture or lower pH and higher moisture (Fig. 5).

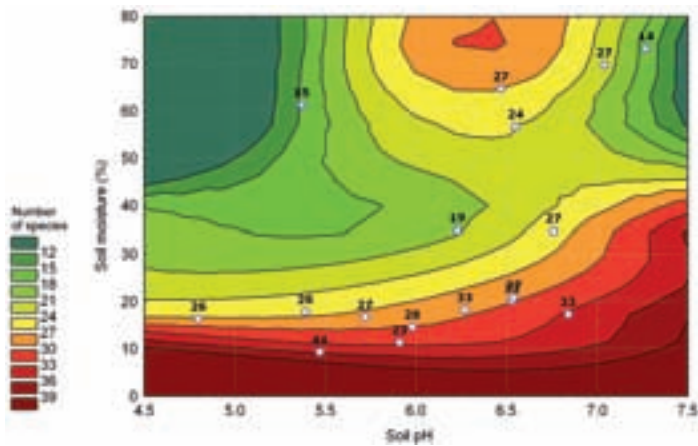


Fig. 5. Relationship between number of species and soil pH (horizontal axis) and soil moisture (vertical axis) according to negative exponential model

Our study has shown that a sequence of changes in soil indicators is reflected in a sequence of changes in plant communities, mainly in their species richness and the share of different groups of indicative species. The environmental factors determining soil chemical properties and vegetation pattern to the greatest extent were soil moisture and elevation. The numbers of species varied also according to the joint pattern of soil acidity and moisture content. This modifying influence of soil acidity (and fertility) on species richness seems to

be of general nature, as it was shown in many studies.

Relationships between topographic differentiation, soil properties and vegetation features are multi-aspectual and multi-scalar in nature. Spatial differentiation and non-monotonic changes of analyzed features corresponds to zones showing a prevalence of different processes, namely erosion (ridges and upper parts of slopes), transition (middle parts of slopes) and accumulation (valleys and local depressions). This differentiation is most pronounced by vegetation features (Ellenberg's indices and diversity indices) and less visible in soil.

References

- Solon J., Degórski M., Roo-Zielińska E. (2007). Vegetation response to a topographical-soil gradient. *Catena*, 71, 309–320.
- Roo-Zielińska E., Solon J., Degórski M. (2007). Ocena stanu i przekształceń środowiska przyrodniczego na podstawie wskaźników geobotanicznych, krajo-brazowych i glebowych (podstawy teoretyczne i przykłady zastosowań). *IGiPZ PAN Monografia*, 9.

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Assessing marine biodiversity

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Biodiversity has taken on strong political and juridical connotations following a sequence of international events like world summits, EU directives, and political recommendations to protect biodiversity and halt its loss. The 1992 United Nations Earth Summit in Rio de Janeiro defined biodiversity as “the variability among living organisms from all sources, including terrestrial, marine, and

other aquatic ecosystems, and the ecological complexes of which they are part.” The Rio de Janeiro Summit initiated intensive biodiversity research, yet our actual and practical understanding of the patterns of marine diversity is problematic and remains to be unraveled. Papers presenting the Institute of Oceanology's biodiversity research in Arctic fjords were published in 2007, as an effect of interna-

tional collaboration by IOPAS scientists within the EU Network of Excellence for Marine Biodiversity – MARBEF. The papers were based on materials collected in glacial fjords off west Spitsbergen on board the R/V “Oceania” (Fig. 1) and focused on the diversity of soft-bottom macrozoobentos (i.e. animals retained on 1 mm mesh sieve). First, we explored the performance of surrogates (i.e. quantities which reflect species-level diversity patterns but can be more easily determined) in a study of natural patterns of benthic diversity in an Arctic glacial fjord (Włodarska-Kowalczyk & Kędra 2007). Second, we contributed to the debate on the presence and processes responsible for large-scale patterns of benthic biodiversity by a comparative study of the polychaetes diversity of Arctic and Antarctic marine inlets (Włodarska-Kowalczyk et al. 2007).

Traditionally, the analysis of diversity patterns required a data matrix containing species abundances in samples. However, identifying all sampled animals down to the species level is very expensive, being time consuming, labor intensive, and requiring a considerable level of taxonomic expertise. The need for easier and cheaper methods has fueled the search for surrogates. The two main surrogacy methods (lowering the resolution of taxonomic identifications and the selection of surrogate taxonomic group) were first developed and widely tested in pollution impact studies. The performance of surrogates in natural benthic diversity studies has remained largely unexplored. We tested both surrogacy methods (taxonomic sufficiency and selected taxa) in predicting benthic diversity changes in response to a natural disturbance gradient produced by glacial sedimentation in an Arctic fjord (Włodarska-Kowalczyk & Kędra 2007). There was a strong correlation between benthic diversity patterns observed at the level of species, genus, and family (Fig. 2). Similarly, little information was lost when polychaetes were extracted from the basic dataset and analyzed separately. The species diversity patterns observed along the glacial disturbance gradient did not persist when taxonomic resolution was lowered to the class or phylum level or when only molluscs or crustaceans were analyzed. Thus the family level identifications or analyses based on polychaetes only can be recommended as a reliable measure of benthic diversity when species identifications are not available.

The general interest in large scale patterns of marine diversity has driven interest in questions of



Fig. 1. The R/V “Oceania” in the Arctic

the relative diversity of the Arctic and Antarctic. It is generally assumed that Antarctic fauna is more diverse due to longer history and higher heterogeneity of the Antarctic sea bottom, yet the comparable quantitative data sets on the benthic fauna from polar areas are sparse. We aimed to contribute to the debate on polar diversity by comparing data sets on polychaetes at the scale of marine embayments (Włodarska-Kowalczyk et al. 2007). Two Arctic fjords off west Spitsbergen (Kongsfjord and van Mijenfjord) and an Antarctic marine inlet off King George Island (Admiralty Bay) were compared. In all sites the fauna was sampled using van Veen grabs, sieved on 0.5 mm sieve. The polychaetes were the dominating component of macrobenthic communities in all sites. We observed no difference in diver-

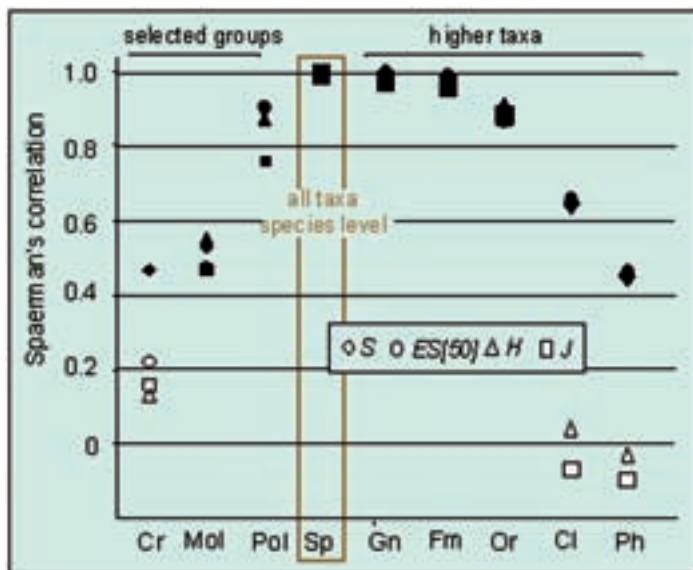


Fig. 2. Spearman rank correlations between different diversity measures (S – number of taxa per sample, $ES[50]$ – Hurlbert index, H – Shannon-Wiener index, J – Pielou index) of basic dataset comprising all taxa identified to species level (Sp) and surrogate matrices constructed for selected groups: Cr – Crustacea, Mol – Mollusca, Pol – Polychaeta, and for higher taxonomic levels: Gn – genera, Fm – families, Or – orders, Cl – classes, Ph – phyla. Solid symbols indicate significant correlations (at $P < 0.05$)

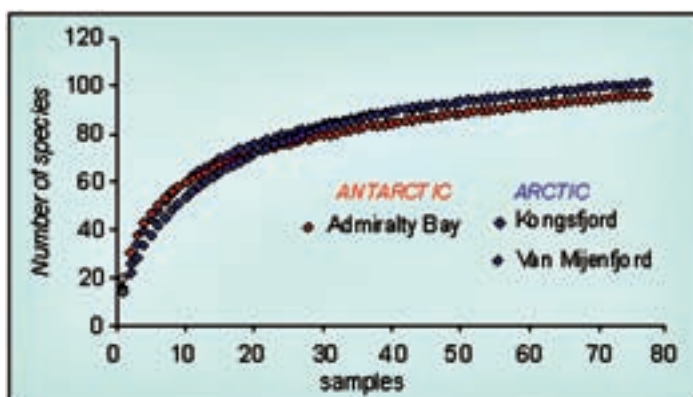


Fig. 3. Species accumulation curves for the two Arctic (Kongsfjord, Van Mijenfjord) and one Antarctic (Admiralty Bay) site

sity, across a range of measures, between the infaunal polychaetes of the Antarctic Admiralty Bay and the Arctic fjords of Svalbard (Fig. 3). This finding contrasts with substantial differences in diversity reported for Arctic and Antarctic epi-megafauna. We suppose that the widely accepted paradigm of higher Antarctic diversity first perceived and well documented for the epi-fauna is linked to differences in the three-dimensional heterogeneity of their habitat. The 3D structures created by large drop stones and mass occurrences of large suspensivores provide extra substrata, increase the structural habitat complexity, and result in the vast species enrichment of epifauna. This difference in heterogeneity is not experienced by soft-bottom infaunal animals. Within the sediment fabric there is little heterogeneity of the scale described for the epibenthos. Our study suggests that the patterns of diversity of polar benthic communities are shaped by patterns of habitat heterogeneity, which appears to mask any historical processes.

References

- Włodarska-Kowalczyk M., Kędra M. (2007). Surrogacy in natural patterns of benthic distribution and diversity: selected taxa versus lower taxonomic resolution. *Marine Ecology Progress Series*, 351, 53-63.
- Włodarska-Kowalczyk M., Siciński, J., Gromisz, S., Kendall, M.A., Dahle, S. (2007). Similar soft-bottom polychaete diversity in Arctic and Antarctic marine inlets. *Marine Biology*, 151, 607-616.

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CO₂ sequestration via mineral carbonation in ash-aqueous suspensions

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Mineral carbonation is one of the methods for reducing anthropogenic CO₂ emissions. It consists in the permanent, and at the same time ecologically safe bonding of CO₂ through mineral resources and waste (Fig. 1). Alkaline mineral waste can be used for CO₂ bonding, such as the fly ash that originates from professional power industry plants – the greatest source of anthropogenic CO₂ emissions in Poland. Employing ash-aqueous suspensions in CO₂ bonding will help reduce CO₂ emissions and allow fly ash to be used in a broad economic spectrum. Professional power industry plants in Poland are often situated near hard coal mines, which supply them with coal and which are used for the depositing power industry waste (fly ash). CO₂ release into the fly ash disposed in such underground mines, in the form of suspensions, will allow CO₂ emissions to be reduced (Uliasz-Bocheńczyk et al. 2006).

The issue of carbon dioxide emission reduction via its sequestration has become particularly important since the signing of the Kyoto Protocol. Poland has committed to reduce greenhouse gas emissions in 2008-2012 by 6% below their 1990 level. Actions have therefore been taken, in Poland like elsewhere

in the world, to reduce CO₂ emissions through capture and disposal or utilization.

Electric and heat energy production in the Polish professional power industry is based on combustion of conventional fuels, above all lignite and hard coal. Thus the main source of anthropogenic CO₂ emission is the professional power industry, accounting for 147 thousand Gg.

The professional power industry also produces waste, primarily fly ash, more than 99% of which is captured, amounting to 12,000 Gg of fly ash. The ash from the professional power industry can be divided into the following groups: fly ash from conventional boilers, fly ash with desulphurization products, fly ash from lignite combustion, and fly ash from fluidized bed boilers.

The applicability of fly ash to CO₂ bonding hinges above all upon its CaO and free CaO content. The ash used for CO₂ bonding should be characterized by high calcium content, due to which it reacts with water in a direct way. Ash hydration leads to the formation of Ca(OH)₂, C-S-H phase, and other compounds, which are reactive towards carbon dioxide. Of the types of fly ash produced in professional power industry plants, the ones char-

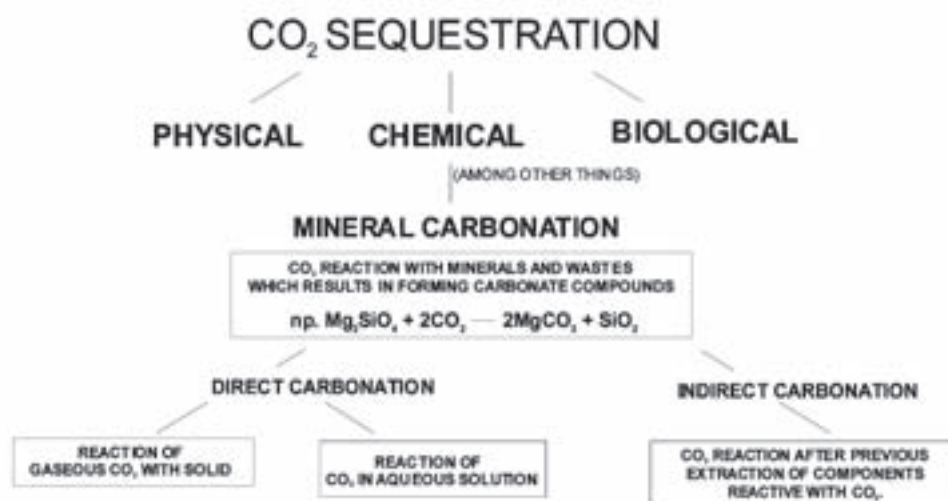


Fig. 1. Mineral carbonation as one method of CO₂ sequestration (Uliasz-Bocheńczyk et al. 2006)

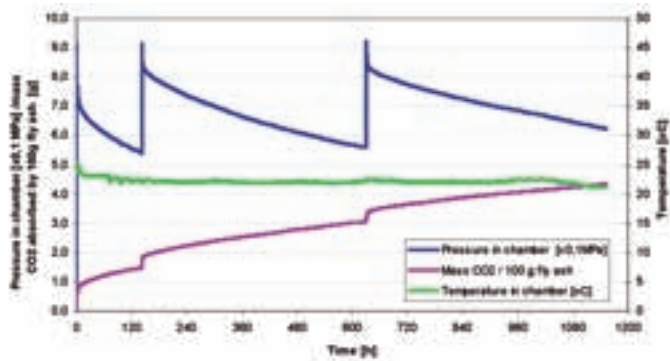


Fig. 2. Example chart of CO₂ absorption by a sample suspension, with content based on fly ash from fluidized bed boilers (Uliasz-Bocheńczyk et al. 2007)

acterized by the highest CaO and free CaO content are from lignite combustion and from fluidized bed boilers. High CaO and free CaO content can also be found in ash with desulphurization products. The fly ash from conventional hard coal combustion is characterized by the lowest CaO content (Uliasz-Bocheńczyk, Mokrzycki 2006).

A research project has aimed to determine the potential for utilizing fly ash from the Polish professional power industry. The project has examined CO₂ absorption by fresh ash-aqueous suspensions

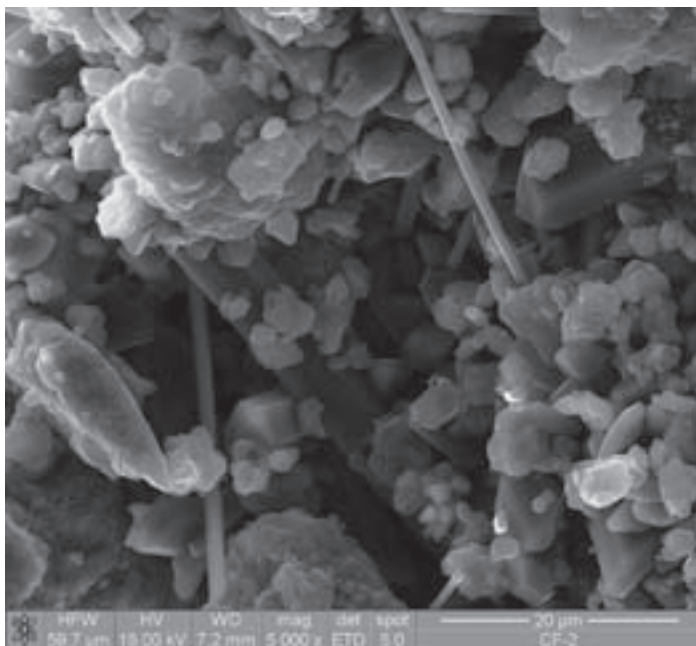


Photo. Suspension after carbonation based on fly ash from fluidized bed boilers from lignite combustion. The sample has evidenced an increased calcite content, confirming the occurrence of the carbonation process

as well as the degree of CO₂ bonding by hardened suspensions.

The results of this research revealed that CO₂ absorption by fresh ash-aqueous suspensions depends above all on the ash type (Fig. 2). Suspensions formed on the basis of fly ash from coal combustion in conventional boilers cannot, in fact, be considered for CO₂ absorption. The other suspensions are characterized by maximum absorption ranging from 2.35 g CO₂/100 g for fly ash with desulphurization products from the semi-dry method, up to 10.93 g CO₂/100 g for fly ash from lignite combustion in fluidized bed boilers (Uliasz-Bocheńczyk et al. 2007).

The basic product of fly ash mineral carbonation is calcium carbonate (Photo). The presence of dolomite has been confirmed as well, and phases which are the products of fly hydration, which with time undergo carbonation.

The findings show that most of the samples with inserted CO₂ demonstrate CaCO₃ content at a comparable level of 5-10% and above 10%.

The highest CaCO₃ content can be found in suspensions with ash types from fluidized bed boilers, with desulphurization products from the semi-dry and dry method, as well as from lignite combustion in fluidized bed boilers (Uliasz-Bocheńczyk et al. 2007).

When choosing fly ash for CO₂ bonding, consideration must be given to CaO content and whether such ash is currently in mass use in the economy. Ash from conventional boilers with low CaO content should not be employed in CO₂ bonding, as its absorption and CO₂ bonding degree is insignificant and moreover it is widely used as raw material, such as in cement and concrete production.

For many years, fly ash has been disposed in underground coal mines in the form of mixtures with water. This offers an opportunity for the joint deposition of fly ash and carbon dioxide, bonded via mineral carbonation, thus enabling the two combustion products to be utilized (Uliasz-Bocheńczyk et al. 2006). At the same time, CO₂ bonding in ash-aqueous suspensions via mineral carbonation and their disposal in underground mines solves the problem of deposition of the products originating from carbonation (Uliasz-Bocheńczyk et al. 2007).

References

Uliasz-Bocheńczyk A., Mokrzycki E. (2006). Fly Ashes from Polish Power Plants and Combined Heat and Power Plants and Conditions of their Application for Carbon Dioxide Utilization. *Chemical Engineering Research and Design*, 84(A9), 837-842.

Uliasz-Bocheńczyk A., Mokrzycki E., Mazurkiewicz M., Piotrowski Z. (2006). Utilization of Carbon Dioxide in Fly Ash and Water Mixtures. *Chemical Engineering Research and Design*, 84(A9), 843-846.

Uliasz-Bocheńczyk A., Mokrzycki E., Piotrowski Z., Pomykała R. (2007). *The underground storage of CO₂*

with ash-water suspensions (Składowanie CO₂ z zawiesinami popiołowo-wodnymi pod ziemią). IGSMiE PAN, Kraków.

Uliasz-Bocheńczyk A., Mokrzycki E. (2007). Emissions from the Polish power industry. *Energy*, 34(12), 2370-2375.

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Conflict of interests connected with the planned construction of the Kąty-Myscowa dam reservoir (Western Polish Carpathians)

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The advance of civilization entails growing human pressure on the environment, although this tendency may be reversed by historical cataclysms or by conscious action taken to protect and shape the environment. An interesting example can be found in the case of the Wisłoka River Valley between the Kremarna and Kąty villages, where plans call for a dam reservoir to be constructed (Fig. 1, 2 and 3) – an opportunity for the changing relations between man, nature, and the landscape to be observed within a relatively small area (c.a. 35 km²). Here such changes have been caused by post-war displacements of inhabitants, unsuccessful attempts at transforming the traditional economy into state-owned farms, the area being slated for use in hydro-engineering, and active implementation of the ideas of nature protection.

The area under discussion is located in the eastern part of the Polish Outer Carpathians, in the Low Beskids, in the area of old Lemkovina – an ethnic region on the Poland-Slovakia frontier, inhabited up until WWII by a population from the Ukrainian linguistic region with its own distinct

tradition and culture. As a consequence of post-war repatriation, the area's population witnessed a four-fold decrease. Post-arable lands were subjected to partial afforestation or were converted into state-owned farms. These state-owned agricultural establishments proved unprofitable and therefore halted their activity by the late 1980s. Through the mid-1990s this region was an isolated, solitary spot, remaining in stagnation and oblivion. In view of the reservoir-building project here, the plans for which stretched from the 1960s to the 1990s, a ban was imposed on any investment in the area, leading to a revival of nature that is nowadays evident.

The logical consequence of this was the development of regional forms of nature protection. The protection plan of the Magurski National Park, established in 1995, provided for the possibility of the construction of a dam, as had been planned since the 1960s. Building it will require the flooding of ca. 40 ha of protected surface, that is about 0.2% of the area, with an equivalent compensation (Fig. 1). These plans gained the support of natural-

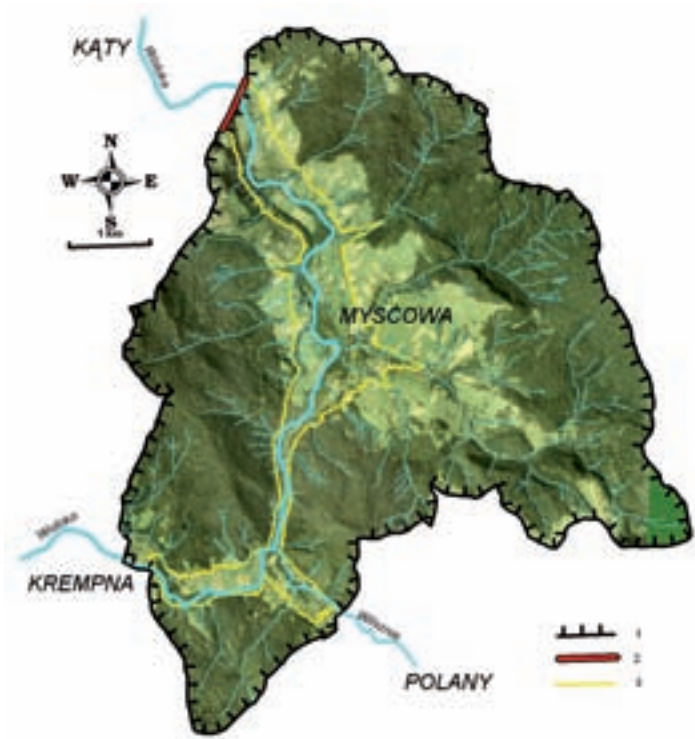


Fig. 1. Designed dam reservoir “Kały-Myscowa” – direct river basin and borders of planned inundation. 1 – borders of direct river basin, 2 – designed dam, 3 – range of planned inundation

ists at that time, including those who were involved in establishing the National Park. The situation was complicated after the implementation of a new tool of nature conservation – the Natura 2000 Network. It has proven impossible to create, within a short period of time, the required documentation to define the obligatory priorities and rules of protection, this giving rise to a specific “decision-making paralysis.” Poland has noted an economic recovery in recent years, related to its accession to the EU. Simultaneously, a certain kind of “race” began between adherents of the hydrotechnical project vs. individuals who wish to restrain those plans in the name of natural rights. There is also another interest group: the local community.

At present, three options of space organization are in conflict in the area under discussion:

- the “hydrotechnical” option, envisaging the establishment of a dam reservoir with the highest capacity,
- the “reserve” option, envisaging the development of spatial forms of nature conservation while



Fig. 2. Bed of the Wisłoka River in Myscowa village

imposing serious limits on colonization and economic, agricultural, and forestry activity,

- the “local independence” option, preferring multi-directional economic development leading the area to make rapid progress in catching up, under conditions of liberty in spatial reserves.

None of these foregoing concepts can be reconciled with a harmonious idea of development. Each concept has both supporters and opponents, and for all of them the motto of “sustainable development” is employed.

Administrative procedures are presently underway, launched at the request of the Regional Board for Water Management in Kraków, in regard to the location chosen for the Kały-Myscowa dam reservoir project. Meanwhile, in February 2008, the planned investment was added to the “black list” of investments most controversial in ecological terms, published by Bankwatch Network and Friends of the Earth Europe.



Fig. 3. Historic Orthodox Church in Myscowa village, in the area slated for flooding

References

- Sroczyński W. (2007). Оценка и прогноз эгзодинамических опасностей, связанных с планируемым строительством водохранилища Конты-Мысцова на реке Вислоце (юго-восточная Польша). [in] Опасные природные и техноприродные экзогенные процессы: закономерности развития, мониторинг и инженерная защита территорий. *Сергеевские Чтения*, 9, 246-250, Russian Academy of Sciences, Moscow.
- Sroczyński W., Bonenberg J., Koczur A., Pietrzyk-Sokulska E., Skrzypczak R., Syposz-Łuczak B. (2006). *Studium form i mechanizmów degradacji środowiska w systemach rekreacyjnych brzegów jezior zaporowych południowo-wschodniej Polski* (Study of

the forms and mechanisms of environmental degradation in recreational systems of dam lake banks in south-east Poland). IGSMiE PAN, Kraków.

Sroczyński W., Syposz-Łuczak B. (2007). The dispute about principles of sustainable development of the Carpathian Valley – on the example of planned reservoir “Kały-Myscowa.” *Polish Journal of Environmental Studies*, 16(2B), 462-464.

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The International Relations of the Polish Academy of Sciences

The issues of climate change have become an important problem on the international scale. The Polish Academy of Sciences has likewise devoted part of its activity to addressing this problem. In 2007, several of our professors participated in developing materials which were subsequently included into the report put forward by the UN's Intergovernmental Panel on Climate Change (IPCC). Scientific committees of the Polish Academy of Sciences (e.g. the Committee on Thermodynamics and Combustion and the Committee on Chemical Engineering) devoted special sessions to discussing the problems of CO₂ emissions and the role of the modern energy industry in reducing greenhouse gas emissions. The 109th Session of the General Assembly of the Polish Academy of Sciences, held on 13 December 2007 and dedicated to "Global Climate Change," hosted research papers addressing the issues of climate change and emission-free energy. In the closing portion of this General Assembly session, members of the Academy adopted a position on climate

change, global warming, and their alarming consequences.

Global climate change was also the topic of a visit to Poland by former US Vice President Al Gore, winner of the 2007 Nobel Peace Prize.

In 2007, the leaders of the Polish Academy of Sciences took part in many foreign meetings, including the V4 Science Academies Forum in Slovakia, a meeting of the Presidents of European Science Academies in France, the IUPAC (International Union of Pure and Applied Chemistry) congress in Italy, a UNESCO session in France, and Poland also hosted delegations from such foreign academies as the Chinese Academy of Technical Sciences, Academia Sinica, and the Montenegrin Academy of Sciences and Arts.

In 2007 a catalog of research achievements by Polish Academy of Sciences institutes and higher education institutions in Poland (*Selected Research Findings of an Innovative Nature*) was published and presented at a seminar organized by the Polish Embassy in Luxembourg in November 2007.

Impacts of global climate change

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The Fourth Assessment Report of the Intergovernmental Panel on Climate Change concludes, on the balance of evidence, that the warming of the global climate system is unequivocal and most of it is very likely due to increased atmospheric greenhouse gas concentrations. Observed climate change has extended beyond temperature.

The climate projections indicate a further rise in temperature and accompanying changes in other variables. With greater warming, the net aggregate global effects will be negative. The European Union has set an objective to limit global warming by 2100 to no more than 2°C above the pre-industrial level. Unless adequate climate mitigation efforts are taken, a much stronger warming (4-5°C) may occur.

Observations of changes in the climate system and their impact

Over the last 50 years the linear global temperature trend shows a 0.65°C warming. In the global instrumental observation record (available since 1850), 12 of the 13 warmest calendar years are from 1995-2007. Existing record 12-month mean temperatures have recently been exceeded at a number of spatial scales: ranging from the local to national and continental (Europe) scale, to the whole of the Northern Hemisphere.

Many systems and sectors have been affected by climate changes, particularly increased temperature,

rising sea level, and changing precipitation. In Europe, such trends include: shrinking glaciers and permafrost; decreasing seasonal snow cover at lower elevation; northward and upward movement of flora and fauna; phenological changes (earlier onset of spring events; earlier egg-laying in birds; earlier arrival and later departure of migratory birds; lengthening of the growing season and advance in its beginning); earlier onset and longer season for allergenic pollen; positive changes in wine quality; increasing productivity and carbon sink of forests; increased crop stress during hotter, drier summers; and increased heatwave morbidity and mortality.

Climate scenarios and projected impacts

Climate models broadly agree on the sign (but not necessarily on the magnitude) of future temperature change, consistently projecting warming everywhere. However, projections of future precipitation and related variables do not agree among climate models. In high latitudes and parts of the tropics, climate models are consistent in projecting increased precipitation, while in some subtropical and lower mid-latitude regions, they are consistent in projecting decreased precipitation. Between these areas of robust change, even the sign of precipitation change is inconsistent across models, e.g. over Poland, some models project a decrease, others an increase in summer precipitation.

While mean summer precipitation is projected to decrease over much of Europe, the highest quantities of precipitation and annual maximum precipitation are likely to increase over many areas, driving flood risk. Flash floods are likely to increase throughout Europe, while snowmelt-related floods in Central Europe are expected to decline.

A considerable increase in hot and dry extremes is projected. A decrease in summer precipitation in much of Europe, accompanied by rising temperatures which enhance evaporative demand, would inevitably lead to reduced summer soil moisture and more frequent and more intense droughts. What is now a 100-year drought would, on average, return more frequently, e.g. every 10 years or less in parts of Poland.

Climate change is expected to magnify regional differences in Europe's natural resources and assets. There will be winners and losers. In the North, re-



Fig. 1. Highest-ever 12-month mean temperature values on record (1901-2007) were recently observed in much of Europe. Gray dots mark records established in 2006/2007, where anomalies were stronger than two standard deviations above the 1901-2007 mean (Kundzewicz et al., 2008)

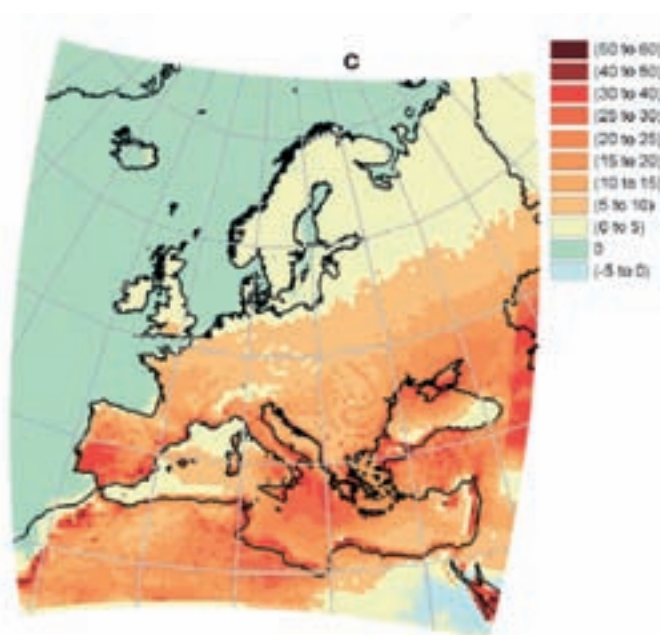


Fig. 2. Change of mean duration (days) of the longest 'dry and hot' spell ($T_{max} \geq 30^{\circ}\text{C}$, precipitation ≤ 0.5 mm), between 2070-2099 and 1961-1990, according to HadRM3-P (SRES A2 scenario for the future) (Kundzewicz et al., 2006)

duced demand for heating, increased crop yields, a longer vegetation season, the extension of agricultural land areas, increased forest growth, increased water temperature, and increasing water power are

projected. In the South, on the other hand, climate change is projected to reduce water availability, hydropower potential, and crop productivity. Southern Europe may become too hot for summer holidays and the increasing attractiveness of other European regions (including the Baltic Sea coast) is a threat for the Mediterranean. The ski industry in central Europe is likely to be disrupted by less reliable natural snow cover, especially at lower elevations.

Particularly vulnerable systems and sectors include: certain specific ecosystems, low-lying coastal regions, water resources, agriculture in low-latitude regions, and human health in areas with low adaptive capacity. It is likely that just a small degree of global warming will cause considerable adverse effects in some developing countries, while a larger warming is very likely to have a much more deleterious and widespread impact.

Climate change impact on freshwater resources is a reason for concern. By mid-century, annual average river runoff and water availability are projected to increase by 10-40% in the north and to decrease by 10-30% in the south. Droughts will likely become more frequent, intense, and extensive. Over the course of the century, water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by meltwater from major mountain ranges, where over a billion people currently live. Climate change undermines the stationarity assumption that historically has facilitated water resources management.

The health status of many people will be adversely affected by climate change-related exposures. Heat waves will become more frequent and affect increasingly ageing European society. Adverse health effects of increasing weather extremes and the altered spatial distribution of some infectious disease vectors are likely. Those with low adaptive capacity (the poor, ill, old, and small children) are particularly vulnerable.

In Europe, the effects of climate change and increased atmospheric CO₂ are expected to lead to overall increases in crop productivity. An increase in the area suitable for grain production is projected. Crops which currently grow in southern Europe, like maize, sunflower, and soybeans, will become viable further north. In southern Europe, on the other hand, general decreases in yield and increases in plant water demand are expected. The expected rate of climate change in Europe is likely

to exceed the current adaptive capacity of some natural ecosystems and various non-cultivated plant species.

Coasts will be exposed to increasing risks, including coastal erosion, due to climate change and accompanying sea-level rise (caused by both thermal expansion and enhanced ice melting). The effect will be exacerbated by considerable, and increasing, human-induced pressures on coastal areas.

Typically, there is a continuity and consistency between the observed impacts of climate change and those projected for the future. Some of the observed impacts are positive, others are negative. As climate change continues, negative impacts are likely to outweigh its benefits.

Mitigation of climate change and adaptation to climate change impacts

Through effective mitigation, constraining the temperature rise to 2°C above the pre-industrial level would improve the chances of avoiding a number of adverse impacts, such as:

- lowering the risk of widespread deglaciation of the Greenland ice sheet;
- avoiding large-scale transformation of ecosystems and degradation of coral reefs;
- preventing terrestrial vegetation becoming a carbon source, constraining species extinction, and preserving many unique habitats.

The relationship between adaptation and mitigation is complex. Adaptation can only be effective if impacts are not too severe (i.e. if effective mitigation takes place). However, conflicts may exist in the sense that an option which is advantageous for adaptation does not serve mitigation, or the other way round. Air-conditioning, an adaptation option, contributes to greenhouse gas emission due to large energy use, magnifying the greenhouse effect. Afforestation has impacts on land resources (competition for land) and water resources (soil conservation, flood control, and increased water storage in humid and sub-humid areas, but in arid and semi-arid regions, afforestation reduces water availability). Similar impacts affect bio-energy crops, now receiving increasing attention as a mitigation option.

Since climate change cannot be reversed, at least over a few decades, adaptation may be the only

available option for reducing climate change impacts in the short to medium term. However, in some sectors and systems there is little scope for adaptation. Many organisms and natural ecosystems cannot adapt to rapid climate change. Alpine regions have restricted adaptability, facing glacier retreat, reduced snow cover, and extensive species losses.

Adaptation to climate change impacts on water aims to alleviate problems of having too much water, too little water, or unacceptable water quality. The severity of these problems is projected to increase in many areas.

Developing protection against drought requires improved efficiency of water use (most importantly – agriculture, the main water user worldwide). However, extension of irrigated agriculture may not be a feasible solution everywhere. For instance, Polish agriculture is mostly rain-fed and no water is available for massive irrigations.

Three flood preparedness strategies have been recognized: protect (as far as technically possible and financially feasible), accommodate (“living with floods”), or retreat (relocation to flood-safe areas). This latter option aims to correct maladaptation and floodplain development by creating “room for rivers.” Despite the uncertainty in projections, water managers have begun to consider the implications of climate change explicitly by increasing design flood magnitudes.

Adaptation in the health sector includes early warning systems for heatwaves and anticipatory emergency plans. Mitigation of ‘heat islands’ may be carried out by urban planning, the adaptation of housing design to the local climate, expanding air conditioning, shifts in work patterns, and heatwave forecasting.

Adaptation strategies for enhancing biodiversity may take an *in situ* form of conservation areas or involve *ex situ* adaptation, embracing conservation of germplasm. Despite the existence of extensive reserve areas in Europe, some migratory species are vulnerable to loss of habitat outside Europe, so that trans-continental conservation policies need to be put in place.

A variety of adaptation measures are available in other sectors and systems. Artificial snowmaking compensating for reduced snowfall is already a common practice, for coping with inadequate snow pack depth. In the Mediterranean region, the likely reduction of tourism during the hotter summer months may be compensated for by encouraging

visitors to come in the shoulder season. Improving construction techniques to render buildings and infrastructure more robust to extreme climate events is an obvious adaptation measure against property damage in the changing climate.

Concluding remarks

Climate change is one of multiple pressures of global change, other stresses including population growth, land use and land cover changes (urbanization, especially in coastal areas, deforestation). The projected changes in the climate system and their impact do give grounds for concern.

Modeling climate impacts involves considerable uncertainty, increasing with the projected time horizon. In the near-term, climate model uncertainties play the most important role, while over longer time horizons, uncertainties as to emission scenarios become increasingly significant.

Due to the importance of related problems and to the degree of uncertainty, climate change impacts remain a challenging research area. Such scientific challenges include detecting and attributing observed changes, as well as projecting future changes in the climate system and their impacts, mitigation, and adaptation.

References

- IPCC (Intergovernmental Panel on Climate Change) Climate Change 2007: The Physical Science Basis. Summary for Policymakers. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Solomon S., Qin D., Manning M., Chen Z., Marquis M., Averyt K.B., Tignor M. & Miller H.L. (eds.). Cambridge University Press, Cambridge, UK.
- IPCC (Intergovernmental Panel on Climate Change). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Parry M.L., Canziani O.E., Palutikof J.P., van der Linden P.J. & Hanson C.E. (eds.). Cambridge University Press, Cambridge, UK.

Kundzewicz Z.W., Gerstengarbe F.W., Österle H., Werner P.C. & Fricke W. (2008b). Recent anomalies of mean temperature of 12 consecutive months – Germany, Europe, Northern Hemisphere. *Theor. Appl. Climatol.* DOI: 10.1007/s00704-008-0013-9.

Kundzewicz Z.W., Radziejewski M. & Pińskwar I. (2006). Precipitation extremes in the changing climate of Europe. *Clim. Res.*, 31, 51-58.

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Emission-free energy – Opportunities and challenges

(Paper presented at the 109th General Assembly of the Polish Academy of Sciences, Warsaw, 20 November 2007)

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Climate change is a controversial issue. Whereas some argue that the global temperature changes are just a part of long-term cycles and have already occurred in the past, others see these changes as a serious warning sign and ask for countermeasures to be introduced as quickly as possible. However circumstantial the evidence may seem, the prevailing approach is that some action should be taken, especially as concerns the major culprit – carbon dioxide emitted in the production of energy.

Energy-related CO₂ emissions have been on the increase throughout the world. The dynamics of this increase are, however, much more pronounced in rapidly developing economies like China, India, Brazil, and Russia, and around the year 2020 emissions will surpass those of the OECD countries.

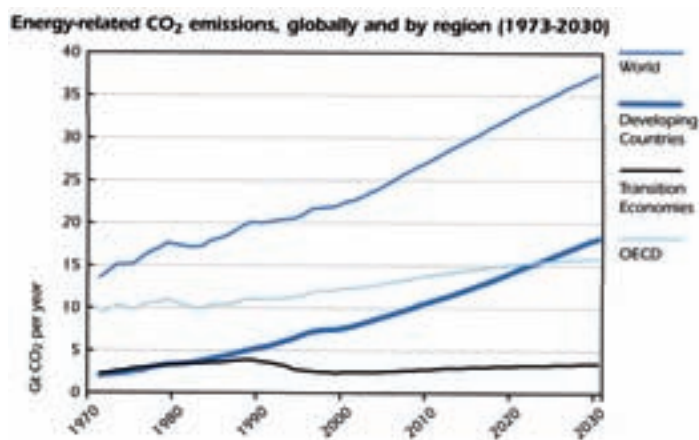


Fig. 1. Energy-related CO₂ emissions, globally and by region (*Prospects for CO₂ capture and storage*, 2004)

The principal source of carbon dioxide is power generation. The amount of CO₂ emitted by this sector is an order of magnitude larger than the amount of CO₂ associated with the second-largest emitter – cement production (Fig. 2). Consequently, if our efforts to curb CO₂ emissions are to be efficient, we have to focus the various mitigation initiatives on energy production based on fossil fuels (natural gas, oil, and coal).

There are a number of options for reducing energy-related CO₂ emissions. Some of them, like the conservation of energy, are quite obvious and can be implemented almost immediately. Others are more sophisticated and require high-tech expertise (and, more often than not, public acceptance).

Of the various options it is CCS (carbon capture and storage) that has the greatest potential in terms of limiting CO₂ emissions. Although contested by some NGOs (most notably by Greenpeace, which argues that CCS might reduce research into other options of energy conservation), this technique can be based on fairly mature technologies and might be implemented almost immediately. It has to be stressed, however, that none of these options used by itself is able to stabilize CO₂ emissions, not to mention lowering them by a reasonable amount. This is what we call *stabilization wedges*: a synergy effect produced by simultaneous use of several mitigation options (Fig. 3). In what follows, CCS will be discussed in more detail as one of the most interesting options.

The purpose of CO₂ capture is to produce a concentrated stream of carbon dioxide in a dense

Process	Number of sources	Emissions (MtCO ₂ yr ⁻¹)
Fossil fuels		
Power	4,942	10,539
Cement production	1,175	932
Refineries	638	798
Iron and steel industry	269	646
Petrochemical industry	470	379
Oil and gas processing	Not available	50
Other sources	90	33
Biomass		
Bioethanol and bioenergy	303	91
Total	7,887	13,466

Fig. 2. Stationary CO₂ sources with emissions larger than 0.1 million tons of CO₂ per year (IPCC Special Report on Carbon Dioxide Capture and Storage, 2005)

supercritical state that can be readily transported to a storage site. Today, CO₂ is separated at some large industrial plants, among them natural gas processing and ammonia production facilities. These plants, however, remove CO₂ to meet process demands and are not designed for storage purposes. An exception is the Sleipner gas field in the North Sea, where some 20,000 tons per week of carbon dioxide are captured and then injected into a sandstone layer, rather than vented to the atmosphere.

Generally, there are three main approaches to CO₂ capture:

- *Post-combustion* systems, which separate CO₂ from the flue gases produced by the combustion in air of a primary fossil fuel (coal, natural gas or oil) or biomass fuel.
- *Pre-combustion* systems, which process the primary fuel in a reactor in the presence of steam or oxygen to produce separate streams of CO and then CO₂ for storage, and hydrogen that is used as an energy carrier.
- *Oxyfuel combustion* systems, which use oxygen instead of air for combustion to produce a flue gas that is mainly water and CO₂, which is subsequently removed for storage.

There are several commercially available technologies which in principle can be used for CO₂ capture from flue gases. However, comparative assessment studies have shown that absorption processes based on chemical solvents are currently the preferred option for post-combustion CO₂ cap-

ture. At this point in time, they offer high capture efficiency and selectivity, the lowest energy use and lowest cost per ton of CO₂ avoided when compared with the other post-combustion capture processes.

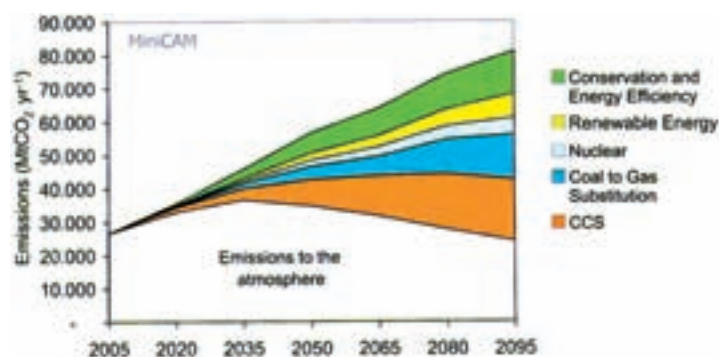


Fig. 3. The various options that can be used in reducing CO₂ emissions (IPCC Special Report on Carbon Dioxide Capture and Storage, 2005)

A pre-combustion capture process typically comprises a first stage of reaction producing a mixture of hydrogen and carbon monoxide (commonly termed *syngas*) from a primary fuel. The two main routes are to add steam (in which case the process is called *steam reforming*) or oxygen to the primary fuel. In the latter case, the process is often called *partial oxidation* when applied to gaseous and liquid fuels and *gasification* when applied to a solid fuel, but the principles are the same. The two reactions are followed by the shift reaction to convert CO to CO₂ by the addition of steam.

It is possible to envisage two applications of pre-combustion capture. The first is in producing a fuel (hydrogen) that is essentially carbon free. Secondly, pre-combustion capture can be used to reduce the carbon content of fuels, with the excess CO₂ being made available for storage. It has to be pointed out that producing hydrogen from fossil fuels with carbon capture and storage is less costly than doing so using nuclear or renewable energy.

The oxyfuel combustion process eliminates nitrogen from the flue gas by combusting a hydrocarbon or carbonaceous fuel in either pure oxygen or a mixture of pure oxygen and a CO₂-rich recycled flue gas. The flame temperature is fixed by the proportion of the recycled flue gas.

It has to be stressed that although most of the capture techniques are well developed, it is the scale of the problem that makes the whole exercise extremely difficult. Figure 4 shows a plant used to separate some 500 tons of CO₂ per day. At the same time, a 1000 MW coal-fired power station produces around 20,000 tons of CO₂ per day! With the current technologies we would thus have to build a large chemical factory next to a power station in order to carry out full-scale separation.

Long-term storage of carbon dioxide underground is a widespread geological phenomenon, with natural accumulations of CO₂ remaining trapped underground for millions of years. This suggests that injecting CO₂ into deep geological

formations may similarly result in its storage for millions of years, provided that the sites are carefully selected and that human activity underground or other external factors do not disturb the reservoir's stability. At depths below 800 to 1000 m, supercritical CO₂ has a liquid-like density that provides the potential for efficient utilization of underground storage space in the pores of sedimentary rocks. Oil and gas reservoirs (potentially depleted), possibly coal formations and particularly saline formations (deep porous reservoir rocks filled with brackish water or brine) can be used for the storage of CO₂.

CO₂ injected into suitable, depleted oil reservoirs can typically enhance oil recovery by 10-15% of the original oil in place in the reservoir. This is an established technique, called CO₂-EOR (enhanced oil recovery). The additional oil production could, in certain circumstances, more than offset the cost of CO₂ capture and injection. CO₂-EOR could also replace other energy-intensive enhanced oil production techniques, resulting in further greenhouse gas emission benefits.

There are also many underground water-filled strata (aquifers) that could potentially be used to store CO₂. The aquifers that would be used for CO₂ storage are deep underground, containing saline water unsuitable for extraction as potable water. CO₂ would partially dissolve in the water in the aquifer. In some formations, CO₂ would slowly

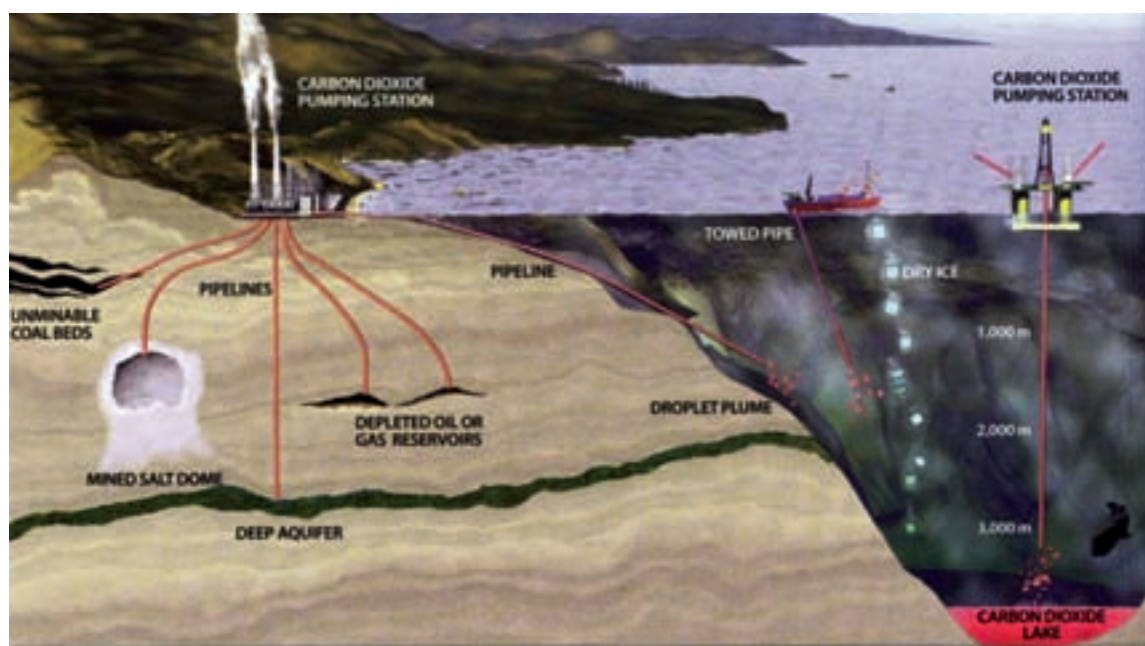


Fig. 4. The various options for the long-term storage of CO₂

react with minerals to form carbonates, which would essentially lock up the CO₂ permanently. Suitable aquifers would have a cap rock of low permeability to minimize CO₂ leakage. Injection of CO₂ into deep saline reservoirs would use techniques similar to those for depleted oil and gas fields and many of the aspects described above will also apply to aquifer storage.

Another potential storage medium is unmineable coal. Carbon dioxide can be injected into suitable coal beds where it will be adsorbed onto the coal, locking it up permanently, provided the coal is never mined. Moreover, it preferentially displaces methane that exists along with the coal. Methane is already extracted from coal beds by depressurisation but this typically recovers only about 50% of the gas in place. Injection of CO₂ enables more methane to be extracted, while at the same time sequestering CO₂. Coal can adsorb about twice as much CO₂ by volume as methane, so even if the recovered methane is burned and the resulting CO₂ is reinjected, the coal bed can still provide net storage of CO₂.

The method of ocean injection of carbon dioxide is controversial. Advocates of storage in the deep ocean point out that atmospheric CO₂ passes continuously into the ocean surface, as the air and ocean system seeks chemical equilibrium. Opponents of ocean storage cite international law that protects the oceans from certain kinds of industrial uses, and the difficulties in monitoring carbon dioxide transport after injection.

When William Shakespeare took a breath, 280 molecules out of every million entering his lungs were carbon dioxide. Each time we draw breath today, 380 molecules per million are carbon dioxide. That portion climbs about two molecules every year. The good news, however, is that the technology for capture and storage already exists and that the obstacles hindering implementation seem to be surmountable.

References

- Prospects for CO₂ capture and storage*. (2004). OECD/IEA, Paris.
- IPCC Special Report on Carbon Dioxide Capture and Storage*. (2005). Cambridge University Press, Cambridge.
- Warmuziński K. (2006). Unwanted Abundance. *Academia*, No. 4(12).
- Pacala S., Socolow R. (2004). Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies. *Science*, 305.

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Educational and Promotional Activity within the Polish Academy of Sciences



The headquarters of the Museum of the Earth, Polish Academy of Sciences, on Na Skarpie avenue in the center of Warsaw – two historical buildings and open-air exhibit space (M. Ryszkiewicz)

The Museum of the Earth in Warsaw, established in 1948 and continuing a tradition initiated by the Earth Museum Society back in 1932, has been operating within the structure of the Polish Academy of Sciences since 1959. It collects, studies, preserves, and exhibits collections covering all the geological sciences, with special regard to Polish minerals, meteorites and rocks, Baltic amber, fossil flora and fauna, and archival documents on the history of the Earth sciences in Poland. The museum's collection comprises over 170,000 specimens and objects. Particular noteworthy is its extensive collection of amber and other fossil resins, ranking among the largest natural-science collections of its type worldwide. The museum's interdisciplinary program of research and documentary work (i.e. palaeobotany, palaeozoology, mineralogy – especially amber studies, the preservation of geological heritage, the history of the Earth sciences, and museology) is closely linked to the varied profile of specimen collections, open to specialists from both national and foreign centers. The Museum is also committed to a varied program of natural science promotion, targeting a wide audience. It organizes permanent, temporary, and visiting exhibitions, which alongside its educational activity constitute the main element of the museum's public presence. The Museum has



The historical palace building at the address of Na Skarpie 20/26 in Warsaw, one of the two historical buildings housing the collections and exhibitions of the Museum of the Earth, Polish Academy of Sciences (L. Dwornik)

also been successful in initiating exhibitions exploring the confluence of many fields of science and culture, especially the expositions in the “Nature and Art” series.

The Museum of the Earth is located in two historical buildings on Na Skarpie avenue in the center of Warsaw, perched on the high Vistula escarpment.

The Museum of the Earth – Towards ongoing natural-science education

K.J. Jakubowski | Museum of the Earth | Polish Academy of Sciences

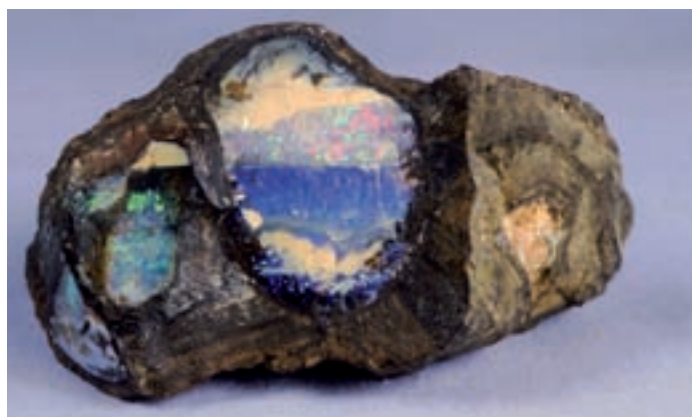
Contemporary museums have been experiencing intensive change of late, reflecting a quest on the part of museum institutions to seek new forms of public activity to better respond to the challenges posed by the current developmental stage of mass culture. A reevaluation of museums' current role and opportunities within the broader institutional system for promoting and disseminating science points to a distinct set of tools available for effectively relaying scientific knowledge. The main vehicle which museums have at their disposal consists in the display of original science-related objects and exhibits, drawn from their amassed collections. The comprehensive capability such displays give museums to visualize scientific information constitutes an attractive and hard-to-replace form of science promotion. This is particularly true in the case of the natural sciences. Cyberspace, while undoubtedly alluring in its own right, is here unable to take the place of the unique museum atmosphere and the cognitive and emotional spark that comes from interacting with real objects and real phenomena.

The experiences of the Museum of the Earth, Polish Academy of Sciences, in promoting science and disseminating scientific awareness embrace a whole range of efforts, with a special role played by diverse forms of educational activity. Our efforts are based upon the fundamental medium of educational exchange for museums, i.e. museum collections and their interpretative depiction within specially prepared public exhibitions.

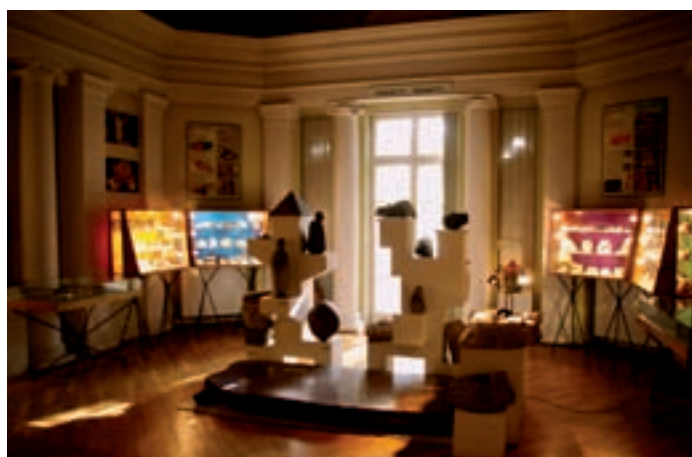
The main thrust of our educational program lies in the museum's **permanent exhibitions**. These include a set of targeted exhibitions under the collective title *The Earth and Its History*, offering an overview of geological phenomena and processes that make up the canon of elementary knowledge about the Earth. At its core lie a set of dedicated spaces which begin with an introductory exhibition *Planet Earth*, continue through an exhibition *Processes Shaping the Earth* that highlights the most important manifestations of our planet's geodynamics, and end with a synthetic synopsis of geological history presented in the exhibition *From the Earth's Geological Past*. These exhibitions take an "overview"



Mineralogical collection



Australian opals from the mineralogical collection (K. Jakubowski)



Arrangement of an exhibit room in the permanent exhibition "Granites, Granites..." (R. Szczęsny)



Ammonite from the Cretaceous period (*Anapachidiscus wittekindi*), one of the largest and best preserved specimens in Polish collections, on display in the exhibition “From the Earth’s Geological Past” (L. Dwornik)



Workshop for children as part of the Festival of Science (B. Rudnicka)



A group of disabled individuals during an activity in an exhibition room (M. Wierzbicki)

approach and boast a regularly-changing set of the most intriguing specimens in the museum’s collections, supplemented with informational materials geared to deliver educational content to visitors on a broad range of levels. Certain specific exhibits are outfitted with specially-stylized commentaries addressed to the youngest visitors, together forming a “children’s route” that is an integral part of the permanent exhibitions. For younger children and teens, separate exhibition sectors have been designed to facilitate hands-on interaction with specimens chosen in keeping with the “see me and touch me!” principle. We should also note that parts of the permanent exhibitions are likewise adapted to host groups of disabled visitors, including the blind, for whom educational packages written in Braille are available.

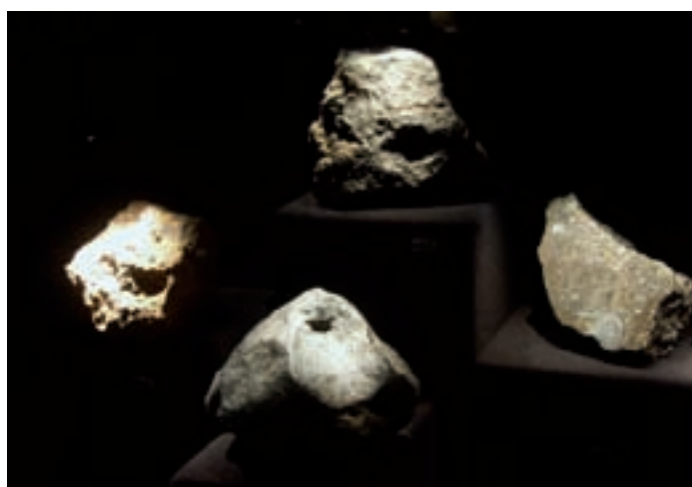
The effective cognitive impact of museum exhibitions hinges to a large extent upon ensuring a broad scope of topics addressed, geared to meet a diverse range of expectations on the part of potential visitors. Our permanent exhibition space is therefore punctuated with exhibit stands illustrated with particularly interesting materials from the museum’s collections, devoted to selected issues in the Earth sciences. Specimens from the fossil flora collections are used as source material for thematic exhibit stands on *Before Coal Was Formed* and *The Plant World and Climate Change*, taking a retrospective geological look at the problems of global warming now in the public limelight. The always-popular issues of the evolution of life forms and their fossilized remains are further accented with special exhibit stands accenting such diverse curiosities as *Miracles of Fossilization*, depicting the most famous “fossil treasures,” and *Armored Lords of the Early Seas*, portraying early stages in the evolution of fish.

One important, complementary part of the process of natural science education involves telling the story of scientific research itself. Drawing upon museum archives which document the history of inquiry into the Earth sciences, a separate sector of the permanent exhibitions has been designed to address these topics, including *The Sources of Modern Geological Thought* and *The Beginnings of Geology in Poland*. This sector has recently (2007) been enriched with special exhibit stands entitled *From the Archive Treasures of the Museum of the Earth*, presenting selected sets of objects and historical documents relating to important anniversaries and events (e.g. illustrating Poland’s Antarctic research

tradition in connection with the International Polar Year). Another unconventional and eye-catching method is used to highlight the achievements of outstanding researchers in the exhibition *Earth Science Scholars on Postage Stamps*, put on display in 2008.

The quest for effective forms of raising natural science awareness should take account of the inherent educational power of specific types of museum collections. Visual impact is the first stimulus that piques visitors' interest. Museologists frequently draw attention to the causative power of the "enchantment" factor, i.e. the extraordinariness and charm of objects on display. Classical examples of this can be found in the Museum of the Earth's arrangements of two outstanding collections: amber and meteorites. The new edition of the standing exhibition *Amber – From Liquid Resin to Ornamental Art* takes an interdisciplinary approach to presenting key problems of our contemporary knowledge about amber and other fossil resins. It is illustrated with a specially-chosen selection of the most interesting specimens drawn from the extensive museum collections, widely renowned among amber specialists and aficionados. Of a different nature is the exhibition *Meteorites – Stones from the Sky*, whose arrangement uses the latest exhibition techniques to accent the magic of unlocking the secrets of outer space. This extraordinary opportunity to look first-hand at meteorites which document the nature of extraterrestrial matter makes a strong impact on visitors' imaginations and encourages them to learn more.

One of the inherent challenges of museum-based education lies in striving to formulate exhibition content able to reach out to the broadest range of visitors. This objective is closely linked to the "life-long education" concept, a notion which stretches from preschool-aged children all the way to senior visitors in the so-called "third age." Many visitors want museums to provide not just education and information but also emotional and esthetic experiences. The Museum of the Earth strives to rise to that challenge, such as with a recently implemented (2006/07) new arrangement of our changing exhibitions. Two exhibitions addressing diametrically different subject matter were consciously situated within a single exhibition space. The first, *Mineralogical Alphabet*, highlighting the diversity and unparalleled beauty of the mineral world, speaks directly and vividly to visitor's esthetic sensibilities.



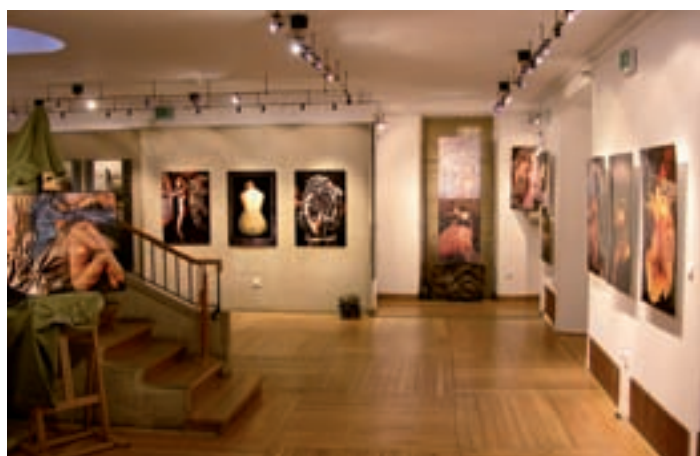
A fragment of the permanent exhibition "Meteorites – Stones from the Sky" (R. Szczęsny)



Young visitors viewing the "Large Mammals of the Ice Age" exhibition (B. Rudnicka)



Museum lecture at the exhibition “Amber – From Liquid Resin to Ornamental Art”



A fragment of the exhibition “Visions” – photographic images by Rimantas Dichavicius (2006), an exhibition in the “Nature – Art” series (M. Wierzbicki)

The second, *Large Mammals of the Ice Age*, marvels visitors with extraordinary finds of animal remains from the youngest geological age in the Earth’s history. Educational programs developed based on these two exhibitions draw attention to their rich and diverse source material, enabling form and content to be adapted to meet the needs of a broad range of visitors. They are accessible to children starting from preschool-age, up to adults with varied interest horizons.

Drawing in new museum-goers demands unconventional initiatives that extend far beyond the specialized profile of a natural history museum. Such a role is performed marvelously by highly-popular **temporary exhibitions** in the “Nature – Art” series and “Earth Landscape” series. Their main objective is to underscore the natural sources of creative in-

spiration, ranging from documentary and artistic photography to graphic arts, painting, and sculpture. While raising awareness of the changing nature of the natural environment and the need to protect its most precious components, these exhibitions also quite simply open visitor’s eyes to the amazing beauty inherent in the natural world. The conscious choice of diverse content for such exhibitions, prepared in cooperation with artistic associations and prominent Polish and foreign artists, has yielded many high-profile events that have been well received by public and by the museum community.

A different tack is taken by exhibitions that portray the relationship between the Earth sciences and technology. Here we can mention such exhibitions as *Silicon Associations – The World of Minerals and Microelectronics*, *Microworlds*, and the futuristic computer-graphic images of the Earth presented in the *Planet of the Imagination*.

Another important way of achieving greater audience outreach involves exhibitions organized jointly with renowned foreign partners like the Discovery Channel (the exhibition *Among the Mammoths and Forest Elephants*, prepared in connection with the latest discovery of mammoth remains in Siberia), and successive editions of prestigious exhibitions in the “Wild Nature Photography” series, presented in collaboration with the National History Museum in London and *BBC Wildlife Magazine*.

In its exhibition operations, the Museum of the Earth has for many years been developing greater with regional museums throughout the country. Aside from granting access to its own collections, the Museum has launched special **traveling exhibitions** (e.g. *Nature in Antarctica*, *Ornamental Stones of Poland*, *Plants of the Carboniferous Forest*). Particular attention is attracted by traveling exhibitions devoted to amber, successive editions of which have now visited a dozen-odd museums throughout Poland. In 1996-2004 this was known as *Amber – Treasure of the Ancient Seas*, while a new exhibition has been presented since 2006: *The History and Splendor of Amber*. The broad esteem enjoyed by Museum of the Earth’s amber collection and the experience gained in popularizing amber-related issues have led to the implementation of **foreign exhibitions**, prepared at the invitation of European museums. Starting with precursory exhibitions at the National Museum in Prague (*Amber – Fossil Resin from Polish Collections*) and the Doge’s Palace in Venice (*Ambra – oro del Nord*), amber-related

exhibitions have been put on display in numerous German museums (two editions in 1988-1992: *Geheimnisse und Schönheit des Bernsteins* and *Spuren des Bernsteins*) in Hungary in 2002 (*The Amazing World of Amber*), and in Rumania in 2002-2005 (*Amber – From Liquid Resin to Jewelry* and *Amber – Science, Art, Legend*). In 2007, the exhibition *Sur le routes de l'Ambre*, prepared by the Museum of the Earth at the request of the Adam Mickiewicz Institute, was presented as part of the European Cultural Festival in Algiers.

Efficiently harnessing the educational capacity of museum collections so as to spread greater natural science awareness requires a constant quest for new forms of activity. One such initiative involves presenting selected geological objects outside of dedicated natural science exhibition spaces. Specimens from the Museum of the Earth have been displayed in specific contexts at exhibitions of an archeological focus (e.g. the exhibitions *Between Mycenae and the Baltic* and *Treasures of the Eastern Goths* at the State Archeological Museum), of an artistic nature (e.g. the exhibitions *Rafael and Titian* at the Royal Castle in Warsaw, *Serenissima – Light of Venice* at the National Museum in Warsaw and in Poznań), and even dealing with literary history (e.g. the exhibitions *Promethidion – Cyprian Kamil Norwid* at the Malczewski Museum in Radom, and recently the exhibition *Voyages of Mr. Cogito* at the Mickiewicz Museum of Literature in Warsaw). Another such form of activity involves participation in trade fairs and exhibitions of a commercial nature. Small exhibits of museum collections, appropriately prepared and distinctly separated from the surrounding commercial activities, can prove very useful to educational efforts. The Museum of the Earth's years of participation in such events, such as the annual "Gold – Silver – Time" trade fair in Warsaw or the prestigious "Amberif" International Fair of Amber, Jewelry and Gemstones in Gdańsk, have yielded very interesting experiences. Presenting selected collections of minerals and ornamental stones, especially amber-themed exhibits, has not only generated surprisingly great interest among fair exhibitors and visitors alike, but also encouraged subsequent visits to the museum building.

Aside from their inherent functions, museum exhibitions likewise offer a main space for organizing various educational activities, ranging from museum lectures, workshops, and demonstrations to diverse forms of meetings and special events. They



Amber variants from the collection of the Museum of the Earth (M. Wierzbicki)



The rich collection of amber insect inclusions held at the Museum of the Earth is of particularly great research value as well as offering eye-catching exhibit material (Z. Wyleżyński)



Educational programs held during the Night of Museums (17 May 2008) event enjoy great popularity (M. Wierzbicki)



Science at play: recognizing minerals during a “Birthday Party at the Museum” (M. Wierzbicki)



Opening of the outdoor exhibition entitled “10 Questions About the Earth – the Past for the Future,” kicking off the International Year of Planet Earth in Poland (11 April 2008), with Academy President Prof. M. Kleiber in attendance (M. Wierzbicki)

are supplemented by specially-prepared textbook materials about the collections, didactic displayboards, and multimedia presentations. Some of these have already made a lasting mark for themselves, such as the special activities organized in connection with the Night of Museums, Science Festival and Earth Day events. The museum setting, a kind of *genius loci* amid the various exhibitions, generates an attractive atmosphere for all sorts of science promotion events. This is probably what explains the unwavering interest shown by the public participating in such events and meetings held

at the Museum of the Earth building. Here we might mention a series of meetings with well-known travelers entitled “Traveling Passions,” which have been successfully organized for a number of years in collaboration with the Terra Incognita agency and the Horizons Travel Club, as well as seminars devoted to contemporary environmental protection issues for “Third Age University” students. One new initiative addressed to the youngest audience involves educational-play events as “My Birthday Party at the Earth Museum,” which have sparked great interest by offering unconventional forms of educational activities. We should also mention our initiatives that extend far beyond the museum space itself, such as the original and attractive program called *What Are We Walking on When We Enter the Subway?* implemented as part of the 7th Science Festival, aimed at promoting awareness of the geological resources used in the construction of the Warsaw subway system.

Promotion of the Earth sciences in an easily-accessible way, raising public awareness of the processes which shape our planet in its geosphere, hydrosphere, biosphere, and atmosphere, is nowadays becoming one of the key factors determining the living conditions of the Earth’s residents. Broader awareness of the basic principles of the wise and efficient management of the Earth’s mineral resources, of the potential threats caused by natural disasters or the improper harnessing of its resources, will be crucial for the its residents in the near future. Such objectives are served by the worldwide International Year of Planet Earth, a project planned for 2007-2009. It is indicative that Poland’s Planet Earth Committee was inaugurated at a session of the Presidium of the Polish Academy of Sciences held at the Museum of the Earth building (13 Nov 2007). The Museum’s premises also hosted, on 11 April 2008, the launch of an outdoor exhibition entitled *10 Questions About the Earth – The Past of the Future*, which showcases the most important challenges facing the contemporary Earth sciences, promotes the idea of the International Year of Planet Earth, and will be put on display in more than a dozen Polish cities.

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Expert Reports and the Activities of Selected Scientific Committees

One important component of the overall activities of the Polish Academy of Sciences consists in the work of its scientific and task force committees. Drawing together professors and outstanding experts elected by the Polish research community, these committees are not only obliged to ensure the further development and highest standards of research in their respective disciplines, but also organize various academic forms of research activity with the aim of promoting young researchers.

Moreover, the activity of such scientific committees also encompasses drawing up special expert reports and studies. In 2007, like in previous years, several such reports were authored, the most important of them including:

- A study on emigration to and from Poland since 1989, drawn up by the Committee for Research on Population Migrations and the Polish Diaspora, Polish Academy of Sciences,
- An expert study on construction in ecologically precious areas, developed by the Committee on Civil Engineering and Hydroengineering, Polish Academy of Sciences,

- A report on environmental protection against noise in Poland in the light of European Union legislation, by the Committee on Acoustics, Polish Academy of Sciences,

- An expert analysis of the potential for decreasing thermodynamic imperfections in the supply of electricity, heat and cooling agents from the viewpoint of sustainable development, drawn up by the Committee on Thermodynamics and Combustion, Polish Academy of Sciences.

Such expert studies are submitted to Polish state institutions, local government bodies, and scientific institutions, as they address the current state of affairs in a given field, the need and potential for development, and recommendations for orienting the proper research, R&D work, and future organizational efforts in an overall sense. Below we present summaries of exemplary expert studies drawn up by Polish Academy of Sciences committees in 2007.

The Planet Earth Committee

A. Żelazniewicz | Planet Earth Committee | Polish Academy of Sciences

The Planet Earth Committee was set up by the Polish Academy of Sciences to help foster greater public awareness of advances in the Earth sciences. The Committee's activities are planned for the triennium 2007-2009 in compliance with the worldwide efforts comprising the International Year of Planet Earth (IYPE), which climax in 2008. The IYPE Global Launch Event took place on 12-13 February 2008 at UNESCO headquarters in Paris.

The year 2008 was proclaimed by the United Nations General Assembly the UN Year of Planet Earth. Its aims are implemented at national levels through Outreach and Science programs intended to be the "Greatest Geo-Show on Earth." To achieve this, IYPE national committees have been established in some 80 countries.



In Poland, the Planet Earth Committee also functions as the Polish National Committee for IYPE and integrates the activities of several local committees that have arisen throughout the country. The Polish Launch Event of IYPE was held on 11 April 2008 in Warsaw, when an outdoor exhibition enti-



The Cape of Good Hope, a place where the icy Atlantic and the warmer Indian Ocean meet. Oceanic circulation has a great impact on the Earth's climate.



Hairlachbach, the Ötztal Alps. Rainy weather can turn such an enchanting mountain stream into a dangerous flooding river.

tled "10 Questions About the Earth – the Past for the Future" was opened at the Museum of the Earth, Polish Academy of Sciences. It focuses on 10 main themes and draws attention to geo-solutions relevant to important societal problems, ranging from Groundwater and Resources, to Megacities, to

Oceans and Climate. The exhibition will be on public display in central areas of other major Polish cities during 2008 and 2009. Other ongoing activities include: talks with Earth scientists broadcast by Polskie Radio, science festivals organized in all of Poland's university cities (in Warsaw, 20-24 Sept.), the publication of a series of 12 thematic brochures, exhibitions organized in natural science museums, event-related papers, leaflets, posters, calendars and the website www.planetaziemia.pan.pl.

One of the Committee's intents is to illustrate to the public and decision-makers that societies (Poland's in specific), can benefit greatly from the knowledge offered by the Earth sciences, often underused or overlooked. One example can be found in a recent alarm raised by biologists about the threat of a legendary lake in central Poland, Lake Gopło, becoming dewatered. This danger was said to be posed by industrial plans to start brown coal mining not far from the lake. In the wake of the fuss raised by ecologists, media sources reported that mining efforts would lower the groundwater level, thus leaving Gopło and the nearby nature reserve dry. The Polish parliament and government have demanded that these plans be halted. Nevertheless, Earth scientists familiar with the local geological structures are aware of no such threat. There is an impermeable bed at the bottom of the lake which firmly prevents its waters from any leakage and the lake is steadily replenished by the Noteć river. Professor Jan Przybyłek, a hydrogeologist from the University of Poznań, will address parliament to clarify the whole issue in detail. Such activity is excellently in line with the subtitle of the International Year of Planet Earth: Earth sciences for society.

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The Committee for Research on Population Migrations and the Polish Diaspora, affiliated with the Presidium of the Polish Academy of Sciences

G. Babiński | Committee for Research on Population Migration and the Polish Diaspora | Polish Academy of Sciences

The main task of the Committee is to coordinate the efforts underway at various Polish research units to investigate contemporary migrations and the Polish diaspora (Polish émigré communities and Poles living abroad). For instance, the Committee has held discussion on the report *The Polish State Towards the Polish Diaspora and Poles Abroad 1989-2005*, drawn up by the Inter-Ministerial Task Force for the Polish Diaspora and Poles Abroad (affiliated with the Prime Minister's Chancellery).

The tasks of the Committee also include preparing a project of research activity for the period of 2008-2010. The most important points of this project include: studying post-1989 emigrations out of Poland as compared to other European migrations (their magnitude, characteristics, circumstances, and the economic-cultural consequences of emigration since EU enlargement), investigating post-1989 migrations into Poland (the migration and repatriation of Poles from the former USSR, the reemigration of individuals who left Poland during the communist era, and the immigration of foreigners), providing analysis and consultancy on establishing policy agendas for the state and other institutions with respect to Poles abroad, Polish émigré communities, and modern-day emigrants (evaluating existing programs, drawing up supplementary programs, and analyzing the impact of state measures, such as the "Polish Charter" program and the new program encouraging recent emigrants to return to the country), and pursuing interdisciplinary research on emigration out of Poland in the wake of WWII and in the communist era (continuing previous research, recapping current knowledge about emi-

gration away from Poland during the communist era, and investigating the sociocultural impact of emigration).

The Committee's program of activity should crucially take account of the proposals and expectations of Polish government institutions. In 2006, the European Cooperation Section under the Department of Consular and Polish Diaspora Affairs, Polish Foreign Ministry, requested an evaluation of the magnitude and characteristics of emigration away from Poland since 2004. In September 2007, the Interministerial Task Force for the Polish Diaspora and Poles Abroad requested evaluation and materials which could be of assistance in developing new policies and modifying the current agenda with respect to Polish émigré communities and Poles living abroad.

In its activities, the Committee for Research on Population Migrations and the Polish Diaspora takes account of the existence and efforts of other institutions and associations, such as the recently-founded Commission on the Polish Diaspora (Polish Academy of Arts and Sciences – PAU) and the World Research Council on Poles Abroad. It seems crucial not just for such cooperative links to be forged, but also for joint efforts to be undertaken.

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Environmental protection against noise in Poland in the light of European Union legislation

Z. Engel | Committee on Acoustics | Polish Academy of Sciences

This study describes the current level of noise hazard in Poland, both in the external environment and in the human work and life environment. It

concludes that the level of vibro-acoustic pollution is so high that the noise and vibration hazard can be regarded as a wide-spread hazard in Poland. Noise

and vibration are a nuisance that permeates every field of the environment, affects everyone, has an adverse impact on human health, hampers recreation and relaxation, decreases labor output, and increases the risk of accidents. Noise has negative economic effects (health problems, lower work efficiency, lower land and property prices in areas with high noise emissions).

Noise reduction requires more effective measures. Mention should be made of the following actions:

- Coordination of actions within every domain of our lives. Such coordination should be undertaken either by the Committee on Acoustics (Polish Academy of Sciences) or for instance by a State Council for Environmental Protection (set up in affiliation with Parliament or the Prime Minister's Office). The need for such coordination stems from the fact that a great deal of scientific and technical research currently ends up being duplicated.
- Better enforcement of the law. While appropriate legal regulations in this area exist (albeit many of them containing errors), legal requirements concerning environment protection against noise need to be enforced more effectively. The development of new legal regulations on noise should be more

widely consulted with, for instance, the Committee on Acoustics (Polish Academy of Sciences), the Noise Control League, etc.

- Acoustic classification of investment sites and buildings.
- Changes in infrastructure. Roads, streets, railway and tram routes have a direct impact on noise levels in the environment.
- The development of noise environment protection programs, acoustic maps, etc. (in accordance with Polish and EU legislation). Although this should be undertaken by administrative bodies, program and maps must be developed by professional institutions and specialists.
- Planning efforts. The continuous growth seen in transport noise hazard needs to be taken into consideration (a constant increase in the number of planes and car traffic intensity).
- The noise certification of all machines, electronic devices and means of transport.

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Construction in ecologically precious areas

W. Radomski | Committee on Civil Engineering and Hydroengineering | Polish Academy of Sciences

Construction on ecologically precious areas is undoubtedly among the most important social problems faced in Poland, now and in the near future. This fact has been demonstrated of late by the controversy surrounding the construction of a transport route running through the Rospuda Valley. This issue was therefore the topic of the problem-focused portion at the 2007 Krynica Conference, organized under the direct patronage of the Committee on Civil Engineering and Hydroengineering, Polish Academy of Sciences. A special volume of conference papers was published, authored by outstanding experts of the issues in question, representing the world of both science and practice: *Problemy Naukowo-Badawcze Budownictwa* (R&D Problems of Construction), vol. 1 *Problemy budownictwa na terenach ekologicznie cennych* (Problems of Construc-

tion in Ecologically Precious Areas), Wydawnictwo Politechniki Białostockiej, Białystok 2007, 352.

On this basis, the Committee on Civil Engineering and Hydroengineering has developed a synthetic overview of its recommendations for construction in ecologically precious areas, as a kind of expert report. This report encompasses:

- the legal and economic basis for environmental protection in the construction field, taking account of the requirements of the "Natural 2000" European Network,
- natural and ecological aspects of construction in especially valuable areas,
- environmental determinants of road construction,
- engineering and technological aspects of ecological construction.

The report finishes by offering conclusions which point out the proper directions (in the Committee's view) to be taken by scientifically, technologically, and economically justified efforts, likewise taking account of the ecology-related requirements of the EU institutions and reconcilable domestic needs for building and infrastructure construction. These conclusions are addressed for the most part to state and local governmental officials.

The report, together with the above volume of papers, has been submitted to the Environment

Ministry, the authorities of Division IV of the Polish Academy of Sciences, and also state and local governmental officials in the Podlaskie province.

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Analysis of the potential for decreasing thermodynamic imperfections in the supply of electricity, heat, and cooling agents from the viewpoint of sustainable development

A. Ziębik | Committee of Thermodynamics and Combustion | Polish Academy of Sciences

The utilization of the limited resources of non-renewable energy ought to comply with the principle of sustainable development. This means rational utilization, keeping in mind future generations. Rationalization of the use of energy consists, first of all, in the improvement of the thermodynamic imperfection of phenomena occurring in energy and cooling processes. Thermodynamic imperfection involves the devaluation of energy (exergy losses). Exergy losses are admissible only when they are indispensable for the purpose of reducing capital investments. When not economically justified, they entail an error in the craft of engineering. Unnecessary energy input or excessive capital investments aimed at energy savings are examples of what are called "Second Law errors." A design not containing any Second Law errors may be considered optimal.

The most important cause of heat supply imperfection is irreversible heat transfer. Considerable exergy losses occur already during the combustion. The irreversibility of heat transfer in the heating boiler can be reduced by cogeneration with the production of power. This enables the chain of irreversible thermodynamic processes to be shortened in comparison with the separate production of heat and power.

Considerable exergy losses also occur due to the heat transfer between the heaters and the heating space. This may be reduced by introducing low-

temperature (low exergy) heating systems. Decreasing losses of non-renewable primary exergy in heating systems becomes possible by using renewable energy sources (solar and geothermal energy and biofuels).

Each of the applied techniques of electricity production involves a certain potential for improvement. The net energy efficiency of the best Polish coal-fired power stations amounts to 36-37%, whereas in Western Europe it stands at about 46%. An increase of steam parameters towards supercritical ones is only one factor improving the efficiency, others being the improvement of the construction of boilers and turbines, the application of the second stage of an interstage reheater, decreasing the pressure in the condenser, as well as a more complete utilization of the enthalpy of flue gases. A further increase in steam parameters can come with the application of nickel-based materials, which may result in an energy efficiency of 52%. Gas-steam cycles, making use of the advantages of the gas cycle and steam cycle, may reach an energy efficiency of nearly 60%. The application of fuel cells, thanks to the direct conversion of the chemical energy of fuels into electricity, may shorten the chain of irreversible processes.

In the case of producing cooling agents, the fundamental trend of improving thermodynamic imperfections is connected with an improvement of the irreversibility of heat transfer. Exergy losses in

the course of compression are limited by the improvement of the driving systems. Exergy losses caused by throttling may be decreased thanks to subcooling, multistage throttling and compression, as well as by the application of non-throttling elements.

Heat, electricity and cooling agents are produced in complex systems. Thus the effect of thermodynamic improvements, realized in one element, on exergy losses in the other elements must always be

taken into account. Comprehensive assessment of exergy losses, therefore, requires the application of the method of system analysis.

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The “Polish Nobel Prizes” for 2007 – Leaders of Science

Prof. Karol Modzelewski, Prof. Włodzimierz Krzyżosiak, Assoc. Prof. Andrzej Sobolewski, and Prof. Andrzej Nowicki were the laureates of this year’s awards of the Foundation for Polish Science (FNP). Now in their 16th year, the FNP awards have the reputation of the top-ranking and most prestigious scientific prizes in Poland. They are

awarded to Polish scholars for their achievements and discoveries in the preceeding four years, making a significant contribution to Poland’s spiritual life and the advancement of civilization in our country, as well as ensuring Poland a significant position in world science.



Professor Karol Modzelewski, a historian and expert on the Middle Ages at the University of Warsaw, is a corresponding member and Vice-President of the Polish Academy of Sciences. His scientific career began at the Institute of History, University of Warsaw. In 1961 Modzelewski was awarded a Fondazione Cini scholarship and went to do research in the archives of Padua and Venice. He wrote his PhD under the direction of Aleksander Gieysztor at the University of Warsaw, and completed his DSc (*habilitation*) degree at the Institute of History, Polish Academy of Sciences. For

political reasons Modzelewski received the title of professor only in 1990. He gave lectures abroad at such universities as École des Hautes Études en Sciences Sociales in Paris, Collège de France, and La Sapienza University in Rome.

Karol Modzelewski is among a group of scientists who are politically engaged. During the rule of Polish communist party he was imprisoned several times, spending more than 8 years behind bars, for his free expression of political views and dissident activity. He served as Polish senator in the 1989-1991 term. In 1998 the President of Poland awarded Prof. Modzelewski together with Jacek Kuroń the Order of the White Eagle, Poland’s highest decoration given to civilians for their merits.

Prof. Modzelewski is the author of over 60 works, including the book *Barbaric Europe* which won him the 2004 Klio Prize and the 2007 Foundation for Polish Science Award in the field of humanities and social sciences. Poland’s highest distinction granted to scientists was bestowed upon Prof. Modzelewski for his “historical study of the beginnings of the European identity, uncovering the import of pre-Christian and multicultural traditions for contemporary Europe.” The book has also been published in France (2006) and Italy (2008).



Professor Włodzimierz Krzyżosiak is head of the Laboratory of Cancer Genetics at the Institute of Bioorganic Chemistry, Polish Academy of Sciences in Poznań, where he began research in 1975 after receiving his PhD degree in chemistry. He completed his DSc (*habilitation*) in 1984, received the title of professor in 1993, and was elected a member of Polish Academy of Sciences in 2004.

Prof. Krzyżosiak had his postdoctoral training at King's College University of London, and has been a visiting professor at: IBMC Strasbourg, the Roche Institute of Molecular Biology, Nutley, New

Jersey, and the National Cancer Center Research Institute, Tokyo.

Since the start of his research activity Prof. Krzyżosiak has been involved in studying the structure and function of nucleic acids. He characterized the reactions of nucleic acids with chloroacetaldehyde – the metabolite of vinyl chloride, developed a new method of structure analysis for ribonucleic acids that relies on specific hydrolysis of RNA induced by metal ions, and reconstituted functional ribosomes from natural proteins and synthetic RNA. His chief achievements in cancer research include identifying a new tumor suppressor gene, finding first mutations in breast cancer susceptibility genes in the Polish population, and demonstrating that the *BRCA1* gene is regulated at the level of translation.

In recent years Prof. Krzyżosiak's biomedical research has shifted focus from cancer genetics to human hereditary neurological disorders known as Triplet Repeat Expansion Diseases. His goal is to define the role of unusual RNA structures which he discovered in the pathogenesis of these diseases. Another of his major objectives is to develop causative therapies for these diseases using RNA interference technology. Prof. Krzyżosiak has demonstrated that RNA interference of triplet repeat sequences shows unusual features that make such a therapeutic approach realistic. For his achievements in this area of research he won the 2007 FNP award.



Andrzej L. Sobolewski won the 2007 Foundation for Polish Science Award (known as the “Polish Nobel Prize”) in the field of pure science for his discovery of the molecular mechanisms of photostability in biological matter.

At present Andrzej Sobolewski is an associate professor at the Institute of Physics, Polish Academy of Sciences, where he completed his PhD degree in 1981 followed by his DSc (*habilitation*) degree in 1989. For more than twenty years Sobolewski has collaborated with Prof. Wolfgang Domcke from the Technical University of Munich, and since 2006 both researchers have been involved

in a joint research project devoted to theoretical investigations of the photophysics of organic photostabilizers. He is also a member of the International Advisory Editorial Board of *Physical Chemistry Chemical Physics*, the journal of the Royal Society of Chemistry, and a member of the European COST Action P9 on radiation damage of biological matter.

In the past Andrzej Sobolewski was an Alexander von Humboldt postdoctoral fellow at the Technical University of Munich. Later he was a visiting scholar at the University of Arizona and worked as a guest professor at the University of Düsseldorf. His current research interests focus on the theoretical investigations of the electronic structure of excited states in polyatomic molecules, photoinduced chemical reaction dynamics, as well as on the effects of solvation on these processes studied in clusters of polar solvents.

He has authored over 120 original publications and 3 review book chapters, his papers having been cited over 2650 times. Andrzej Sobolewski was nominated twice for the Marie Skłodowska-Curie Award in physics (2005, 2007) and for the Smoluchowski-Warburg Prize (2004). This year, together with Prof. Wolfgang Domcke from the Technical University of Munich, Sobolewski received the Copernicus Award granted by the Foundation for Polish Science and Deutsche Forschungsgemeinschaft for significant achievements in Polish-German scientific cooperation.



Professor Andrzej Nowicki won the 2007 Foundation for Polish Science Award (sometimes described as the “Polish Nobel Prize”) in the field of technical sciences. He was commended for his work on theoretical development and application of Doppler Ultrasonography and high frequency coded ultrasonography.

Prof. Nowicki is head of the Ultrasound Department and deputy director for research at the Insti-

tute of Fundamental Technological Research, Polish Academy of Sciences, where he received his PhD degree in 1979 and his DSc (*habilitation*) degree in 1980, becoming a full professor in 1992. In 2005 Nowicki received the title of honorary professor at the Biomedical Ultrasound Research and Education Center at Drexel University, Philadelphia, USA. Since 2002 he has served as president of the Polish Ultrasound Society.

Through the 1980s and 1990s, Prof. Nowicki conducted research on developing better description of the velocity estimators extracted from ultrasonic echo acquisition. At the same time he investigated color visualization of tissue movements – Tissue Doppler Imaging (TDI) – applied to heart wall examinations. In recent years his activity has been dedicated to the development of high resolution microsonography using coded excitations. An important part of his “ultrasonographic” activity is dedicated to educating physicians about US techniques, the physics of medical ultrasound, Doppler and hemodynamics.

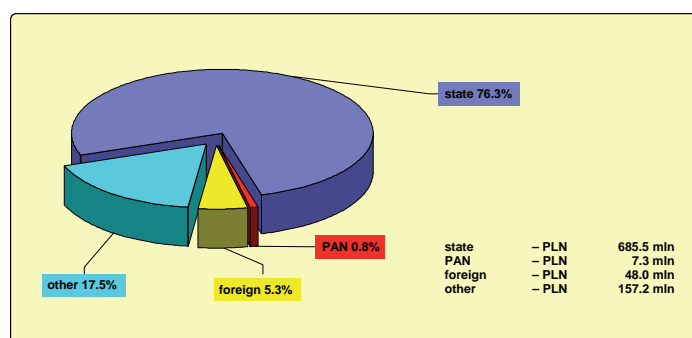
He has published 4 books on the basics of ultrasonic medical imaging and Doppler, as well as numerous scientific papers (73 in international journals). In the past 5 years Prof. Nowicki has been invited to present papers on ultrasonographic imaging at international conferences in Shanghai, Geneva, Philadelphia, Washington, Seoul, Bologna, and Gdańsk.

Polish Academy of Sciences in 2007

Sources of financing for the Academy and its scientific institutions

The primary source of funding for the Polish Academy of Sciences and its institutions in 2007 came from the state budget. This funding, PLN 53.86 mln, was allocated for the Academy's corporate activity as well as for maintaining centers constituting the infrastructure of the scientific community. Funds for the Academy's scientific institutions were allocated to their statutory activities and research projects completed through the end of 2007.

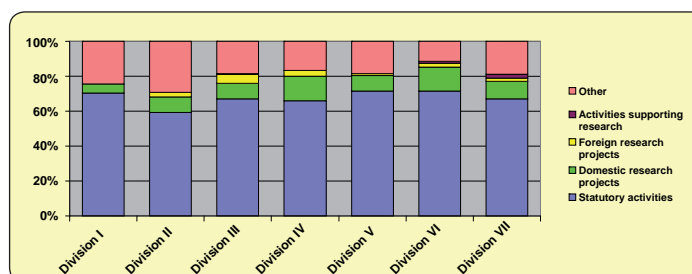
Sources of financing for the Academy's institutions in 2007



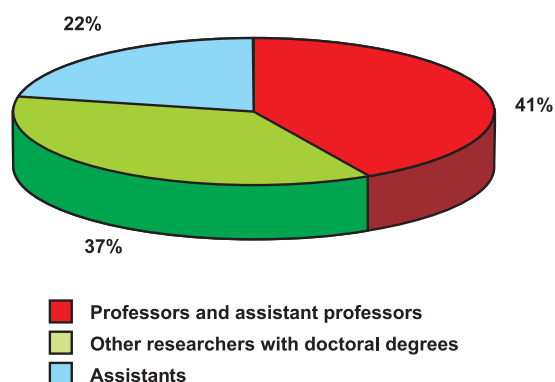
Staff

In 2007 the Polish Academy of Sciences employed a staff of ca. 8800 individuals, almost 8000 (91%) of them in scientific units. The remaining staff, i.e. 800 individuals (9%) were employed in its supporting institutions – independent libraries, Archives, the Museum of the Earth, experimental stations, etc.

Breakdown of funding according to the activity of the Academy's institutions in 2007



Research staff in the Academy's scientific units in 2007



Activities of the PAN committees in 2007

Conferences	386
Conference participants	47 884
Lectures, conference reports, articles	15 291
Expert reports and opinions	30
Journal titles	107

Scientific degrees and titles granted in the units of PAN in 2007 (by PAN division)

	Scientific degrees and titles		
	PhD degrees	DSc (<i>habilitation</i>) degrees	Professorship nominations
Division I	29	20	4
Division II	26	15	5
Division III	35	27	16
Division IV	29	21	4
Division V	16	9	7
Division VI	17	7	4
Division VII	10	8	3
Total	162	107	43

Didactic activity of PAN scholars in institutions of higher education in 2007 (by PAN division)

	The number of people teaching in universities
Division I	474
Division II	170
Division III	315
Division IV	182
Division V	91
Division VI	119
Division VII	98
Total	1449

Foreign Scientific Centers

■ CENTER FOR HISTORICAL STUDIES OF
THE POLISH ACADEMY OF SCIENCES IN
BERLIN

ZENTRUM FÜR HISTORISCHE
FORSCHUNG BERLIN DER POLNISCHEN
AKADEMIE DER WISSENSCHAFTEN

Majakowskiring 47, 13156 Berlin
phone: 49 30 486 285 40
fax: 49 30 486 285 56
e-mail: info@panberlin.de
www.panberlin.de
Director: Robert Traba

■ SCIENTIFIC CENTER OF THE POLISH
ACADEMY OF SCIENCES IN MOSCOW

ПОСТОЯННЫЙ ПРЕДСТАВИТЕЛЬ
ПОЛЬСКОЙ АКАДЕМИИ НАУК
В МОСКВЕ

Klimaszkina 4, 123557 Moskwa
phone: 7 495 23 11 710
fax: 7 495 23 11 711
e-mail: PAN.Moskwa@mail.ru
www.panmoskwa.pl
Director: Mariusz Wołos

■ SCIENTIFIC CENTER OF THE POLISH
ACADEMY OF SCIENCES IN PARIS

CENTRE SCIENTIFIQUE DE L'ACADÉMIE
POLONAISE DES SCIENCES A PARIS

74 rue Lauriston, 75116 Paris
phone: 33 156 90 18 34
fax: 33 147 55 46 97
e-mail: sekretariat.parispan@free.fr
www.academie-polonaise.org
Director: Jerzy Pielaszek

■ SCIENTIFIC CENTER OF THE POLISH
ACADEMY OF SCIENCES IN ROME

ACCADEMIA POLACCA DELLE SCIENZE
– BIBLIOTECA E CENTRO DI STUDI
A ROMA

vicolo Doria 2, Palazzo Doria, 00187 Roma
phone: 39 06 679 21 70
fax: 39 06 679 40 87
e-mail: accadpol@tin.it
www.accademiapolacca.it
Director: Elżbieta Jastrzębowska

■ SCIENTIFIC CENTER OF THE POLISH
ACADEMY OF SCIENCES IN VIENNA

WISSENSCHAFTLICHES ZENTRUM
DER POLNISCHEN AKADEMIE
DER WISSENSCHAFTEN IN WIEN

Boerhaavgasse 25, 1030 Wien
phone: 43 1 713 59 29
fax: 43 1 713 03 83 550
e-mail: office@viennapan.org
www.viennapan.org
Director: Bogusław Dybaś

■ POLSCA – POLISH SCIENCE CONTACT
AGENCY

Rue du Trône 98, B-1050 Bruxelles
phone: 32 022 134 160
fax: 32 022 134 169
e-mail: polsca@skynet.be
www.polsca.eu
Director: Jan Krzysztof Frąckowiak

Scientific Institutes and Branches of the Polish Academy of Sciences



Scientific Units

Division I Social Sciences

- Center for Studies on Non-European Countries (Warszawa)
e-mail: csnec@zkppan.waw.pl
www.zkppan.waw.pl
- Institute of Archeology and Ethnology (Warszawa)
e-mail: director@iaepan.edu.pl
www.iaepan.edu.pl
- Institute of Art (Warszawa)
e-mail: ispan@ispan.pl
www.ispan.pl
- Institute of Economic Sciences (Warszawa)
e-mail: inepan@inepan.waw.pl
www.inepan.waw.pl
- Institute of Legal Studies (Warszawa)
e-mail: inp@inp.pan.pl
www.inp.pan.pl
- Institute of Literary Research (Warszawa)
e-mail: ibadlit@ibl.waw.pl
www.ibl.waw.pl
- Institute of Philosophy and Sociology (Warszawa)
e-mail: sekretar@ifspan.waw.pl
www.ifspan.waw.pl
- Institute of Polish Language (Kraków)
e-mail: ireneusz@ijp-pan.krakow.pl
www.ijp-pan.krakow.pl
- Institute of Political Studies (Warszawa)
e-mail: politic@isppan.waw.pl
www.isppan.waw.pl
- Institute of Psychology (Warszawa)
e-mail: sekretariat@psychpan.waw.pl
www.psychpan.waw.pl
- Institute of Rural and Agricultural Development (Warszawa)
e-mail: irwir@irwirpan.waw.pl
www.irwirpan.waw.pl
- Institute of Slavic Studies (Warszawa)
e-mail: ispan@ispan.waw.pl
www.ispan.waw.pl
- Institute of the History of Science (Warszawa)
e-mail: ihn@ihnpan.waw.pl
www.ihnpan.waw.pl
- Research Center for Mediterranean Archeology (Warszawa)
e-mail: zaspan@zaspan.waw.pl
- Tadeusz Manteuffel Institute of History (Warszawa)
e-mail: ihpan@ihpan.edu.pl
www.ihpan.edu.pl

Division II Biological Sciences

- Center for Ecological Research (Dziekanów Leśny)
e-mail: cbe@cbe-pan.pl
www.cbe-pan.pl
- Department of Antarctic Biology (Warszawa)
e-mail: profesor@dab.waw.pl
www.arctowski.pl
- Institute of Anthropology (Wrocław)
e-mail: zapan@antro.pan.wroc.pl
www.antro.pan.wroc.pl
- Institute of Biochemistry and Biophysics (Warszawa)
e-mail: secretariate@ibb.waw.pl
www.ibb.waw.pl
- Institute of Bioorganic Chemistry (Poznań)
e-mail: ibch@ibch.poznan.pl
www.ibch.poznan.pl
- Institute of Dendrology (Kórnik)
e-mail: idkornik@man.poznan.pl
www.idpan.poznan.pl
- Institute of Ichthyobiology and Aquaculture (Gołysz)
e-mail: zigr@bb.onet.pl
www.fish.com.pl
- Institute of Nature Conservation (Kraków)
e-mail: okarma@iop.krakow.pl
www.iop.krakow.pl
- Institute of Systematics and Evolution of Animals (Kraków)
e-mail: office@isez.pan.krakow.pl
www.isez.pan.krakow.pl
- International Institute of Polish Academy of Sciences – European Regional Centre for Ecohydrology (Łódź)
e-mail: erce@erce.unesco.lodz.pl
www.erce.unesco.pl
- Mammal Research Institute (Białowieża)
e-mail: mripas@bison.zbs.bialowieza.pl
www.zbs.bialowieza.pl
- Museum and Institute of Zoology (Warszawa)
e-mail: sekretariat@miiz.waw.pl
www.miiz.waw.pl
- Nencki Institute of Experimental Biology (Warszawa)
e-mail: dyrekcja@nencki.gov.pl
www.nencki.gov.pl
- Roman Kozłowski Institute of Paleobiology (Warszawa)
e-mail: paleo@twarda.pan.pl
www.paleo.pan.pl
- Witold Stefański Institute of Parasitology (Warszawa)
e-mail: iparpas@twarda.pan.pl
www.ipar.pan.pl
- Władysław Szafer Institute of Botany (Kraków)
e-mail: iboffice@ib-pan.krakow.pl
www.ib-pan.krakow.pl

Division III Mathematical, Physical and Chemical Sciences

- Center for Theoretical Physics (Warszawa)
e-mail: cft@cft.edu.pl
www.cft.edu.pl
- Center of Polymer and Carbon Materials (Gliwice)
e-mail: secretariat@cmpw-pan.edu.pl
www.cmpw-pan.edu.pl

- Henryk Niewodniczański Institute of Nuclear Physics (Kraków)
e-mail: dyrektor@ifj.edu.pl
www.ifj.edu.pl
- High Pressure Research Center (Warszawa)
e-mail: sylvek@unipress.waw.pl
www.unipress.waw.pl
- Institute – Center for Molecular and Macromolecular Studies (Łódź)
e-mail: cbmm@bilbo.cbmm.lodz.pl
www.cbmm.lodz.pl
- Institute of Catalysis and Surface Chemistry (Kraków)
e-mail: ncwitko@cyf-kr.edu.pl
www.ik-pan.krakow.pl
- Institute of Mathematics (Warszawa)
e-mail: im@impan.gov.pl
www.impan.gov.pl
- Institute of Molecular Physics (Poznań)
e-mail: office@ifmpan.poznan.pl
www.ifmpan.poznan.pl
- Institute of Organic Chemistry (Warszawa)
e-mail: icho-s@icho.edu.pl
www.icho.edu.pl
- Institute of Physical Chemistry (Warszawa)
e-mail: ichf@ichf.edu.pl
www.ichf.edu.pl
- Institute of Physics (Warszawa)
e-mail: director@ifpan.edu.pl
www.ifpan.edu.pl
- Nicolaus Copernicus Astronomical Center (Warszawa)
e-mail: camk@camk.edu.pl
www.camk.edu.pl
- Space Research Center (Warszawa)
e-mail: cbk@cbk.waw.pl
www.cbk.waw.pl
- Włodzimierz Trzebiatowski Institute of Low Temperature and Structure Research (Wrocław)
e-mail: intibs@int.pan.wroc.pl
www.int.pan.wroc.pl

Division IV Technical Sciences

- Aleksander Krupkowski Institute of Metallurgy and Materials Science (Kraków)
e-mail: office@imim-pan.krakow.pl
www.imim.pl
- Institute of Biocybernetics and Biomedical Engineering (Warszawa)
e-mail: ibib@ibib.waw.pl
www.ibib.waw.pl
- Institute of Chemical Engineering (Gliwice)
e-mail: secret@iich.gliwice.pl
www.iich.gliwice.pl
- Institute of Computer Science (Warszawa)
e-mail: ipi@ipipan.waw.pl
www.ipipan.waw.pl
- Institute of Fundamental Technological Research (Warszawa)
e-mail: director@ippt.gov.pl
www.ippt.gov.pl
- Institute of Hydroengineering (Gdańsk)
e-mail: sekr@ibwpan.gda.pl
www.ibwpan.gda.pl
- Institute of Theoretical and Applied Informatics (Gliwice)
e-mail: office@iitis.gliwice.pl
www.iitis.gliwice.pl
- Robert Szwalski Institute of Fluid-Flow Machinery (Gdańsk)
e-mail: imp@imp.gda.pl
www.imp.gda.pl
- Systems Research Institute (Warszawa)
e-mail: ibs@ibspan.waw.pl
www.ibspan.waw.pl

Division V Agricultural, Forestry and Veterinary Sciences

- Bohdan Dobrzański Institute of Agrophysics (Lublin)
e-mail: agrof@demeter.ipan.lublin.pl
www.ipan.lublin.pl
- Botanical Garden – Center for Biological Diversity Conservation (Warszawa)
e-mail: obpan@ikp.atm.com.pl
www.ogrod-powsin.pl
- Franciszek Górski Institute of Plant Physiology (Kraków)
e-mail: ifr@ifr-pan.krakow.pl
www.ifr-pan.krakow.pl
- Institute of Animal Reproduction and Food Research (Olsztyn)
e-mail: institute@pan.olsztyn.pl
www.pan.olsztyn.pl
- Institute of Genetics and Animal Breeding (Jastrzębiec)
e-mail: panighz@atos.warman.com.pl
www.ighz.edu.pl
- Institute of Plant Genetics (Poznań)
e-mail: office@igr.poznan.pl
www.igr.poznan.pl
- Jan Kielanowski Institute of Animal Physiology and Nutrition (Jabłonna)
e-mail: office@ifzz.pan.pl
www.ifzz.pl
- Research Center for Agricultural and Forest Environmental (Poznań)
e-mail: zbsril@man.poznan.pl
www.zbsril.poznan.pl
- Research Station for Ecological Agriculture and Preservation of Native Breeds (Popielno)
e-mail: popielno@pan.pl
www.turysta.net.pl/atrakcje/pan

Division VI Medical Sciences

- Institute of Human Genetics (Poznań)
e-mail: igcz@man.poznan.pl
www.igcz.poznan.pl
- Institute of Medical Biology (Łódź)
e-mail: aobidowska@cbm.pan.pl
www.cbm.pan.pl
- Institute of Pharmacology (Kraków)
e-mail: ifpan@if-pan.krakow.pl
www.if-pan.krakow.pl
- Ludwik Hirsfeld Institute of Immunology and Experimental Therapy (Wrocław)
e-mail: secretary@iitd.pan.wroc.pl
www.iitd.pan.wroc.pl
- Mirosław Mossakowski Medical Research Center (Warszawa)
e-mail: sekretariat@cmdik.pan.pl
www.cmdik.pan.pl

Division VII Earth and Mining Sciences

- Institute of Environmental Engineering (Zabrze)
e-mail: ipis@ipis.zabrze.pl
www.ipis.zabrze.pl
- Institute of Geological Sciences (Warszawa)
e-mail: ingpan@twarda.pan.pl
www.ing.pan.pl
- Institute of Geophysics (Warszawa)
e-mail: sn@igf.edu.pl
www.igf.edu.pl

- Institute of Oceanology (Sopot)
e-mail: office@iopan.gda.pl
www.iopan.gda.pl
- Mineral and Energy Economy Research Institute (Kraków)
e-mail: centrum@min-pan.krakow.pl
www.min-pan.krakow.pl
- Museum of the Earth (Warszawa)
e-mail: mzpaleo@warman.com.pl
www.mz-pan.pl
- Stanisław Leszczycki Institute of Geography and Spatial Organization (Warszawa)
e-mail: igipzpan@twarda.pan.pl
www.igipz.pan.pl
- Strata Mechanics Research Institute (Kraków)
e-mail: biuro12@img-pan.krakow.pl
www.img-pan.krakow.pl

Branches

- The Gdańsk Branch of the Polish Academy of Sciences (Gdańsk)
e-mail: office@opan.gda.pl
- The Katowice Branch of the Polish Academy of Sciences (Katowice)
e-mail: opankatowice@interia.pl
- The Kraków Branch of the Polish Academy of Sciences (Kraków)
e-mail: paniec@zdp.pan.krakow.pl
www.pan-krakow.pl
- The Lublin Branch of the Polish Academy of Sciences (Lublin)
e-mail: pan-ol@hektor.umcs.lublin.pl
www.pan-ol.lublin.pl
- The Łódź Branch of the Polish Academy of Sciences (Łódź)
- The Poznań Branch of the Polish Academy of Sciences (Poznań)
e-mail: opan@man.poznan.pl
www.pan.poznan.pl
- The Wrocław Branch of the Polish Academy of Sciences (Wrocław)
e-mail: kontakt@oddz.pan.wroc.pl
www.pan.wroc.pl

Shared scientific units

- Henryk Frąckiewicz Center for Laser Technology of Metals of Kielce University of Technology and the Polish Academy of Sciences (Kielce)
e-mail: zbigwes@eden.tu.kielce.pl
www.tu.kielce.pl
- International Institute of Molecular and Cell Biology (Warszawa)¹
e-mail: secretariat@iimcb.gov.pl
www.iimcb.gov.pl
- International Laboratory of High Magnetic Fields and Low Temperatures (Wrocław)
e-mail: intlab@alpha.ml.pan.wroc.pl
www.alpha.mlspmint.pan.wroc.pl

¹ The Institute was established pursuant to the act passed by the Parliament on June 26, 1997. It has been functioned as an independent scientific unit since January 1999. According to the decision of PAN President, the Institute is supervised by the chairman of Division II Biological Sciences.

Scientific and Task Force Committees

Task Force Committees

Committees affiliated with the Presidium of the Academy

- **The Committee on Biotechnology**
ul. Stefanowskiego 4/10, 90-924 Łódź,
Instytut Biochemii Technicznej,
Politechnika Łódzka
e-mail: stefan_malepszy@sggw.pl
- **The Committee on Energy**
ul. Konarskiego 18, 44-100 Gliwice
Instytut Maszyn i Urządzeń Energetycznych,
Politechnika Śląska
e-mail: tadeusz.chmielniak@polsl.pl
- **The Committee on Ergonomics**
ul. Grzegórzecka 20, 31-531 Kraków,
Collegium Medicum, Uniwersytet Jagielloński
e-mail: mmpokors@cyf-kr.edu.pl
- **The Committee on Ethics in Science**
ul. Krakowskie Przedmieście 3,
00-047 Warszawa,
Instytut Filozofii, Uniwersytet Warszawski
e-mail: kenpan.wfs@uw.edu.pl
- **The Committee on Polar Research**
ul. Księcia Janusza 64, 01-452 Warszawa,
Instytut Geofizyki PAN
e-mail: kbp@igf.edu.pl
- **The Research Committee on Human Migrations and on Polish Diaspora**
ul. Jodłowa 13, 30-252 Kraków-Przegorzały,
Instytut Amerykanistyki i Studiów Polonijnych,
Uniwersytet Jagielloński
e-mail: gbabinski@interia.pl
- **The Committee for Research on Threats**
ul. Chodakowska 19/31, 03-815 Warszawa,
Wydział Psychologii, Szkoła Wyższa
Psychologii Społecznej
e-mail: kbz@swps.edu.pl
- **The Committee on Space and Satellite Research**
ul. Bartycka 18A, 00-716 Warszawa,
Centrum Badań Kosmicznych PAN
e-mail: bpop@cbk.waw.pl
- **The Committee on Spatial Economy and Regional Planning**
Pałac Kultury i Nauki, 00-901 Warszawa
e-mail: kpzk@pan.pl
- **The Committee on Water Management**
ul. Podleśna 61, 01-673 Warszawa,
Instytut Meteorologii i Gospodarki Wodnej
e-mail: maciej.maciejewski@imgw.pl
- **The “Poland 2000 Plus” Forecast Committee**
Pałac Kultury i Nauki, 00-901 Warszawa
e-mail: komprog@pan.pl
- **The Council for Scientific Societies**
Pałac Kultury i Nauki, 00-901 Warszawa
e-mail: rtn@pan.pl
- **The Council for the Polish Language**
ul. Nowy Świat 72, 00-330 Warszawa
e-mail: rjp@rjp.pl
- **The Council for the Promotion of the Public Understanding of Science**
ul. Pawińskiego 5a, 02-106 Warszawa,
Instytut Biochemii i Biofizyki PAN
e-mail: m.fikus@ibb.waw.pl

Committees affiliated with the Division VII

- **The Planet Earth Committee**
ul. Podwale 75, 50-449 Wrocław
e-mail: rokziemi@planetaziemia.pan.pl
www.planetaziemia.pan.pl

Scientific Committees at the Divisions of the Academy

Division I Social Sciences

- **The Committee on Art Studies**
ul. Długa 26/28, 00-950 Warszawa,
Instytut Sztuki PAN
e-mail: tadeuszlub@poczta.onet.pl
- **The Committee on Cultural Studies**
Pałac Kultury i Nauki, 00-901 Warszawa,
skr. poczt. 24
e-mail: l.kolankiewicz@uw.edu.pl
- **The Committee on Demographic Studies**
Al. Niepodległości 162, 02-554 Warszawa,
Instytut Statystyki i Demografii, Szkoła
Główna Handlowa
e-mail: ewaf@sgh.waw.pl
- **The Committee on Economic Sciences**
Pałac Kultury i Nauki, 00-901 Warszawa,
skr. poczt. 24
e-mail: emil.panek@ac.poznan.pl
- **The Committee on Ethnological Sciences**
ul. Św. Marcina 78, 61-803 Poznań,
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