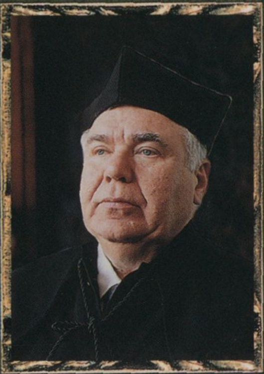
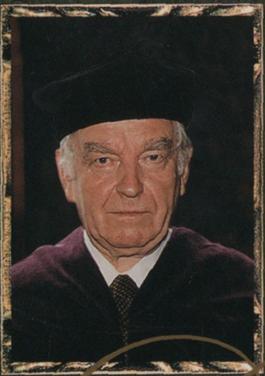
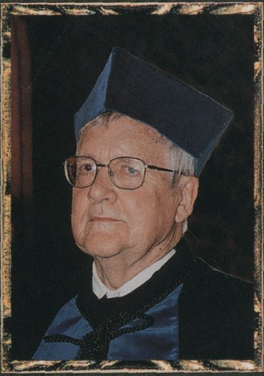
POLITECHNIKA
KRAKOWSKA
IM. TADEUSZA KOŚCIUSZKI

TADEUSZ KOŚCIUSZKO
CRACOW UNIVERSITY
OF TECHNOLOGY
KRAKÓW 2001







TYTUŁY NADANE
W 1998/99

DOCTOR HONORIS CAUSA

TITLES CONFERRED
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ISBN 83-7242-137-4

Edited by Editorial Board of the CUT Publications
Secretary of information publications: Barbara Luraniec-Czopek
Compiled by Krystyna Hajduk
Graphic design and phototype by Jadwiga Mączka
Photographs taken by Jan Zych
Translated by Elżbieta Han-Wiercińska
(introduction and curricula vitae)

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Sapientia felicitas

The co-operation of the Cracow University of Technology with foreign universities and institutions has taken on an imposing dimension in recent years. Our co-operation, dating back to the 1970s, with outstanding scientists and innovators from two continents has given us the honour to confer the title of doctor honoris causa of the Cracow University of Technology in the academic year 1998/99 on:

Jamie LERNER, Brazil

– an eminent architect and town planner, the author of pioneer solutions of urban communication systems in Brazilian cities, governor of the Paraná state, the mayor of Curitiba, the state capital. The title was conferred, on the basis of the resolution of the Senates of the Warsaw University of Technology and the Wrocław University of Technology, on March 30, 1999. The promotor was Andrzej Kadłuczka, the Faculty of Architecture.

Jan HULT, Sweden

– professor emeritus of Chalmers Tekniska Högskola, Göteborg, a scientist of world renown in deformable bodies mechanics, a great organiser of international scientific co-operation (the secretary of the Union of Theoretical and Applied Mechanics), a historian of engineering, the originator of this specialisation at Swedish universities. The title was conferred, following the resolution of the Senate of the Poznań University of Technology and the Scientific Council of the Institute of Basic Problems of Technology of the Polish Academy of Sciences, on June 9, 1999. The conferring procedure was held at the Faculty of Civil Engineering, the promotor – Michał Życzkowski, the Faculty of Mechanical Engineering.

Oscar H. G. MAHRENHOLTZ, Germany

– professor emeritus of the Technische Universität Hamburg-Harburg, foreign member of the Polish Academy of Sciences, an eminent engineer in the field of mechanics, innovator, educator of many generations of scientists, an author of numerous monographies on plasticity, fluid mechanics, aero-elasticity, numerical methods, former president of Gesellschaft für Mathematik Mechanik. The title was conferred, on the basis of the resolution of the Senate of the Gdańsk University of Technology and the Scientific Council of the Institute of Basic

Problems of Technology of the Polish Academy of Sciences, on June 9, 1999. The promotor – Józef Nizioł, the Faculty of Mechanical Engineering.

The ceremonies of handing down the diplomas to professors Hult and Mahrenholtz were traditionally held in the historical halls of the Jagiellonian University to emphasise the close links of the Cracow academic circles. The ceremony for Jamie Lerner was held in the historical Chamber of Deputies at the Wawel Royal Castle to honour his high state rank and receive the numerous guests, many from Brazil. These references to the history of our country, our university traditions and glorious past, serve to highlight our national dignity so important at the time of globalisation and international unification.

The present bulletin volume introduces the doctor honoris causa conferees, in the chronological order of the titles being conferred, together with the texts of the lectures they delivered in English and summaries in the Polish language, the language used during the ceremonies – with one exception: Latin, in which the diplomas are written and read out.

Marcin Chrzanowski
Vice-Rector of Cracow University of Technology

Cracow 2000

Sapientia felicitas

Współpraca międzynarodowa Politechniki Krakowskiej, prowadzona na szeroką skalę od wielu lat, w ostatnim okresie nabiera nowego blasku. Przydają go także doktorzy honoris causa, którym nadano ten tytuł w roku akademickim 1998/99, wybitni naukowcy i twórcy z dwu kontynentów. Ich współpraca z Politechniką sięga lat siedemdziesiątych i odzwierciedla zarówno międzynarodową pozycję naszej Uczelni, jak i zasięg kontaktów naukowych jej pracowników.

W roku akademickim 1998/99 tytuły doktora honoris causa Politechniki Krakowskiej otrzymali:

Jamie LERNER, Brazylia

– wybitny architekt i urbanista, twórca i realizator pionierskich rozwiązań komunikacyjnych współczesnych miast brazylijskich, gubernator stanu Parana, wieloletni burmistrz Kurytyby, stolicy tego stanu. Tytuł, na podstawie opinii Senatów Politechniki Warszawskiej i Wrocławskiej, nadano dnia 30 marca 1999 r., promotorem przewodu przeprowadzonego na Wydziale Architektury był Andrzej Kadłuczka, profesor tego Wydziału.

Jan HULT, Szwecja

– emerytowany profesor Chalmers Tekniska Högskola, Göteborg, uczony o światowej renomie w zakresie mechaniki ciał odkształcalnych, wybitny organizator międzynarodowej współpracy naukowców (sekretarz Unii Mechaniki Teoretycznej i Stosowanej), a także historyk techniki, twórca tej specjalności na uczelniach szwedzkich. Tytuł, zgodnie z opiniami Senatu Politechniki Poznańskiej i Rady Naukowej Instytutu Podstawowych Problemów Techniki PAN, nadano dnia 9 czerwca 1999 r., promotorem przewodu przeprowadzonego na Wydziale Inżynierii Lądowej był Michał Życzkowski, profesor Wydziału Mechanicznego.

Oskar H. G. MAHRENHOLTZ, Niemcy

– emerytowany profesor Technische Universität Hamburg-Harburg, członek zagraniczny Polskiej Akademii Nauk, wybitny inżynier mechanik, twórca, wychowawca wielu pokoleń młodych naukowców, autor licznych monografii z zakresu plastyczności, dynamiki płynów, aerosprężystości, metod numerycznych, były prezydent Gesellschaft für Mathematik Mechanik. Tytuł, opierając się na opiniach Senatu Politechniki Gdańskiej i Rady Naukowej Instytutu Podstawowych Problemów Techniki PAN, nadano dnia 9 czerwca 1999 r., promotorem przewodu przeprowadzonego na Wydziale Mechanicznym był Józef Nizioł, profesor tego Wydziału.

Ceremonie wręczania doktoratów profesorom Hultowi i Mahrenholtzowi odbyły się, zgodnie z tradycją naszej Uczelni, w zabytkowych salach Uniwersytetu Jagiellońskiego, dla podkreślenia więzi krakowskiego środowiska akademickiego, które wywodzą się z wielowiekowej tradycji tego Uniwersytetu. Uroczystość związana z wręczaniem tytułu Jaime Lernerowi, z uwagi na jego wysoką pozycję rządową i licznych gości, także z Brazylii, miała miejsce na Zamku Królewskim na Wawelu, w historycznej Sali Poselskiej. Te odniesienia do historii naszego Kraju, ściśle związanej zarówno z tradycją uniwersytecką, jak i z jej chlubną przeszłością, służą w naszym przekonaniu podkreśleniu naszej dumy narodowej, czynnika tak ważnego w dobie globalizacji i unifikacji międzynarodwej, elementu niezbędnego do funkcjonowania akademii i wymagającego oparcia w poczuciu własnej wartości.

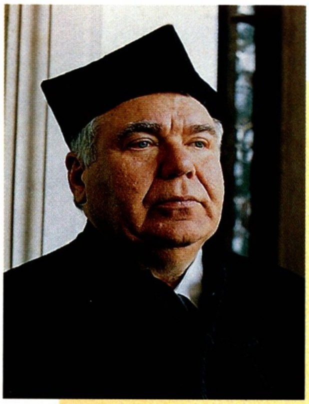
Niniejszy tom zawiera, w układzie chronologicznym nadawanych tytułów, podstawową dokumentację powyższych uroczystości – także fotograficzną – sylwetki doktorów oraz ich wykłady promocyjne w języku oryginału, ze streszczeniami w języku polskim; języku, w którym uroczystości te są prowadzone – z jednym wyjątkiem: odczytaniem łacińskiego tekstu dyplomu nadania tytułu.

Marcin Chrzanowski
Prorektor Politechniki Krakowskiej

Kraków 2000

Governor of the State of Paraná, Brazil

Jaime Lerner



Quod felix faustum fortunatumque sit

Nos

Rector et Senatus Academicus

POLYTECHNICAE THADDAEO-KOSCIUSZKIANAE CRACOVIENSIS

et

Consilium Facultatis Architecturae

in virum doctissimum ac clarissimum

IACOBUM LERNER

Paranae Brasiliensis gubernatorem amplissimum, Universitatis Technicae in Nova Scotia Canadensi et Universitatis Sancti Francisci nomine ornatae in urbe Brasiliensi Bragança Paulista doctorem honoris causa creatum, Societatis Regiae Architectorum Canadensium et Societatis Architectorum Americanorum socium honoris causa ascitum, virum multis summisque praemiis internationalibus ornatum, architectum et urbanistam peritissimum atque nobilissimum

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qui cives Brasilienses gente Polona ortos animo iuvat fovetque amicissimo

doctoris honoris causa

nomen et dignitatem, iura ac privilegia contulimus atque in eius rei fidem hoc diploma Polytechnicae Cracoviensis sigillis sanciendum curavimus.

Dabamus Cracoviae, die tricesima mensis Martii anno millesimo nongentesimo nonagesimo nono

Thaddaeus BARTKOWICZ
scientiarum technicarum doctor
architecturae et urbanisticae professor
PROMOTOR

Andreas KADŁUCZKA
scientiarum technicarum doctor
architecturae et urbanisticae professor
DECANUS

Casimirus FLAGA
scientiarum technicarum doctor
aedificationis professor
RECTOR

Governor of the State of Paraná, Brazil

Jaime Lerner

Jaime Lerner was born on 17th December 1937 in Curitiba into a Polish family who came to Brazil from Lwów (Lvov) in 1936.

In 1960 he graduated in engineering from the Federal University of Paraná, and in 1964 he completed studying at the architecture and urban planning department of the same university, obtaining a thorough and versatile education for creating urban structures.

For 30 years he has been dealing with architectural and spatial planning and solving regional and urban problems – complex plans of development and reconstruction of large urban structures not only of Curitiba but also cities such as Rio de Janeiro, Campo Grande, São Paulo, Caracas and San Juan. The town planning conception of the reconstruction of Curitiba and its development was generally met with approbation, and the trust for the architect – town-planner Jaime Lerner – became a basis to entrust him with the position of the mayoralty of Curitiba in 1971. Holding the office for a period of three terms (1971–1975, 1979–1983, 1989–1993) and consistently realizing his vision for the spatial extension of the town, he managed to involve the local community in its realization, thanks to which Curitiba – a metropolis with over two million inhabitants – is described today as the best managed and most efficiently functioning city in the world. Its development and economic rise was totally submitted to environment protection (for example constructing "Metal Opera" on the recultivated post industrial area, Botanical Garden or the Natural History Museum). Jaime Lerner's most spectacular town-planning success was the realization of an integrated urban transport system in Curitiba, without the necessity for an underground system.

It should be emphasized that through the reconstruction and development of Curitiba he enabled the poorest people to lead a dignified life giving them a chance to learn a job and work, their own roof over their head and with hope for a better life. He created and suggested educational programmes, established foundations (The Open University for Environmental Problems, The Centre for Health Education for the children from poor families and also for children who need special care). The programme of town-planning activity in harmony with nature and bringing its contribution back to human life brought the green areas increase from 0,5 m^2 per person in 1970 to 50 m^2 per person after 25 years.

In 1995 Jaime Lerner took on the post of the Governor of the State of Paraná, which he has been holding up till now (the second term). Experiments from Curitiba are carried out in the 371 towns of Paraná. They concern not only his theoretical ideas but also practical ones connected with restoring old town centres, improving their communication and transport systems and recreation grounds with the developing of social participation programmes.

The creative activity concerning the spatial reconstruction of Curitiba has been widely recognized also outside Brazil, among the town-planners and mayors of such different cities as: New York, Toronto, Montreal, Paris, Lyon, Moscow, Prague, Santiago, Buenos Aires and Lagos.

His extensive creative activity in architecture and town-planning is enriched with research and didactic work. He has actively participated in many prestigious conferences and scientific meetings, among others in the New York Academy of Science, at the Smithsonian Institute in Washington and at the National Council of Technology in the United States Congress. He has delivered lectures and seminars at universities of many countries, among others Columbia, Spain, Great Britain, Norway, Germany, the United States and Japan. For many years he has been a United Nations consultant in town-planning and integrated programmes of spatial reconstruction of towns. In 1996 the Secretary General of the United Nations Organization appointed him to a post of the Coordinator of the Latin-American and Carribbean Committee for Settlement. He is a member of the Brazilian National Committee for Metropolitan Regions and Urban Policy, member of the Brazilian Institute of Architecture, honorary member of the Royal Union of Architects of Canada, honorary member of the American Architects Association.

Honoured by the Technical University in Nova Scotia (Canada) and the University of São Francisco-Bragança Paulista (Brazil) with the title of doctor honoris causa and distinguished with awards by: UNEP (United Nationals Environment Programme), IIEC (International Institute for Energy Conservation, Washington, DC), HABITAT Association, IUNC (International Union for Nature), UNICEF and others.

Jaime Lerner's professional achievement is an example of unusual diligence and creative passion, an architect – a town-planner – devoted and kindly to people for whom through his vision and public work he wants to create a better world.

Jaime Lerner

Jaime Lerner urodził się 17 grudnia 1937 roku w Kurytybie, w rodzinie polskiej przybyłej do Brazylii ze Lwowa w 1936 roku.

W 1960 roku ukończył Wydział Inżynierii na Uniwersytecie Federalnym Parany, a w 1964 Wydział Architektury i Planowania Urbanistycznego, na tej samej uczelni, uzyskując gruntowne i wielostronne przygotowanie do działalności w zakresie kształtowania struktur miejskich.

Od 30 lat zajmuje się architekturą i planowaniem przestrzennym, rozwiązując problemy: regionalne i miejskie – kompleksowe plany rozwoju i przebudowy dużych struktur miejskich nie tylko Kurytyby, ale również takich miast, jak: Rio de Janeiro, Campo Grande, São Paulo, Caracas i San Juan. Koncepcja urbanistyczna przebudowy Kurytyby i jej rozwoju zyskała powszechne uznanie, a zaufanie do architekta-urbanisty Jaime Lernera stało się podstawą do powierzenia Mu w 1971 roku stanowiska Burmistrza Kurytyby. Sprawując ten urząd przez okres trzech kadencji (1971–1975, 1979–1983, 1989–1993) i urzeczywistniając konsekwentnie swoje wizje rozbudowy przestrzennej miasta potrafił zaangażować w ich realizację społeczność lokalną, dzięki czemu Kurytyba – ponaddwumilionowa metropolia – określana jest dzisiaj jako najlepiej zarządzane i najsprawniej funkcjonujące miasto na świecie, którego rozwój i rozkwit gospodarczy podporządkowany został w maksymalnym stopniu ochronie środowiska (np. realizacja na rekultywowanych terenach poprzemysłowych: „Opery Metalowej", Ogrodu Botanicznego czy Muzeum Historii Naturalnej). Spektakularnym sukcesem urbanistycznym Jaime Lernera była realizacja w Kurytybie zintegrowanego systemu transportu miejskiego, bez udziału metra.

Na podkreślenie zasługuje fakt, iż w przebudowie i w rozwoju Kurytyby uwzględnił stworzenie warunków godnego życia ludziom najuboższym, dając im szansę nauki zawodu i pracy, własnego dachu nad głową i nadzieję lepszego życia. Opracował i zaproponował programy edukacyjne, powołał fundacje (Otwarty Uniwersytet ds. Środowiska, Centrum Edukacji Zdrowotnej na rzecz dzieci z ubogich rodzin i dzieci specjalnej troski). Program działania urbanistycznego w zgodzie z naturą i przywracanie jej udziału w życiu człowieka przyniósł przyrost terenów zielonych z 0,5 m^2/osobę w 1970 roku do 50 m^2/osobę po 25 latach.

W 1995 roku Jaime Lerner objął urząd Gubernatora Stanu Parana, który piastuje do dziś (II kadencja).

Doświadczenia z Kurytyby wdrażane są w 371 miastach Parany. Dotyczą one nie tylko Jego koncepcji teoretycznych, ale także praktycznych w zakresie rehabilitacji starych ośrodków miejskich, poprawy ich systemów komunikacji i transportu oraz obszarów rekreacji, przy rozwinięciu programów partycypacji społecznej.

Zamysły twórcze w zakresie przebudowy przestrzennej Kurytyby zyskały szerokie uznanie także poza granicami Brazylii, wśród urbanistów i merów tak różnych miast, jak: Nowy Jork, Toronto, Montreal, Paryż, Lyon, Moskwa, Praga, Santiago, Buenos Aires czy Lagos.

Swą rozległą działalność twórczą na polu architektury i urbanistyki J. Lerner wzbogaca o pracę naukową i dydaktyczną. Czynnie uczestniczył w wielu prestiżowych konferencjach i spotkaniach naukowych, m.in. w Nowojorskiej Akademii Nauk, w Smithsonian Institute w Waszyngtonie oraz w Narodowej Radzie Technologii Kongresu Stanów Zjednoczonych. Prowadził wykłady i seminaria na uniwersytetach w wielu krajach, m.in. w Kolumbii, Hiszpanii, Wielkiej Brytanii, Norwegii, w Niemieckiej Republice Federalnej, w Stanach Zjednoczonych i Japonii. Od wielu lat jest konsultantem ONZ w dziedzinie urbanistyki i zintegrowanych programów przebudowy przestrzennej miast. W 1996 roku Sekretarz Generalny Organizacji Narodów Zjednoczonych powołał Go na stanowisko Koordynatora Łacińsko-Amerykańskiej i Karaibskiej Komisji ds. Osadnictwa. Jest członkiem Brazylijskiego Narodowego Komitetu ds. Regionów Metropolitalnych i Polityki Miejskiej, członkiem Brazylijskiego Instytutu Architektury, honorowym członkiem Królewskiego Związku Architektów Kanady, honorowym członkiem Związku Architektów Amerykańskich.

Uhonorowany przez Uniwersytet Techniczny w Nowej Szkocji (Kanada) i Uniwersytet São Francisco-Bragança Paulista (Brazylia) tytułem doktora honoris causa oraz wyróżniony nagrodami przez: UNEP (United Nationals Environment Programme), IIEC (International Institute for Energy Conservation, Washington, DC); Stowarzyszenie HABITAT, IUNC (International Union for Nature), UNICEF i inne.

Dorobek zawodowy Jaime Lernera to obraz niezwykłej pracowitości i pasji twórczej architekta-urbanisty oddanego i życzliwego ludziom, który poprzez swoje wizje i działalność publiczną chce stworzyć lepszy świat.

Jaime Lerner

Human dimensions of contemporary cities*

It is with immense joy that I receive on this day this title. I am especially obliged for the generous deference of this prestigious University in awarding me with such a high honour.

The emotion, natural on such a especial occasion as this one, is increased here by the fact that the Polish land and people are so dear in the heart of my family and fellow-countrymen. Sixty-seven years ago, my parents left the Polish soil to start a new life in Paraná, the Brazilian state which I today have the honour of administrating. Like them, except that, about half a century before, thousands of Polish citizens were attracted to Paraná, a territory that was promised to them as blessed by Our Holy Mother of Częstochowa, where they would gain religious freedom and access to the land.

It was not an easy crossing, that which was made by the Polish people to Paraná. The new language, which was very different to that of their motherland, delayed and turned even more difficult their integration. There was also the natural difficulty of a time of precarious communications that imposed an even higher level of isolation, since the absolute majority of the immigrants was composed of farmers who settled in locations that were distant to the main centres.

Yet they fought and persevered. And they overcame the hardships, making come true the prophecy that that was a blessed land.

Today, there are nearly a million Polish descendants in our State, comprising one of the most expressive Polish colonies abroad. In the well-cultivated fields, in exemplary factories, in the surnames that permeate through several different professional activities, in the architecture framed by lambrequins, in the blond skins, in much does our Paraná look like Poland.

That is why my emotion can only grow on this day, to reach the dimension of an indescribable blessing.

Thus, since I already want to share this title with each of the Polish descendants of my State and, also, with each of the inhabitants of Paraná, for there, regardless of ethnic origin, in some way all are Polish, so indelible are the marks imposed by this generous and hard working people. People that dream about a new life and that bequeathed us solidarity and a good way of living.

And that is also the feeling that has influenced my life and the long years of architecture practice. For what is not the mission of an architect, but to help the people fulfil the dream of space, which is essentially the defining of a lifestyle? And what is not the mission of a city planner, than to design and point out paths to fulfil the collective dream of a city?

* The title, as well as the summary in Polish were compiled by the Editor.

Early in life, when I was still a boy, observing the floor design of my father's small shop, I discovered the magic of perspective. Without knowing, there an architecture exercise was beginning.

At that time, already starting primary school, I had the immense joy of discovering on my street a magic world. A street that used to be among the most traditional and important in town, hosting a train station, at that time the main means of transport, the Assembly, newspaper editorial staffs, radio stations, hotels, shops, warehouses, bakers. Especially, there used to be on this street a large vacant lot, normally used by the majority of circuses that came to town.

There on that street I took my first fantasy course.

Without knowing, there I was also taking an imaginary course on city planning, by learning from a very early age about the importance of a street, of any street. Until today, up to when so much time has passed and so many professional experiences have been lived, I have a true obsession for streets.

The city is the human being's most valuable invention.

The society is the city.

The city is the street, in the synthesis sense of the city, street as integration of functions, street that always existed in the life of any neighbourhood. Street as a meeting scene, which is, in essence, a synthesis of all the urban functions and of humanity's very existence.

Nevertheless, the streets are frequently losing this feature, to turn into the space of degradation. It may be for this reason that so many people see with pessimism the future of the cities, imagining that there will never again be an opportunity to humanize them. To these, the cities of the future would be "Blade Runner" scenes.

Others, excessively optimistic with the possibilities of the new technologies, imagine the cities of the future like "Flash Gordon" scenes. The truth is that cities of the future will not be very different in their physical configuration from the cities of today or of yesterday. What will make the difference for the good city will be its capacity of reconciling with its inhabitants and with nature.

Cities that are socially justified.

Cities environmentally cared of.

Throughout more than 30 years working with the urban problems, in my town and in many towns of the world, I settled some convictions. The cities are not the problem. The cities can be the solution. The cities can change more rapidly a region, a country, and in this manner the planet itself.

Yet it is necessary to look generously upon the cities.

The countries that opened their eyes to this premise sooner are the ones that are more rapidly improving the quality of life of their inhabitants. It is necessary to fight against the tragic vision that falls upon some cities. Those who plant tragedy, gather tragedy. Those who plant success, gather success.

The city is not as complex as the complexity that the salespeople want to sell us. The world is full of complexity salespeople. It is necessary not to fear the simple solutions. Simple are most of the urban problems, and the complex equations only serve to postpone the solutions. The excess of diagnosis is the best way to immobilize a city. It is necessary to think about the ideal, it is true. Though it is necessary to do what is possible now.

Proposals for 20 or 30 year ahead are useless, for until then the problems will probably be others and much harder to solve because the opportunity to make the possible intervention was not taken. Many cities got lost in the panning of the ideal, delaying actions that could avoid the dimension of the chaos in which they live today.

The possible solution today is the only certainty that we can counter-pose to tomorrow's problem. This does not mean that we need to have a simplistic vision concerning urban matters.

Before I move on, I want to say that we should have a strategic vision. Essentially, we ought to have the courage to propose. The architect is the professional of the proposal. Working in several cities of the world, I met public administrators with strong feelings of solidarity, who did not possess, however, strategic visions about their city. They used to spend all their time trying to solve people's basic problems, forgetting all about planning for the future. For this reason they used to miss the opportunity of transformation.

Others, worried exclusively about the potentials of their towns, used to end up moving astray from the population, that was being resentful for not having their basic necessities attended to. Also these other public administrators used to miss the opportunity of making consistent changes, for without public involvement nobody gets anywhere.

This is what strategic vision is: operating a correct balancing between the needs and the potentials of a city, and from there gathering an equation of shared responsibility. For each urban problem an equation of shared responsibility is presupposed.

The offer of good collective transport will become higher if the equation found between the public power and the private sector that will invest and operate the system gets better. The solution to the environmental problems will become more efficient if the population gets involved and starts developing better behaviour, which goes from the fight against the irrational use of the automobile, to the separation of rubbish, to energy saving, to the love towards nature. This is an essential chapter, since it is in the cities that the origin of the majority of the problems of the planet is. It is from them as well that will have to come the solution.

And the good example of one will tend to reach its neighbours, like in a domino effect. It is the local action as a factor of global transformation. Very specially, the city has to be planned for the human being. The human being is the centre of everything. The search for the human city is a must to all city planners.

Large or small, any city can be human, if its administrators know how to design a scene that could be accepted by the grand majority. Tendency is not destiny. Whichever the dimension of the problems of a city, it is possible to revert it if the majority of its people wants to.

This has been happening since the beginning of the 1970s, when the population was a third of what it is today, and the city was starting to suffer pressure from an intense country exodus, experiencing a vertiginous growth. And the moment when a society detects an undesirable tendency is the exact moment to revert it. This is really a magic moment, when the true administrator involves the population in the task of transforming a problem into a solution.

That is why the major responsibility of a city planner is to propose scenes that the majority may accept as desirable, thus, helping to set it up.

And what is the scene for a human city? It is that where people belong. Where people may recognize their roots. Where their voice has an echo. Where their opinion is heard.

For this to happen, a correct integration between the macro and micro scales of a city is presupposed, no matter what size. For this to happen, wider integration of urban function, of all urban function, and of social classes are presupposed. Many cities have lowered in quality by forcing a separation of their functions, in a mistaken reading of the Athens Charter. The Athens Charter only defines the urban functions, yet it never recommended that they should be paralyzed.

Human life is not paralyzed.

Humanistyczny wymiar współczesnych miast

Streszczenie

Za punkt wyjściowy rozważań nad współczesnymi miastami Autor przyjmuje historię emigracji polskiej pierwszej połowy XX-wieku, która jest zarazem jego własną historią. Walka o byt w nowych warunkach rodziła szczególną więź i poczucie solidarności, które były poddawane bezwzględnej weryfikacji w sytuacji izolacji w nowych warunkach. Jednak walka ta zakończyła się sukcesem: obecnie Polonia w stanie Parana liczy blisko milion obywateli, którzy są przekonani, że ich marzenie o „szczęśliwym kraju" ziściło się.

W przestrzeni urbanistycznej – to marzenie o mieście, w którym możliwe jest szczęśliwe życie. Mieście, które wkomponowane w środowisko jest społecznie akceptowane. I takie przesłanie kierowało całym życiem zawodowym Autora.

Autor przestrzega zarówno przed zbytnim upraszczaniem problemów współczesnych miast, jak i przed nadmiernym ich komplikowaniem. Nie można też wybiegać w trudną do przewidzenia przyszłość; konieczne jest podejmowanie decyzji na miarę dnia dzisiejszego. Nie zwalnia to nas jednak z obowiązku podążania za określoną wizją miasta. Drogowskazem powinny być: społeczna użyteczność miasta i jego koegzystencja z otaczającą przyrodą, równowaga pomiędzy potrzebami a możliwościami oraz współodpowiedzialność mieszkańców miasta za jego rozwój.

Podkreślając znaczenie komunikacji, rozumianej jako środek integracji zarówno w skali makro, jak i mikro, Autor konkluduje, że postępowanie w myśl Konwencji Ateńskiej, która tylko definiuje funkcje miasta, nie narzucając ich wzajemnego przenikania się, nie może prowadzić do jego sparaliżowania.

Before the ceremony – the Wawel Castle galleries; Governor Jaime Lerner with Prof. Kazimierz J. Flaga, the Rector, and Prof. Ryszard H. Kozłowski, Vice-Rector

Przed uroczystością – krużganki na Wawelu – Gubernator Jaime Lerner w towarzystwie JM Rektora, prof. Kazimierza J. Flagi i Prorektora, prof. Ryszarda H. Kozłowskiego

Prof. Kazimierz J. Flaga, the Rector, opens the ceremony

JM Rektor, prof. Kazimierz J. Flaga otwiera uroczystość

Jaime Lerner, doctor honoris causa, receives congratulations from Ryszard Masłowski, PhD, Voivode of the Małopolska province

Składanie gratulacji doktorowi honoris causa Jaime Lernerowi przez Wojewodę małopolskiego, dr. inż. Ryszarda Masłowskiego

Governor Jaime Lerner's lecture during the ceremony of conferrment of the title of doctor honoris causa

Wykład Gubernatora Jaime Lernera podczas uroczystości nadania tytułu doktora honoris causa

Jaime Lerner, doctor honoris causa, and Prof. Kazimierz J. Flaga, the Rector, on the Wawel Castle galleries

Doktor honoris causa Jaime Lerner i JM Rektor, prof. Kazimierz J. Flaga na krużgankach Wawelu

*The Wawel courtyard (from left): Prof. Marcin Chrzanowski, Vice-Rector,
Fany Lerner – spouse of the doctor honoris causa, Governor Jaime Lerner*

*Na dziedzińcu wawelskim – od lewej: Prorektor, prof. Marcin Chrzanowski,
Fany Lerner – małżonka doktora honoris causa, Gubernator Jaime Lerner*

Professor

Jan Hult

Quod felix faustum fortunatumque sit

Nos

Rector et Senatus

POLYTECHNICAE THADDAEO-KOSCIUSZKIANAE CRACOVIENSIS

et

Consilium Facultatis Ingeniariae Terrestris

in virum doctissimum et clarissimum

IOANNEM HULT

Sueticae Academiae Regiae Scientiarum et Academiae Artium Scientiarumque Regiae Gothoburgensis socium, Universitatis Glasguensis doctorem honoris causa creatum, Unionis Mechanicae Theoreticae et Applicatae Secretarium Generalem, Comitati Executivi Consilii Internationalis Societatum Scientificarum (ICSU) socium, Collegii Scientifici Internationalis Centri Mechanicae (CISM) Utinensis socium, scholae superioris Gothoburgensis, quae Chalmers Tekniska Högskola vocatur, professorem ordinarium, qua in schola nobilissima multos annos magno cum mentis acumine operam dedit mechanicae materiarum et constructionum promovendae, praecipue autem de mechanica fissurae quaesivit, mechanicae continualis lacerationum – novae disciplinae ingeniariae inventorem, monographiarum et enchiridiorum toto orbe terrarum publicatorum auctorem, sed etiam virum humanissimum, omnibus hominibus amicissimum, historiae inventorum technicorum investigatorem egregium, ephemeridis Sueticae, quae "Polhem" vocatur et historiae technicae tractandae destinatur, editorem diligentissimum, Instituti Historiae Technicae in schola illa nobilissima, quae Chalmers Tekniska Högskola vocatur, conditorem, magistrum academicum optimum, quo duce multi iuvenes doctoris nomen ac dignitatem appetentes dissertationes doctas in notis centris academicis scripserunt, virum, qui interfuit plurimis conventibus, in quos qui a Polonis invitati venerunt, quaestiones quasdam scientificas tractaverunt vel studiorum ac laborum suorum fructus inter se communicaverunt, Polonorum scientiis provehendis deditorum amicum benevolentissimum, qui eo adiuvante nomen suum apud alios populos clarum fecerunt

doctoris honoris causa

nomen et dignitatem, iura et privilegia contulimus atque in eius rei fidem hoc diploma Polytechnicae Cracoviensis sigillis sanciendum curavimus.

Dabamus Cracoviae, die nona mensis Iunii anno millesimo nongentesimo nonagesimo nono

Michael ŻYCZKOWSKI
scientiarum technicarum doctor
mechanicae professor
PROMOTOR

Casimirus FURTAK
scientiarum technicarum doctor
DECANUS

Casimirus FLAGA
scientiarum technicarum doctor
aedificationis professor
RECTOR

Professor

Jan Hult

Professor Jan Hult, born in 1927, is a world known specialist in the mechanics of deformable bodies, especially in the field of the theory of creep, mechanics of cracking and failure of materials and structures.

Professor Hult graduated in applied physics from the Stockholm Polytechnic in 1950, and then under the supervision of Prof. Odqvist he received the degree of Doctor of Philosophy in 1953, and the Doctor of Science in 1958. In the meantime he studied as a research student at the Massachusetts Institute of Technology, where under the supervision of Prof. Mc Cllintock he received U.S. doctor's degree. In the years 1958-1961 he held the post of associate professor at the Stockholm Polytechnic, and since 1961 till his retirement in 1992 he was professor at the Chalmers Polytechnic in Göteborg. He still holds the post of a professor of the history of technology in Göteborg.

The list of Professor Hult's publications includes 161 scientific papers and numerous historical essays, polemical and reporting works. Special attention should be drawn to monographs and manuals. His first monograph, written together with F. K. G. Odqvist, *Kriechfestigkeit metallischer Werkstoffe*, Springer 1962, was at the time a landmark and unquestionable contribution to the development of the theory of creep in materials and structures. His next monograph, *Creep in Engineering Structures*, Balisdell 1966, presented further development of structural creep. Its world wide importance was acknowledged by translation into the Japanese language and published in 1973.

Professor Hult has supervised sixteen doctoral studies mainly in the theory of creep, but also in contact stress, thermal stresses, vibrations, rocks mechanics, biomechanics and composite structures.

Professor Hult has had close contacts with Polish scientists in mechanical engineering since 1960 and with the Cracow University of Technology (CUT) research staff especially, inviting them to participate in post-graduate research courses and conferences. He has also been deeply involved in international scientific committees of two symposia organised by the CUT: Euromech 251 in 1989, IUTAM in 1990. He has also participated in several Polish conferences on the Mechanics of Solid Bodies as well as summer schools in Jabłonna and Janowice.

Professor Hult's scientific activities have been recognised many times. The highest distinction he received was in 1976 when he was nominated member of the Swedish Royal Academy of Sciences, and in the same year – an international distinction – when he was nominated the Secretary General of the International Union of Theoretical and Applied Mechanics (IUTAM). He held this function for two terms of office till 1984. He was conferred the title of doctor honoris causa by the Strathclyde University, Glasgow. He is a member of numerous editorial boards of scientific periodicals.

Profesor Jan Hult

Profesor Jan Hult urodził się w 1927 roku. Jest nadal czynnym światowej sławy specjalistą w dziedzinie mechaniki ciał odkształcalnych, a w szczególności w zakresie teorii pełzania, mechaniki pękania i kontynualnej mechaniki uszkodzeń.

Ukończył fizykę techniczną na Politechnice Sztokholmskiej w roku 1950, gdzie następnie pod kierunkiem prof. Odqvista uzyskał doktorat pierwszego stopnia w roku 1953, a doktorat drugiego stopnia (habilitacja) w 1958 roku. W międzyczasie przebywał na stażu w Massachusetts Institute of Technology, gdzie również uzyskał stopień doktora nauk technicznych pod kierunkiem prof. Mc Clintocka. W latach 1958–1961 pracował jako docent na Politechnice Sztokholmskiej, a od roku 1961 – aż do przejścia na emeryturę w roku 1992 – jako profesor na Politechnice im. Chalmersa w Göteborgu. Po przejściu na emeryturę pełni funkcję profesora historii techniki w Göteborgu.

Wykaz publikacji prof. Hulta obejmuje 161 prac naukowych oraz bardzo liczne pozycje historyczne, polemiczne lub sprawozdawcze. Na szczególne podkreślenie zasługują monografie i podręczniki. Już pierwsza monografia, wspólna z Odqvistem, *Kriechfestigkeit metallischer Werkstoffe*, Springer 1962, była w tamtych latach pozycją przełomową i przyczyniła się w zasadniczy sposób do rozwoju teorii pełzania materiałów i konstrukcji. Druga monografia, własna, *Creep in Engineering Structures*, Balisdell 1966, rozwinęła problemy pełzania konstrukcji, a miarą światowego uznania dla tej pozycji może być przetłumaczenie jej na język japoński i opublikowanie w 1973 roku.

Profesor Hult był promotorem 16 ukończonych przewodów doktorskich, głównie z zakresu teorii pełzania, ale również z naprężeń stykowych, naprężeń cieplnych, drgań, mechaniki skał, biomechaniki i konstrukcji kompozytowych.

Od roku 1960 profesor Hult utrzymuje bliskie kontakty ze specjalistami z zakresu mechaniki w Polsce, a zwłaszcza z pracownikami Politechniki Krakowskiej, zapraszając ich do odbywania staży naukowych i udziału w konferencjach. Z drugiej strony należy podkreślić czynny udział Profesora Hulta w międzynarodowych komitetach naukowych dwóch sympozjów organizowanych przez Politechnikę Krakowską: Euromech w 1989, IUTAM w 1990 roku. Uczestniczył również w kilku Polskich Konferencjach Mechaniki Ciała Stałego oraz konferencjach szkoleniowych w Jabłonnej i Janowicach.

Za swą działalność naukową Profesor Jan Hult był wielokrotnie wyróżniany. Największe wyróżnienie szwedzkie spotkało go w roku 1976, gdy został wybrany na członka Królewskiej Szwedzkiej Akademii Nauk, a międzynarodowe, w tym samym roku, kiedy został Sekretarzem Generalnym Międzynarodowej Unii Mechaniki Teoretycznej i Stosowanej (IUTAM). Funkcję tę pełnił przez dwie kadencje do 1984 roku. University of Strathclyde w Glasgow wyróżnił go tytułem doktora honoris causa. Jest członkiem rad redakcyjnych wielu czasopism naukowych o uznanej randze.

Jan Hult

The vulnerable technological society

When I recall my own student days at the Royal Institute of Technology in Stockholm in the late 1940's, I cannot remember any single occasion when a recent technological disaster was mentioned, let alone analysed. In retrospect, it seems as if such failures were considered a shame to the profession and as such of no interest to us future engineers. Indeed, the late 1940's were an era of unlimited technological optimism.

Here a comparison with medical schools suggests itself. They focus not primarily on healthy people but on sick ones. Imagine a medical doctor who had never been exposed to a sick patient during her or his student days. Who would dare to consult such a doctor? No, the most important object of study in a medical education is, of course, the sick patient.

In the same sense I shall argue here that exposure to technological failures is a most valuable ingredient in any engineering education.

I would like to share with you my own experience from two dramatic technological failures, which both occurred in the year 1980. The first one relates to a large bridge in Sweden, the other to an offshore oil platform outside Norway.

The Almö bridge

In June 1960 a chain of three bridges had been built to connect the large island of Tjörn on Sweden's west coast with the mainland. The largest of these bridges, with a span of 278 meters, became known as the Tjörn bridge or the Almö bridge. It was widely admired for its elegant design – but is was a dangerous design.

On the night of January 18, 1980, MS *Star Clipper*, a 27 000 ton freight ship, was about to pass under the bridge. There were ice-floes in the passage, which forced the ship sideways, so that a crane on board hit the bridge. Its main arch consisted of two parallel thin-walled steel tubes with a diameter of nearly four meters and wall thickness varying between 14 and 22 millimeters. Hence the ratio of wall thickness to diameter was about one to two hundred.

As many of you know, a thin-walled cylindrical tube can carry a large axial compressive load as long as there are no defects in the form of buckles. Such buckles may, however, easily be produced by a slight transverse load, and then the tube loses much of its axial strength.

This is exactly what happened on that fateful night in January 1980. When the crane hit the bridge, the arch lost almost all its carrying capacity, and the entire bridge fell down. The time was 1:30 in the morning; it was pitch-dark, and the drivers of seven cars did not observe that the bridge deck had disappeared. Eight people fell 45 meters to an instantaneous death.

One week after this catastrophe, 200 mechanical engineering students at Chalmers Tekniska Högskola came to begin the introductory course in applied mechanics. The theme of my lecture was obvious. The students had all seen the pictures on TV and they had read the newspaper reports. I could almost feel their attention in the air; there was absolutely no talking in the auditorium.

Later on, at the end of the term, I found the examination results in this course to be well above normal. My immediate conclusion was that these students had all come to realize, in a dramatic way, that applied mechanics is not only a matter of certain equations and formulas on a blackboard, but might also be a matter of life or death to fellow beings.

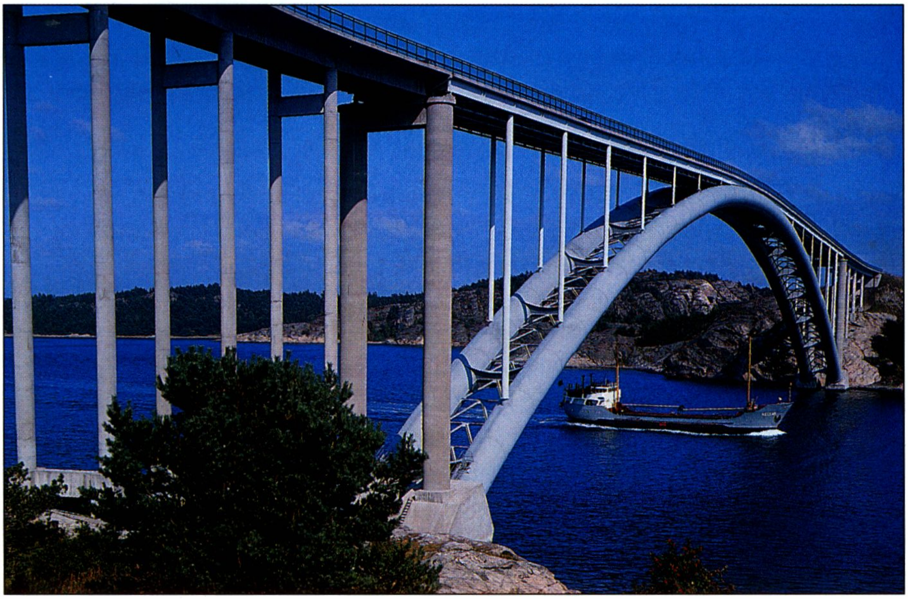


Fig. 1. The Almö Bridge before the collapse
(By courtesy of Lindenhag AB, Tollered)

Let me now depart from the applied mechanics aspects of the failure of the Almö bridge, and turn, instead, to the long time consequences of the catastrophe to the inhabitants on the island of Tjörn, and ask how vulnerable was that local society.

In order to do so, I shall first go back in time to the late 1950s, before the bridge was built. For many years, the population of the island had been decreasing by some 50 people annually, and as a consequence the local services had diminished as well. But the bridge changed all that. Already one year after its completion in 1960, the current had been reversed. Twenty years later the population of Tjörn was 40 percent above the previous bottom line.

The 1960s saw large scale industrial construction of small private homes begin in Sweden. One such project took form on Tjörn, at Myggenäs near the bridge abutment. It came to be populated mostly by young families, who had moved there from the mainland to live in an unspoilt environment, away from the hustle and bustle on the mainland. Many of them had jobs in Göteborg or its suburbs, and – because of the bridge – they could continue to work just as before. Commuting by car took less than 40 minutes.

The family structure at Myggenäs was very different from that at Åstol, a small fishing village just outside the southwestern tip of the island. Its population had its roots there since generations, and the age distribution was a more normal one than that at Myggenäs. When fishing decreased, so that it could not support them all, Åstol people had also sought and found jobs on the mainland, notably in Göteborg.

Automobile traffic across the bridge increased steadily, from 2 600 daily passages in the first year to 13 000 in the last year before the collapse, that is five times as many. The population of the island was then just over 11 000. A top figure during the last summer before the collapse was over 20 000 passages in one day. The bridge was indeed an umbilical cord for the steadily growing population of the island of Tjörn.

The collapse brought about an immediate and complete change of the daily lives for all those inhabitants of the island, who depended upon the bridge to get to work. Everybody also understood that this was going to last a long time.

Two young sociology students at the University of Göteborg, Gudrun Brännberg and Katrin Karlsson, immediately saw a chance here to make an interesting and also unique field study. They wanted to find answers to questions such as these: What kinds of problems arose on the island, when the umbilical cord was cut? Would the families be at all able to adjust to the new situation? And, in a longer perspective: Just how vulnerable is a modern technological society?

The general situation on the island right after the catastrophe, was that almost everything worked just as before. Water supply, electric power and telephone connections were all unaffected by the event, as were also postal and bank services, and also local community services. Some local grocery stores, which had been closed for several years, due to competition from supermarkets on the mainland, eventually came back into existence, a very welcome side effect of the tragedy. The only real problem was that one could not easily get to one's workplace on the mainland. But that problem was certainly real enough.

The severity in the situation was immediately clear to all. Already in the morning after the collapse two fishermen provided their craft as a provisional means of transport to the mainland. Later on more passenger boats were chartered.

But cars to the mainland now had to make a detour via the nearby island of Orust and then proceed by way of the city of Uddevalla, making the travel distance to Göteborg about 100 kilometers longer than before.

There was also an alternative route to the mainland, via Orust and the old car ferry between Svanesund and Kolhättan, but the capacity of this ferry was limited.

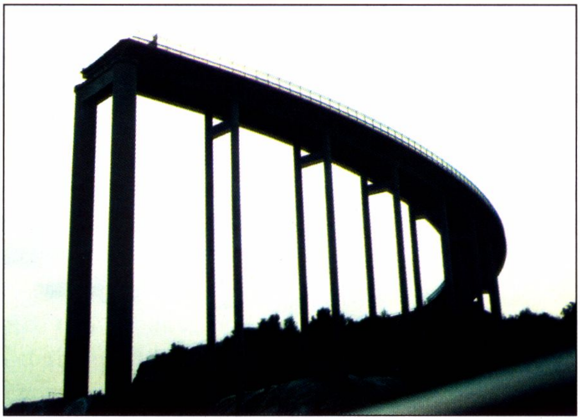


Fig. 2. The Almö Bridge after the collapse
(By courtesy of Chalmers University of Technology Göteborg)

An additional car ferry directly between Almö and the mainland was therefore the next step in handling the situation. It became operational after seven weeks. But the capacity of this ferry was only 4 000 car passages a day, less than a third of the 13 000 car passages that had been recorded on the bridge. A drastic adaptation of habits had to be made.

People had to wait in line, sometimes for hours, to get on board, both in the morning and on return in the afternoon. This, of course, was very demanding, in particular in the winter months, which may be very cold in Sweden.

Already the day after the catastrophe, the planning of a new bridge had started. Contractors were invited to submit proposals, fulfilling the requirement that two motor traffic lanes should be opened for passenger cars within 23 months after the catastrophe. This condition then came to be met six weeks before the stated deadline. As time went by it became more and more obvious that the social problems on the island began to be insurmountable.

The two sociologists wanted to find out how people in a modern technological society react to such a drastic change of living conditions. The study was made in the form of interviews with a number of families, from two local communities: the mentioned "newcomer project" at Myggenäs and the old fishing village at Åstol. The interviews were restricted only to those who had previously been using the bridge to commute by car to work on the mainland. That made possible an interesting comparison between the two communities.

As could be expexted, the problems were felt to be much more severe at Myggenäs that at Åstol. What was largely missing in Myggenäs was a stable social network, which could have eased the burdens. The inhabitants at Myggenäs had most of their friends and relations on the mainland, notably in Göteborg. They were now very much left to themselves.

At Åstol, however, people were used, since generations, to cope with all sorts of problems, which form a main part of fisherman's life. Almost everyone had friends and near relations in the village; they formed a tightly knitted network. By and large they withstood the difficulties very well.

The conclusion is obvious. Social networks are extremely important in demanding situations of this kind, and they cannot be supplanted by any technological arrangements, however sophisticated.

Alexander L. Kielland

On the 27th of March 1980, ten weeks after the fall of the Almö bridge, another, and much larger, catastrophe occurred in the North Sea.

The Norwegian oil platform, *Alexander L. Kielland*, a floating steel monster, weighing 10 000 tons, became a wreck. The reason was eventually discovered to be fatigue failure.

Alexander L. Kielland, named after a Norwegian author, was originally built to be used for prospecting, that is to search for oil wells in the North Sea. A derrick standing on its deck made it possible to drill for oil and so to locate possible wells by moving the platform from place to place.

It had later been converted to a housing platform for oil workers in the Edda oil field in the North Sea, a so-called *floatel*, which was anchored adjoining a production platform. At the end of a workday, the oilmen were transferred by helicopter to *Alexander L. Kielland*, with its living quarters and a restaurant, a cinema and other facilities.

On that fateful evening in March, 212 oil workers were relaxing in this temporary home. 123 of them came to lose their lives in a disaster, which developed without any prior warning.

The platform floated on five huge pontoons, 22 meters in diameter, each forming the base of a sturdy leg, arranged in a regular pentagon pattern. The legs were interconnected by braces, welded to the legs so as to produce a stiff structure.

All of a sudden, on that windy evening, one of the five legs broke off, and the platform began to tilt. The housing units on the platform deck had made the platform less stable. The wind direction was such as to increase the tilt angle, causing the rig finally to turn over. The four remaining pontoons kept the wreck floating upside down.

The ensuing rescue operation, the largest in the history of the offshore oil industry, managed to save only 89 people. A national trauma had fallen upon Norway.

When further search for survivors had been abandoned, the wreck was towed to Stavanger Bay in Norway. The next step was then to turn the rig upright again, so that the bodies remaining inside could be recovered, and the reason for the collapse could be determined. This operation presented enormous difficulties. It took three years and cost 34 million dollars, to upright *Alexander L. Kielland*. But only six bodies were found on board. The others missing had disappeared in the North Sea.

After all technical inspections had been concluded, the rig was towed back to the North Sea to be blown up and sank at a depth of 700 meters.

The investigation of the wreck had shown the origin of the catastrophe to be a 7 cm long crack in a defect weld. This crack had been present already before the platform was launched at the ship yard. Presence of paint on the two crack faces proved this to be the case.

Repeated impact loads from the North Sea waves had then caused this initial crack to grow by a fraction of a millimeter for each wave, until finally the carrying capacity of the brace had been surpassed.

The collapse of the *Alexander L. Kielland* was like a textbook case of fatigue failure. Such failures can often be foreseen well in advance for bridges and similar structures, as also for airplanes, which are regularly inspected. It had been enormously difficult – and costly – to make similar inspections of the *Alexander L. Kielland* with its kilometers of welded joints, all located deeply under water.

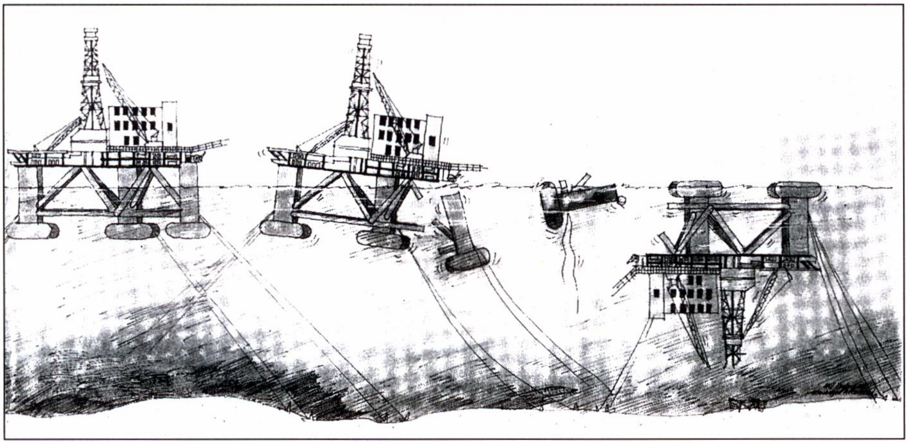


Fig. 3. The *Alexander L. Kielland* disaster
(By courtesy of Stavanger Aftenblad, Stavanger)

We do, in fact, have an illustration here of an engineering structure, of such enormous size and such complexity, that no absolute guarantee could have been given about its long term safety. *Alexander L. Kielland* will be a memento to engineers for a long time to come. Maybe we have reached an upper limit here for the size of large scale steel structures.

The concept of redundancy is of basic importance in the design and analysis of engineering structures, be they bridges, oil platforms, air planes or, for that matter, electric power grids or communication systems. A local defect in a redundant structure, be it a buckle or a small crack, does not cause the entire structure to collapse on overloading. The visible result will normally only be a deformation increase, which then serves as a warning, that something unwanted has happened to the structure, and that safety measures have to be undertaken.

Such advance warnings were not given by the Almö bridge or the *Alexander L. Kielland*. The degree of redundancy was insufficient. People on the bridge or on the platform were doomed. In both these cases minor defects ultimately led to the total collapse of a large structure.

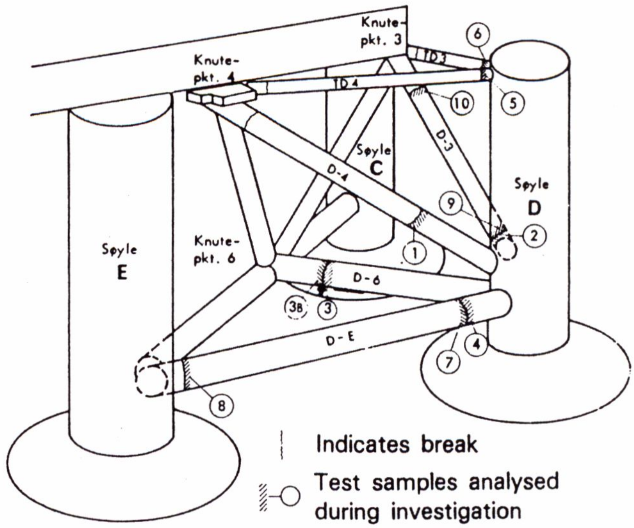


Fig. 4. The substructure of *Alexander L. Kielland*
(By courtesy of Stavanger Aftenblad, Stavanger)

The two dramatic failures bring me back to my starting point. My message is simply that engineering students may learn a lot from careful analyses of failure in engineering structures. Or, briefly stated:

Experience comes from bad design.
Good design comes from experience.

For Chalmers Tekniska Högskola itself, these two events in the winter of 1980 also triggered a change in our education policy, which was implemented a few years later. For all students a new topic was added to our general curriculum, under the general heading *Technology and Society*. The title, I think, speaks for itself. We want our students to realize that in their future profession, be it in industry or in some other sector of society, they will constantly be involved in circumstances which affect other people's well-being. In most cases they would not know who these people are, but their responsibility is of course no less because of that. Technology also has a humanistic aspect, and this is what we want all our students to appreciate.

Zagrożenia na jakie narażone jest społeczeństwo technologiczne

Streszczenie

Autor porusza temat wrażliwości społeczeństwa uzależnionego od osiągnięć współczesnej techniki na katastrofy obiektów inżynierskich, a także znaczenia analizy tych katastrof dla właściwej edukacji technicznej. Jako przykłady omawia dwie katastrofy, które zdarzyły się w 1980 roku na terenie Skandynawii: załamanie się mostu łączącego zachodnie wybrzeże Szwecji z wyspą Tjörn i katastrofę norweskiej platformy wiertniczej na Morzu Północnym.

W pierwszym przypadku powodem katastrofy było zjawisko wyboczenia głównych elementów nośnych mostu (stalowe rury cienkościenne o średnicy około 4 m) spowodowane uderzeniem przepływającego statku. Bezpośrednim skutkiem była śmierć ośmiu osób, pasażerów siedmiu aut znajdujących się w tym czasie na moście. Ten dramatyczny wypadek wyzwolił pouczającą reakcję lokalnej społeczności. Budowa tego mostu na początku lat sześćdziesiątych spowodowała znaczne ożywienie zarówno w odniesieniu do miejscowej ludności wyspy, jak i mieszkańców nowo powstałych osiedli mieszkaniowych. Katastrofa pokazała, że rodzime społeczeństwo, które na przestrzeni lat zbudowało silne więzi społeczne, łatwiej zaadaptowało się do nowych warunków niż ludność napływowa. Przeprowadzone badania socjologiczne potwierdziły ważkość takich więzi w obliczu sytuacji, gdy zawodzi technika.

Przyczyną drugiej katastrofy było pęknięcie zmęczeniowe połączenia spawanego głównego elementu nośnego konstrukcji platformy. Zbyt niski stopień statycznej niewyznaczalności całej konstrukcji przyczynił się do tego, że defekt jednego tylko, ale ważnego, elementu konstrukcyjnego spowodował utratę stateczności całej platformy. Bezpośrednie skutki katastrofy były tu jeszcze tragiczniejsze: życie straciły 123 osoby, a koszty akcji ratunkowej i wyjaśniania przyczyn katastrofy wyniosły 34 miliony dolarów. Całe to zajście postawiło przed konstruktorami potrzebę odpowiedzi na pytanie o granice skali wznoszonych obiektów, których wielkość nie pozwala ani na precyzyjną kontrolę jakości ich wytwarzania, ani na bieżący monitoring ich stanu technicznego.

W konkluzji, z przytoczonych przykładów Autor wysnuwa wnioski dotyczące znaczenia związku istniejącego pomiędzy stopniem skomplikowania obiektów technologicznych, ich bezpieczeństwem i zagrożeniami jakie może stwarzać naruszenie ich integralności. Dla przyszłych inżynierów kluczowym przesłaniem jest sentencja:

Doświadczenie wynika z analizy złych projektów.
Dobre projekty są wynikiem zdobytych doświadczeń.

Rezultatem przemyśleń Autora było – w kilka lat po opisanych katastrofach – włączenie do programu nauczania wszystkich studentów Politechniki w Göteborgu (Chalmers Tekniska Högskola), macierzystej uczelni Autora, przedmiotu **Technika a społeczeństwo**, omawiającego humanistyczne aspekty inżynierii.

Prof. Oscar H.G. Mahrenholtz and Prof. Jan Hult during presentation
Prof. Oscar H.G. Mahrenholtz i prof. Jan Hult w czasie prezentacji

Prof. Jan Hult is conferred the title of doctor honoris causa by Prof. Kazimierz J. Flaga, the Rector (in the background from left to right: Prof. Stefan Piechnik, Prof. David R. Hayhurst and Ryszard Masłowski, PhD, Voivode of the Małopolska province)

Nadanie tytułu doktora honoris causa prof. Janowi Hultowi przez JM Rektora, prof. Kazimierza J. Flagę (w tle od lewej: prof. Stefan Piechnik, prof. David R. Hayhurst i Wojewoda małopolski, dr inż. Ryszard Masłowski)

Oscar H.G. Mahrenholtz and Jan Hult, doctors honoris causa, in conversation

Rozmowa doktorów honoris causa Oscara H.G. Mahrenholtza i Jna Hulta

Prof. Jan Hult during laudation ceremony

Prof. Jan Hult w czasie laudacji

Prof. Jan Hult receives congratulations
from Prof. Marcin Chrzanowski, Vice-Rector

Składanie gratulacji prof. Janowi Hultowi
przez Prorektora, prof. Marcina Chrzanowskiego

Prof. Jan Hult with the commemorative volume

Prof. Jan Hult z Księgą Pamiątkową

Professor

Oskar H. G. Mahrenholtz

Quod felix faustum fortunatumque sit

Nos

Rector et Senatus

POLYTECHNICAE THADDAEO-KOSCIUSZKIANAE CRACOVIENSIS

et

Consilium Facultatis Mechanicae

in virum doctissimum et clarissimum

ANSGARIUM MAHRENHOLTZ

mechanicae applicatae peritissimum, praecipue autem in theoria plasticitatis, dynamica machinarum, aëroelasticitate, dynamica liquorum, mechanica glaciei et methodis numericis in mechanica adhibitis magno cum mentis acumine versatum, magistrum academicum, qui quinquaginta doctores educavit, auctorem plus quam ducentorum quadraginta librorum dissertationumque, olim decanum illustrissimum Facultatis Mechanicae Universitatis Technicae Hannoverensis, huius nobilissimae scholae superioris Rectorem Magnificum, olim moderatorem Cathedrae Artium Technicarum Maritimarum Universitatis Technicae Hamburgo-Harburgensis, olim praesidentem Societati Mathematicae et Machanicae Applicatae (GAMM) et nunc praesidentem Consilio Europaeo Methodorum Mechanicae Applicatae (ECCOMAS), socium Concilii Scientifici Utinensis CISM, Academiae Scientiarum Polonae socium honoris causa creatum, a Germanis ad Consilium Scientificum Foederis, quod NATO vocatur, delegatum, virum ornatum Nummo Honorifico Societatis Ingeniariorum Germanorum, Insigni Primae Classis Rei Publicae Foederatae Germaniae et Nummo Nicolao-Copernicano ab Academia Scientiarum Polona decreto, Universitatis Saravipontanae et Universitatis Rostokiensis doctorem honoris causa creatum, Polonorum amicum firmissimum ac benevolentissimum, qui quae illi in scientiis promovendis sunt assecuti, apud alios populos divulgavit atque propagavit

doctoris honoris causa

nomen et dignitatem, iura et privilegia contulimus atque in eius rei fidem hoc diploma Polytechnicae Cracoviensis sigillis sanciendum curavimus.

Dabamus Cracoviae, die nona mensis Iunii anno millesimo nongentesimo nonagesimo nono

Iosephus NIZIOŁ
scientiarum technicarum doctor
mechanicae professor
PROMOTOR

Georgius CYKLIS
scientiarum technicarum doctor
machinarum aedificandarum professor
DECANUS

Casimirus FLAGA
scientiarum technicarum doctor
aedificationis professor
RECTOR

Professor

Oskar H. G. Mahrenholtz

Professor Oskar H. G. Mahrenholtz, PhD, DSc, Eng., born in Ostrhauderfehn, North-West Germany, in 1932, graduated from the Max-Planck Institute in 1958 with the degree of certified engineer. In the same year he began his academic career with Hannover University. In 1962 he obtained the degree of Doctor of Philosophy in the field of biomechanics and in 1966, on the basis of dissertation *Computer and analogue methods in mechanical engineering* he was conferred the Doctor of Science. In 1963 he became associate professor and in 1966 full professor. In the years 1966-1982 he was the Director of the Institute of Mechanics, Hannover University. In the period of 1968-1969 he was the Dean of the Faculty of Mechanical Engineering, and the Rector of the University in 1974-1975.

In 1982 he was nominated the Head of Chair of Marine Engineering at the Hamburg-Harburg University of Technology where he worked until his formal retirement, however, still continuing to be extremely involved in both research and organization activities.

Professor Oskar H. G. Mahrenholtz is an outstanding scientist in applied mechanics. His scientific interests are very extensive and include the theory of plasticity, machine dynamics, aero-elasticity, dynamics of fluids, mechanics of ice and numerical methods in mechanical engineering.

He is an author of over 240 scientific publications, including four monographs translated into English. His works are on a high theoretical level but most of them are oriented towards particular industrial applications.

Professor Mahrenholtz has supervised fifty doctors, seven of who hold the positions of professors, and many hold executive posts in the main branches of industry.

He has held many prestigious functions in scientific societies. He has been a member of the Polish Academy of Sciences since 1991, he was conferred the Nicolaus Copernicus Medal in 1992, in the years 1989-1992 he was the President of GAMM and he has been a delegate of Germany to the NATO Scientific Committee since 1989, the President of ECCOMAS since 1997.

Professor Oskar H. G. Mahrenholtz is a Doctor Honoris Causa of universities in Saarbrücken, Rostock and Hannover.

Professor Mahrenholtz's co-operation with Polish scientists covers over 30 years. These contacts include the Institute of Fundamental Technological

Research (IPPT), the Polish Academy of Sciences, Universities of Technology in Kraków, Warszawa, Poznań, Białystok.

It was his initiative in 1979 to organise every three years, Polish-German scientific workshops, on mechanics of continuous media, machine dynamics, theory of vibrations, numerical methods.

Professor Oskar H. G. Mahrenholtz is a great friend of the Polish people and an invaluable ambassador of the Polish science.

Oscar H. G. Mahrenholtz

Profesor Oskar H. G. Mahrenholtz urodził się w 1931 roku w Ostrhauderfehn w północno-zachodnich Niemczech. Studia wyższe ukończył w Instytucie Maxa-Plancka uzyskując w roku 1958 stopień dyplomowanego inżyniera. W tym samym roku rozpoczął pracę w katedrze profesora Edwarda Pestela na Uniwersytecie w Hanowerze. W roku 1962 otrzymał stopień naukowy doktora nauk technicznych z biomechaniki, a w roku 1966, na podstawie rozprawy *Metody komputerowe i analogowe w inżynierii mechanicznej*, stopień doktora habilitowanego. W roku 1963 został profesorem nadzwyczajnym, a w roku 1966 profesorem zwyczajnym. W latach 1966-1982 pełnił funkcję dyrektora Instytutu Mechaniki Uniwersytetu w Hanowerze. W latach 1968-1969 był dziekanem Wydziału Mechanicznego, a w latach 1974-1975 rektorem tej uczelni.

W roku 1982 objął Katedrę Technik Morskich na Uniwersytecie Technicznym Hamburg-Harburg, gdzie pracował do 1997 roku, kiedy to formalnie przeszedł na emeryturę, pozostając nadal niezwykle aktywnym naukowo i organizacyjnie.

Profesor Oskar H. G. Mahrenholtz należy do wybitnych uczonych z zakresu mechaniki stosowanej. Jego zainteresowania naukowe są bardzo rozległe i obejmują: teorię plastyczności, dynamikę maszyn, aerosprężystość, dynamikę płynów, mechanikę lodu oraz metody numeryczne w mechanice.

W swoim dorobku ma ponad 240 publikacji naukowych, w tym 4 monografie tłumaczone na język angielski. Jego prace cechuje wysoki poziom teoretyczny, ale większość z nich ukierunkowana była na konkretne zastosowania w przemyśle.

Profesor Mahrenholtz wypromował 50 doktorów, z których 7 otrzymało tytuły profesorów, a wielu zajmuje kierownicze stanowiska w czołowych gałęziach przemysłu.

Pełnił wiele prestiżowych funkcji w towarzystwach naukowych. Jest członkiem zagranicznym Polskiej Akademii Nauk od 1991 roku (nagrodzony Medalem im. Mikołaja Kopernika w roku 1992), był Prezydentem GAMM (1989-1992), jest delegatem Niemiec do Komitetu Naukowego NATO od 1989 roku i Prezydentem ECCOMAS od 1997 roku.

Profesor Oskar H. G. Mahrenholtz jest doktorem honoris causa uniwersytetów w Saarbrücken, Rostocku i Hanowerze.

Współpraca naukowa Profesora z polskimi uczonymi trwa już 30 lat, z takich między innymi ośrodków, jak: Instytut Podstawowych Problemów Techniki PAN, Politechniki – Krakowska, Warszawska, Poznańska i Białostocka.

Z Jego inicjatywy organizowane są od roku 1979 co 3 lata tygodniowe polsko-niemieckie warsztaty naukowe, dotyczące mechaniki ośrodków ciągłych, dynamiki maszyn, teorii drgań, metod numerycznych.

Profesor Oskar H. G. Mahrenholtz jest wielkim przyjacielem Polaków i wspaniałym ambasadorem nauki polskiej.

Oskar Hajo Gerhard Mahrenholtz

Fluid structure interaction-flow induced vibrations

First of all, I should like to thank the Cracow University of Technology for bestowing on me the award of a doctor honoris causa. I should also like to thank the rector magnificus, Professor Flaga, the prorector, Professor Chrzanowski, and my laudator, Professor Nizioł for arranging the degree ceremony to be held in the splendid and historic Aula of the Collegium Novum.

Introductory remarks

As mentioned by Professor Nizioł one of my areas of interest is with aeroelastic behaviour of structures, that means of bluff bodies. This topic originated from the investigation of heavy wind induced vibrations of flood light masts of the Hannover soccer stadium while these masts were under construction. These vibrations did occur totally unexpected – to be more precise: unexpected by the construction engineers. These engineers were experienced in statics and in strength of materials rather than in aeroelastic vibrations.

This was in the mid sixties, and from then on I worked on that subject, and built up a group engaged in aeroelasticity. We were operating for more than 15 years, until I moved Hannover for Hamburg. Even in Hamburg at the Technical University Hamburg – Harburg the aeroelastic experience could be transferred to loading of marine structures by gravity waves.

To the facilities of the Institute of Mechanics of the Technical University Hannover (now University) belonged a wind tunnel of Göttingen type. The wind tunnel was then modernized: thyristor power supply, electronic equipment, online computer, controllable force generator. Thereafter, a new boundary layer wind tunnel was built for special investigations such as the determination of the flow field around moving cars and sets of train coaches.

I mention this because it might show you how lucky we were to have or to produce the right equipment at the right time, and to generate enthusiasm within the group.

Historical remarks

Wind effects on structures have a long history. It goes back to ancient times. Well-known is the Aeolean harp, played by Aeolus, the god of the winds. We know: Karman vortices lead to vibrations of slender structures like cables and wires, where the vibrating structure may interact with the wind velocity field: aero-elastic vibrations.

Our ancestors must have known about wind load on structures. But as Europe does not experience heavy hurricanes, and as highrise buildings like

Gothic cathedrals are heavily damped structures, and their towers are pervious to wind there is scarcely a report on failure of structures caused by extreme winds.

Hence, there was no experience inherited by builders of structures. They knew about earthquakes but not about wind as crucial factor for stability and life time expectation.

There were signs, but these were either not considered or not known. The destruction of the Brighton Chain Pier on November 10, 1836 is such an event. Fig. 1 shows a very informative sketch, which can directly be compared to the picture taken from the failure of the bridge over the Tacoma Narrows 104 years later, Fig. 2.

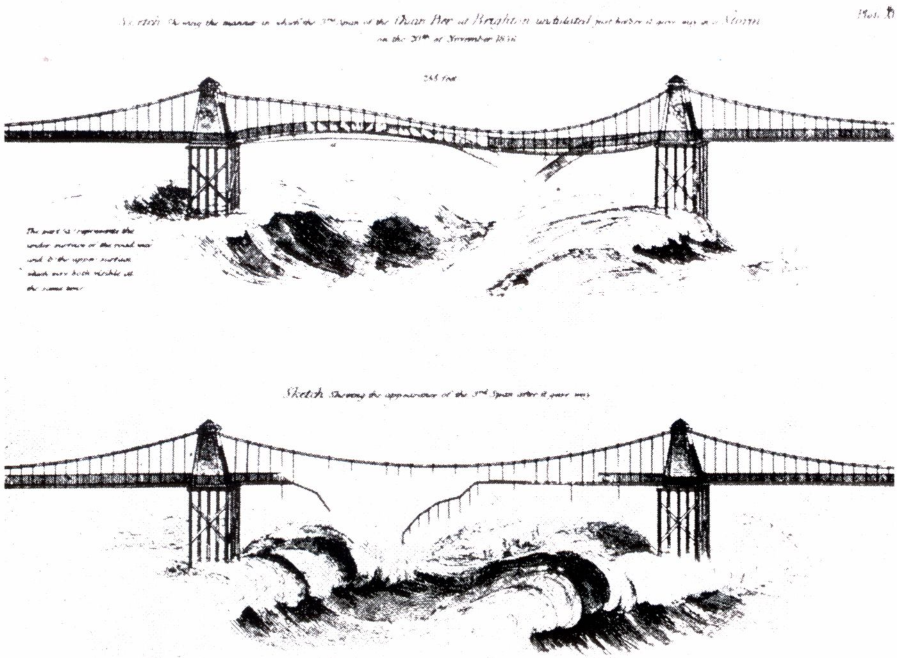


Fig. 1. Sketch by Lt. -Col. W. Reid illustrating the destruction of the BRIGHTON CHAIN PIER on November 30th, 1836

Fig. 2. The bending-twisting oscillations of the TACOMA NARROWS BRIDGE about 30 minutes before its collapse. The aspect of the oscillations is exactly that of Fig. 1

(Figures 1 & 2 are reproduced from Y. Rocard, Dynamic Instability- Automobiles, Aircraft, Suspension Bridges-, English translation, Crosby Lockwood & Son, LTD., London 1957)

Everybody knows the Eiffel tower in Paris, about 300 m high, built for EXPO 1889. Its ingenious designer, A. G. Eiffel, was well aware of the risk of heavy wind loads in great height. He performed model tests in an open wind tunnel, the so-called Eiffel type wind tunnel. These may be seen as the first experiments in this area.

But it took another thirty years until Ludwig Prandtl invented the Göttingen closed loop wind tunnel. His historical sketch, dated May 24, 1915, is displayed in Fig. 3. Countless results have been achieved by this type of wind tunnel, its derivatives and similar test units, including boundary layer wind tunnels and Eiffel type wind tunnels.

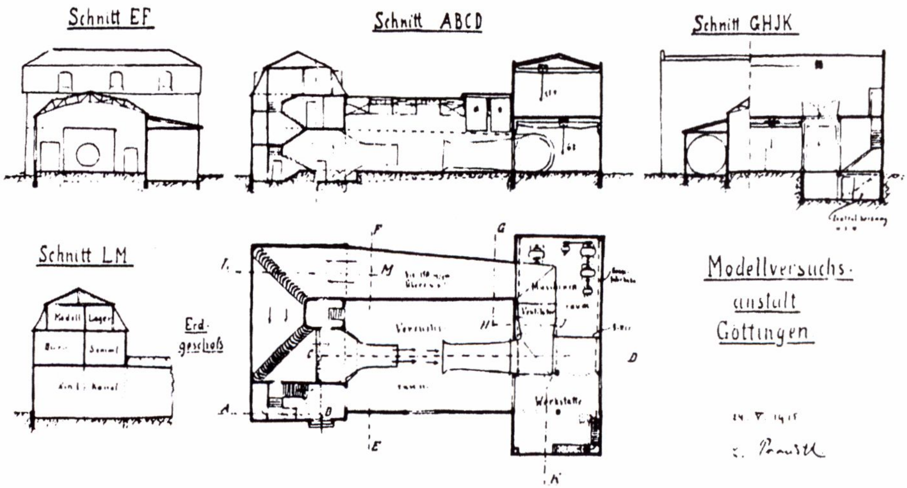


Fig. 3. Draft by Ludwig Prandtl of the *Göttingen type wind tunnel (Modellversuchsanstalt Göttingen, May 24, 1915)*

One has to admit that most of the experimental work and the underlying theoretical investigations were with aircraft problems, in particular tackling the optimisation of lift performance of wings. But there was also a less known activity on aerodynamics of buildings at Göttingen in the twenties and early thirties of the last century, performed by a group around Prandtl – Flachsbart, Ackeret and Wieselsberger may be named. They were close to aeroelasticity, but did not consider any time dependent displacement of their objects.

The collapse of the Tacoma Bridge in 1940 has triggered the investigation of structures under wind load, or, more general, under fluid load. The Tacoma disaster happened at a moderate wind speed – far from being dangerous as a static load. It was the interaction of the – initiated – motion of the bridge deck and the surrounding flow field that has led to a continuous energy input and eventually the collapse of the structure. It is this kind of mechanism that has led to the new field of **aero-** or **fluid-elasticity**.

Different from aircraft problems which can in general be treated as potential flow problems, and where Navier-Stokes solver for the flow field are in use, structural problems deal with bluff bodies, flow separation, and therefore experimental techniques dominate, together with a rather simple mechanical modelling.

There are now, besides buffeting caused by highly randomly winds, three well developed approaches to or mechanisms of fluid elastic vibrations in use:
– flutter,
– galloping,
– vortex excitation.

As these categories are based on phenomena there is no sharp distinction. Von Karman – as a member of the Tacoma task force – was misled to attribute the heavy vibration to his vortices. They were more originating from either flutter or galloping.

Besides the aforementioned phenomena which go more or less with beam like structures there are fluid elastic vibrations of (thin walled) shell type structures such as ovalling (of cross sections). Here, a more analytic approach is necessary, which makes use of the field equations of the surrounding fluid (Navier-Stokes) with time dependant boundary conditions, and that creates a new dimension of numerical difficulties. The engineering practice is still far away from such solutions.

I will describe briefly the three approaches mentioned above.

Flutter of suspension bridges

Flutter is a physical phenomenon. The name has been taken from the flutter motion of a flag in wind. The wind changes the (flat) shape of the flag, and by that the flag changes locally the wind direction. We can observe this, we do not need any mathematical modelling, and we experience that the lifetime of a flag subjected to even moderate wind is very limited. Flutter is destructive!

The flag has no bending stiffness. That leads to an instant reaction on the wind excitation. Let us imagine the flag is stiff. It is then like a thin metal sheet. The inherent phenomenon should still be there, but comes possibly to light only under certain parameter constellations. In general: slender structures can be in danger.

One could now believe – following the argument above – that flutter in man made structures should be expected. It seems that nobody has thought of such a possibility. The flutter effect came to light accidentally.

Let us follow the Chapter *The critical speeds o aircraft wings* by Y. Rocard (cited in the caption of Fig. 2):

A certain number of unexplained accidents in the now „prehistoric" days of the biplane and the braced wings may have been due already to aircraft having reached and even exceeded their flutter speeds, but the phenomenon first appeared *in its pure form with the* Arc-en-Ciel, *the first aeroplane of simple cantilever wing construction. This aircraft showed itself extremely sensitive to vibrations, or rather extremely apt to break out in dangerous wing flutter, and its disappearance in the South Atlantic was probably caused by such an effect.*

Further, reporting on a French observer aircraft built for an operating speed of 160 mph in normal flight, Rocard stated that there was an interest to use the aircraft for dive flights:

Unfortunately, during the first test flight (1938) the aircraft fractured in a dive at a speed estimated by the pilot as 225 mph. The pilot escaped by parachute; he reported that he had seen one of the wings break downwards *after two or three violent deflections. An excessive static force obviously could have been expected to break the wing* upwards *when the pilot pulled out of the dive, and the evidence to the contrary called for an explanation by* vibrations.

Only after the accident it was thought necessary to calculate for stability. The calculated **critical speed** of 210 mph proved very close to the speed that had caused the accident.

Flutter of aircraft wings is a combination of bending and torsional modes of the beam-like slender structure. The corresponding vibrations can be coupled dynamically by the location of the centre of gravity axis versus the flexural axis (which is independent of the speed of the aircraft), and by the flow field (lift and drag, which depend on the speed). The simple mechanism is, that the vibration velocity changes the angle of attack (velocity triangle).

Hence, we deal with a system of self excitation, and there is always a critical speed beyond which vibration occurs: flutter vibration.

Airfoils are designed for maximum lift and minimum drag. The flow is more or less potential. The tools to calculate critical speeds of aircraft wings were available. H. G. Küssner applied the so-called Wagner effect (Wagner, like Küssner a co-worker of Prandtl, had calculated the lift of a "starting airfoil") to a sinusoidally oscillating wing (1929), and Th. Theodorsen published his famous NASA report No. 496 on "General Theory of Aerodynamic Instability and the Mechanism of Flutter" in 1935.

As flutter speed calculations came only in use after accidents occurred it is no surprise that civil engineers were not aware of such mechanisms. In danger are slender structures, and these are obviously suspension bridges. They are similar to airfoils although their cross section is not designed for optimal lift but rather for optimal stiffness. They do not have potential flow but separated flow. Nevertheless, the main features like bending and torsional vibration and lift and drag are there, and hence it is possible that suspension bridges can collapse by wind-induced vibrations.

The two examples in Figures 1 & 2 show the similarity of the vibration modes. Hence, the kind of wind (self) excitation must be the same, and it is similar to airfoil flutter.

The Tacoma accident has triggered numerous investigations, and has led to an adapted flutter theory with lift and drag coefficients taken from wind tunnel testing.

Galloping

Galloping has its name from vibration of transmission lines. The low frequencies of such vibrations give the impression of a galloping horse.

During a sleet storm transmission lines may vibrate in a strong wind. The cause of galloping is the sleet on the conductors. The ice grows against the wind direction, forming an oval cross section. Such a section is unstable in an air stream: **negative damping**. Once the oscillation is started, it will continue to build up, with frequencies close to the natural frequencies of the span. The vibration will stop when the ice is broken and thrown off the line. (See Y. C. Fung, *An Introduction to the Theory of Aeroelasticity*, Dover Publications, New York, 1969 – first published 1955 by John Wiley & Sons).

Vibrations of this type are originated from unfavourable aerodynamic configurations. They go with separated flow in the rear of the structure. One can try to avoid sensible cross sections, but this is not all times possible.

An important unstable cross section is the so-called den Hartog D-section (J. P. den Hartog has been Professor of Mechanical Engineering at MIT). When the windward direction is the curved side of the D, we have a stable case, when it is the flat side, we face a very unstable case.

It results: Galloping is possible even with an ODF system, all it needs is an unfavourable cross section and a sufficient flexibility.

I will report now on two cases of galloping, the first already mentioned at the beginning (flood light mast), the second concerning a pylon of a pedestrian bridge.

Fig. 4 shows one of the four flood light masts. There height is 60 m; they have an extremely rigid foundation, and hence a very low damping. The cross section of the upper third – that is the crucial part – hosting the lamps is displayed in Fig. 5, where the generation of vortices can be seen, and that the cross section comes close to the D-section.

The lift force coefficient c_L and the drag force coefficient c_D are from wind tunnel tests (Fig. 6). While c_D is in the range of 1.0, the lift coefficient c_L exhibits the dangerous negative slope at the angle of attack $\alpha = 75°$.

Another way to check the sensitivity of the system is to measure the energy input per period, expressed by a coefficient k_a. We developed a special, socalled **driven model technique**, and I want to name here my co-worker Horst Bardowicks. The result, Fig. 7, shows indeed an input of energy at $\alpha = 75°$ for the relative velocities beyond $V_r = 10$. What also can be seen: There is a significant excitation peak around $V_r = 10$ for $\alpha = 85°$. This is Karman vortex excitation.

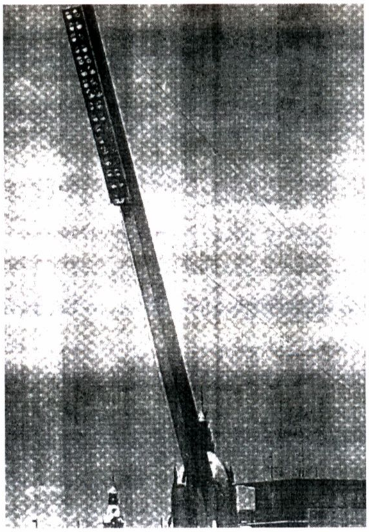


Fig. 4. Photo of a flood light mast, Hannover, soccer stadium

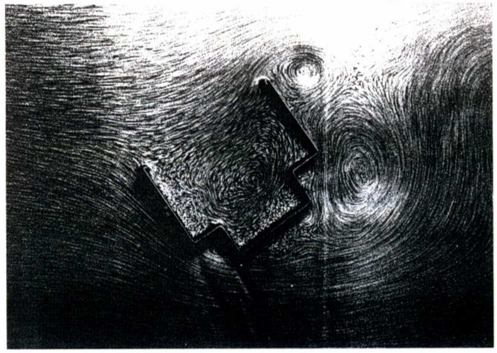


Fig. 5. Cross section of the lamp section of the mast

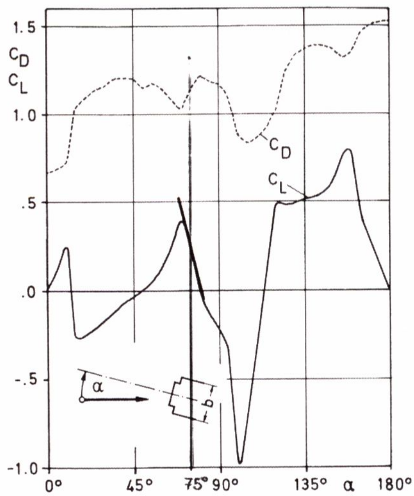


Fig. 6. Lift and drag coefficient vs. angle of attack

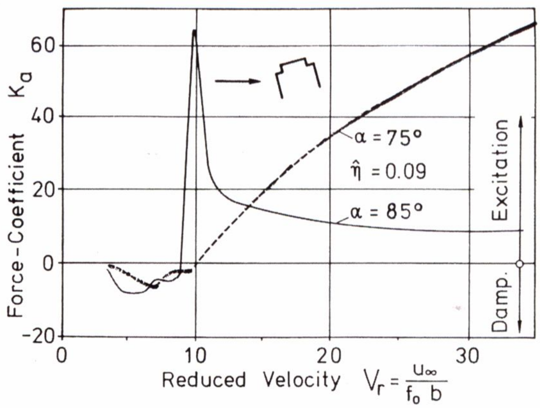


Fig. 7. Energy input per cycle vs. reduced velocity

The second case is the pylon of a pedestrian bridge in Hannover. The pylon was damaged during a steady storm at the night of November 13, 1972. There were no witnesses.

Fig. 8 gives details of the pylon. It cracked – as a cantilever – near its bottom, indicated as crack in the drawing. The nearly hexagonal cross section had its most dangerous angle of attack $\alpha = 14°$, see Fig. 9, which corresponds to the energy diagram of Fig. 10. There, the force coefficient – again as the measure of the energy input per cycle – displays heavy galloping excitation at $\alpha = 14°$, Karman vortex excitation at $\alpha = 0°$, and overall aerodynamic damping at $\alpha = 25°$. The underlying driven model technique is obviously an excellent tool to detect and to measure.

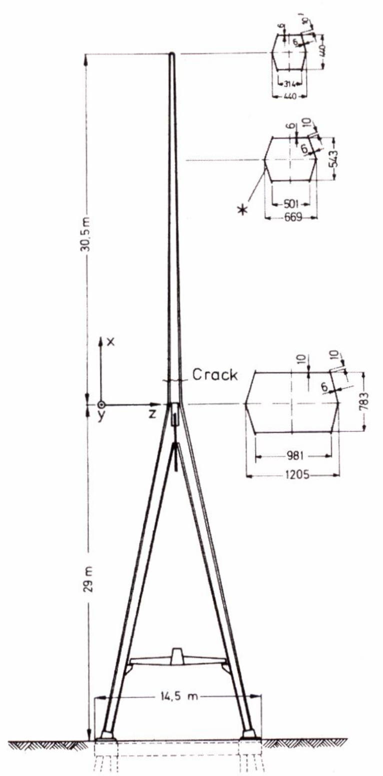


Fig. 8. Pylon of the Lodemann Bridge

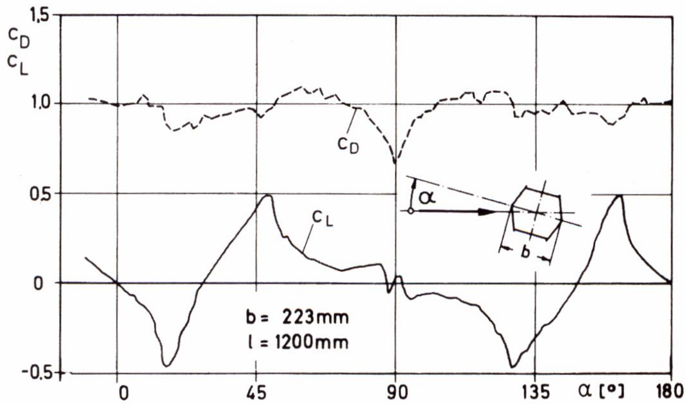


Fig. 9. Lift and drag coefficient of the hexagonal cross-section

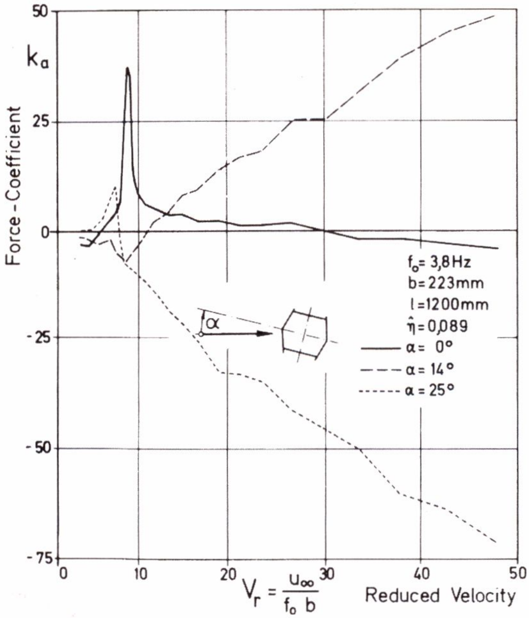


Fig. 10. Force coefficient

Vortex excitation

Vortex excitation has the influence on the stability of structures. The dangerous situation occur when the frequency of the vortex shedding and the eigenfrequency (ies) of the structure coincide (resonance). An important role plays the Reynolds number Re $= vd/v$, depending on the characteristic dimension d of the structure (diameter) and the flow velocity v; v is the kinematic viscosity.

The vortex shedding frequency is usually given in a dimensionless form as a Strouhal number Sh $= fd/v$. Fig. 11 gives an idea about the complexity of the phenomenon. In particular, in very many cases of structures – that is in the range of Re > 300 000 – the vortex shedding gets an increasingly stochastic character, and the structure acts like a filter, sucking the excitation energy from the turbulent flow.

A still open question is the lock-in effect: Near resonance the structure adjusts the vortex shedding frequency to its eigenfrequency. This happens in a certain velocity range. One can develop various interesting models of highly nonlinear self excitation of this phenomenon – as we also did-, but these models are not sufficiently general to allow for a forecast.

In conclusion, I would like to express my appreciation to the various members of the Cracow University of Technology, who have visited the Technical University Hamburg-Harburg over the last years contributing to the success of two co-operation projects supported by Volkswagen Foundation. I believe the collaboration has been a fruitful one for both Cracow and Hamburg and I very much hope that it will continue in the future.

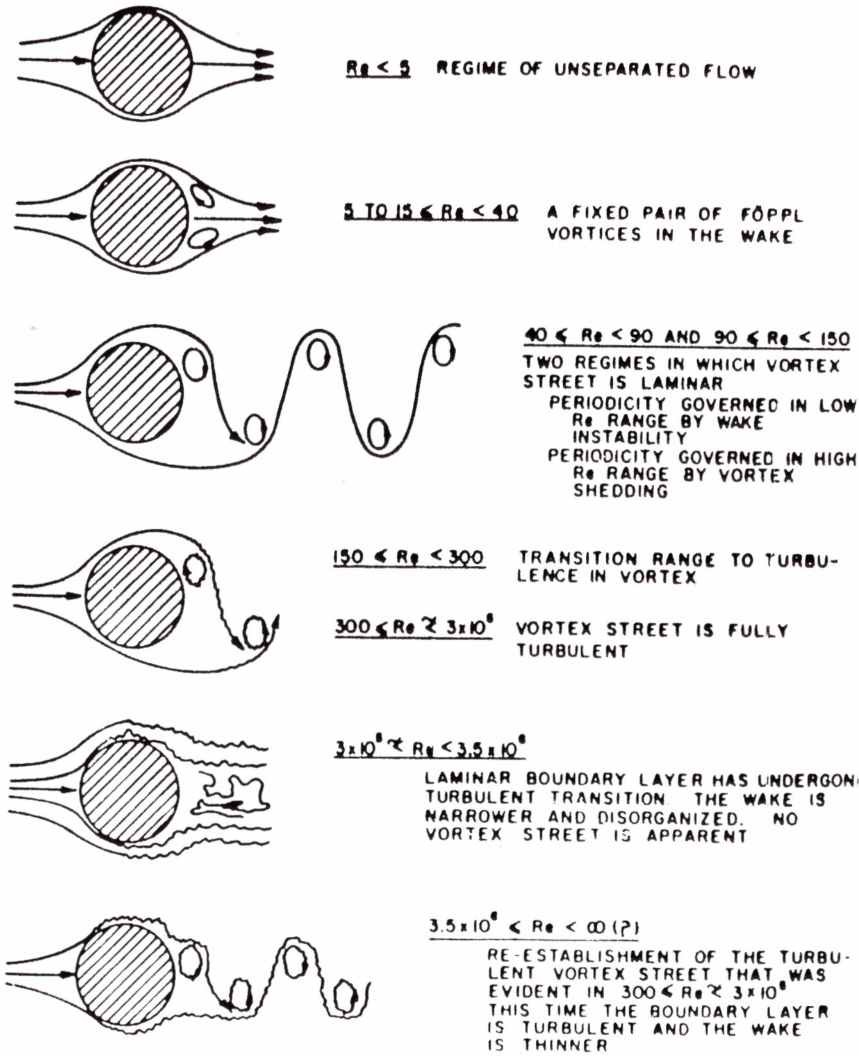


Fig. 11. Evolution of vortex shedding with increasing Reynolds number

Wzajemne oddziaływanie powietrza i opływanych przez nie konstrukcji – drgania wywołane opływem powietrza

Streszczenie

Wykład rozpoczyna się od podziękowania złożonego przez prof. Oskara H. G. Mahrenholtza władzom Politechniki Krakowskiej za nadanie mu tytułu doktora honoris causa.

Wprowadzenie do zasadniczej tematyki wykładu zawiera informacje dotyczące prac z zakresu aerosprężystości, prowadzonych przez Profesora Mahrenholtza, oraz krótki rys historyczny rozwoju badań z tej dziedziny nauki. Część główna wykładu to bardziej szczegółowe omówienie trzech podstawowych mechanizmów powstawania drgań wywołanych opływem powietrza: flatteru, gallopingu i wirów Karmana.

Tematyka ta jest związana z jednym z kierunków prac prowadzonych przez Profesora od początku lat sześćdziesiątych, dotyczącym drgań masztów, na których rozmieszczono reflektory oświetlające stadion piłkarski w Hanowerze. Zespół kierowany przez Profesora miał do dyspozycji tunel aerodynamiczny, sukcesywnie modernizowany i unowocześniany. Po przejściu Profesora na Politechnikę w Hamburgu doświadczenia z zakresu aerosprężystości zostały wykorzystane w obliczeniach konstrukcji morskich.

W ramach ogólnych rozważań na temat historii rozwoju aerosprężystości Autor wspomina mitycznego władcę wiatrów Eola, od nazwiska którego pochodzi nazwa drgań eolskich. Przedstawia najbardziej znanych badaczy zajmujących się zjawiskami drgań wywołanych opływem powietrza (von Karman, Prandtl i jego współpracownicy, Eiffel). Omawia kilka słynnych katastrof budowlanych, których przyczyną były drgania związane z opływem powietrza.

Dalszą część wykładu Profesor Mahrenholtz poświęcił podstawowym mechanizmom oddziaływania poruszającego się powietrza na konstrukcje.

Flatter – jest zjawiskiem fizycznym występującym przy opływie smukłych konstrukcji, np. skrzydeł samolotu, elementów mostów wiszących itp. Badania flatteru wykazały, że jest on związany ze sprzężeniem sił aerodynamicznych z giętno-skrętnymi formami drgań smukłych konstrukcji. W dziedzinie prac dotyczących flatteru skrzydeł samolotów na uwagę zasługują opracowane przez Küssnera i Wagnera narzędzia badawcze i obliczeniowe oraz raport Theodorsena dla NASA.

Galloping – to zjawisko występujące głównie w liniach elektroenergetycznych. Przyczyną drgań jest osadzanie się lodu na przewodach. Przekrój poprzeczny oblodzonego przewodu może stać się przekrojem niestabilnym w strumieniu opływającego go powietrza. Powstaje wtedy efekt ujemnego tłumienia, powodujący narastanie drgań. Dwa przypadki gallopingu, wybrane spośród prac Profesora Mahrenholtza, zostały szczegółowo omówione. Pierwszy – to wieża oświetle-

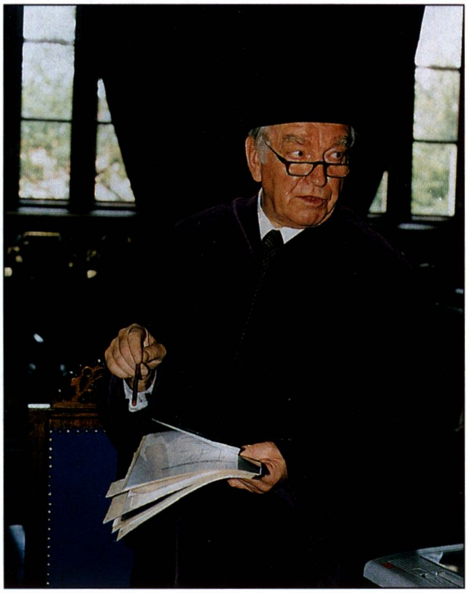
niowa na stadionie w Hanowerze, drugi – to wspornik wiszącego mostu dla pieszych również w Hanowerze. Została także omówiona wprowadzona przez Profesora technika pomiaru energii pobieranej przez konstrukcję (przypadającej na jeden okres drgań) oraz wyniki prac wykonanych tą techniką.

Drgania eolskie – powstają w wyniku oddziaływania wirów Karmana, odrywających się od konstrukcji z częstością bliską częstości drgań własnych konstrukcji. Charakter występujących wirów zależy od liczby Reynoldsa (zobrazowano to graficznie na rysunkach), a częstość jest związana z liczbą Strouhala.

Profesor Oskar H. G. Mahrenholtz zakończył wykład przekazaniem uznania dla tych pracowników Politechniki Krakowskiej, którzy w ramach współpracy między uczelniami mają udział w sukcesach dwóch wspólnych projektów, finansowanych przez fundację Volkswagena.

Prof. Oscar H.G. Mahrenholtz and Prof. Jan Hult during the opening ceremony
Prof. Oscar H.G. Mahrenholtz i prof. Jan Hult podczas rozpoczęcia uroczystości

Prof. Oscar H.G. Mahrenholtz receives congratulations from Prof. Kazimierz J. Flaga, the Rector
Składanie gratulacji prof. Oscarowi H.G. Mahrenholtzowi przez JM Rektora, prof. Kazimierza J. Flagę



Prof. Oscar H.G. Mahrenholtz at lecture

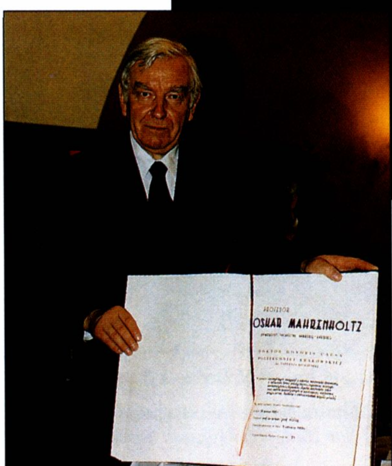
Wykład prof. Oscara H.G. Mahrenholtza

Presentation of addresses and reception after the ceremony of doctor honoris causa conferrment (from left: Margerita Mahrenholtz, Prof. Oscar H.G. Mahrenholtz, Prof. Jan Hult, Prof. Wojciech Szczepiński)

Odczytywanie adresów i lampka wina po uroczystości nadania tytułu doktora honoris causa (od lewej: Margerita Mahrenholtz, prof. Oscar H.G. Mahrenholtz, prof. Jan Hult, prof. Wojciech Szczepiński)

Prof. Oscar H.G. Mahrenholtz and Prof. Roman Bogacz

Prof. Oscar H.G. Mahrenholtz w towarzystwie prof. Romana Bogacza



Prof. Jan Hult (from left) and Prof. Oscar H.G. Mahrenholtz sign the commemorative volume

Wpis do Księgi Pamiątkowej, od lewej: prof. Jan Hult i prof. Oscar H.G. Mahrenholtz

Prof. Oscar H.G. Mahrenholtz with the commemorative volume

Prof. Oscar H.G. Mahrenholtz z Księgą Pamiątkową

Contents