



IIASA

options

International Institute
for Applied Systems Analysis

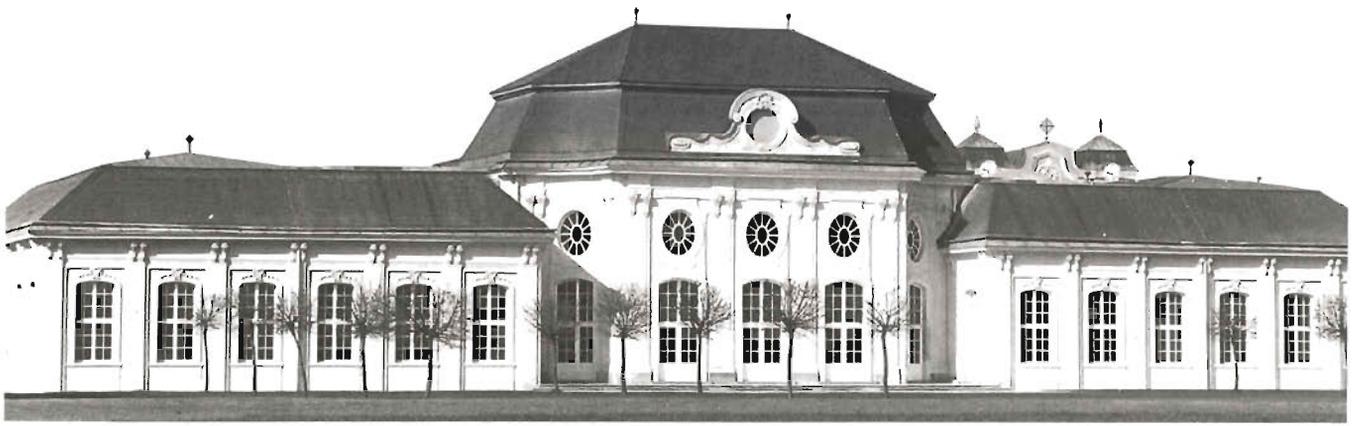
Nov. 88



In this Issue:

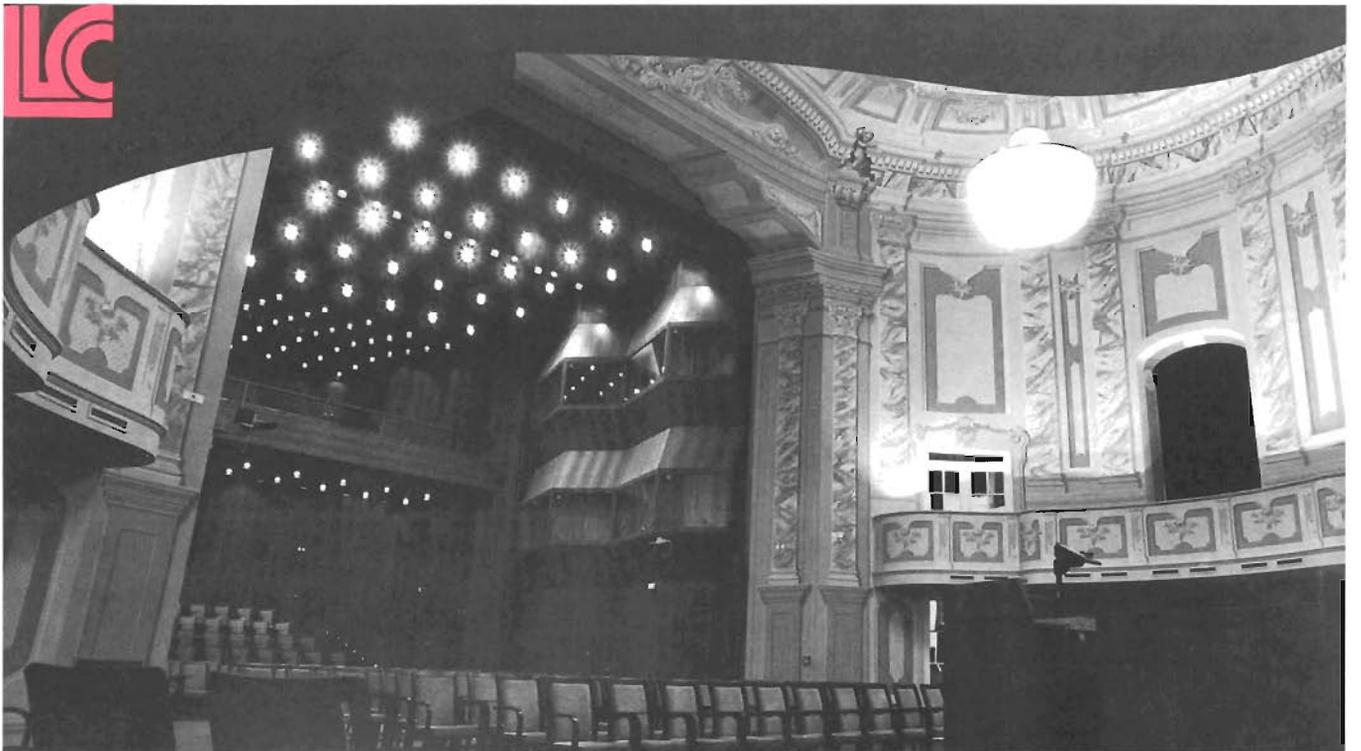
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IIASA's water research**

**«IIASA: Perspectives and Futures»
Impacts of global warming**



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OPTIONS is produced quarterly by IIASA, the International Institute for Applied Systems Analysis.

ISSN 0252 9572

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Design/Graphics: Martin Schobel

Photographs: Franz Karl Nebuda

Typography: Lilo Roggenland

Printed by: Novographic, Vienna

IIASA is an international research institution, which draws on the scientific and financial resources of member organizations in 16 countries to address problems of global significance.

It has four established research Programs, continually updated to target on emerging issues in areas of major international concern.

- * Environment
- * Technology, Economy, and Society
- * System and Decision Sciences
- * Population

Used worldwide, IIASA's results and products have established IIASA as a front-runner in applying systems analysis to the resolution of international issues.

National Member Organizations

Austria – The Austrian Academy of Sciences; *Bulgaria* – The National Committee for Applied Systems Analysis and Management; *Canada* – The Canadian Committee for IIASA; *Czechoslovakia* – The Committee for IIASA of the Czechoslovak Socialist Republic; *Finland* – The Finnish Committee for IIASA; *France* – The French Association for the Development of Systems Analysis; *German Democratic Republic* – The Academy of Sciences of the German Democratic Republic; *Federal Republic of Germany* – The Association for the Advancement of IIASA; *Hungary* – The Hungarian Committee for Applied Systems Analysis; *Italy* – The National Research Council; *Japan* – The Japan Committee for IIASA; *Netherlands* – The Foundation IIASA-Netherlands; *Poland* – The Polish Academy of Sciences; *Sweden* – The Swedish Council for Planning and Coordination of Research; *Union of Soviet Socialist Republics* – The Academy of Sciences of the Union of Soviet Socialist Republics; *United States of America* – The American Academy of Arts and Sciences.

Cover photograph by Robert Duis

EDITORIAL



Beginning this issue, "Options" takes on a new appearance, style, and sectional format. The intention is to better serve readers' needs, by providing timely and reliable information about the Institute and its work. To this end, the new "Options" will appear four times annually, at the end of each quarter.

Although the Institute's research interests will be the dominant theme, the new "Options"

won't focus exclusively on what's happening at the Institute. The news section will also feature alumni and collaborating scientists; the research section will be alert to important research developments wherever they arise; and, "Conference Corner" will provide a calendar of relevant, forthcoming events, both Institute organized and not.

To make this work, we solicit your help in ensuring coverage of items important to you and your organization. We also plan a "Letters" column, and invite correspondence about published material or more generally about Institute matters.

We especially invite reactions to the new series on the usefulness of IIASA's work, which begins this edition with a feature devoted to work on water resources. We would welcome advice on application areas you think are worthy of reporting in future editions.

We thank you for your help and trust that, in the meantime, you enjoy reading the new "Options".

Robert H. Pry, Director

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Stressing the importance of international cooperation – Dr. Franz Vranitzky, Federal Chancellor of the Republic of Austria.

Emerging issues focus of 15th Anniversary Conference

IIASA celebrated its 15th anniversary, June 14–15, with an international Conference focused on the future. “IIASA: Perspectives and Futures”, held at the Laxenburg Conference Center, attracted over 250 decision makers and opinion leaders from around the world. Guest speakers included Academician Jermen Gvishiani and Dr. McGeorge Bundy, both instrumental in founding the Institute, and Dr. Franz Vranitzky, Federal Chancellor of the Republic of Austria.

The Conference was planned as a practical step toward further developing the Institute’s long-term strategy, seen by Director Dr. Robert Pry as essential to preserving relevance in the fast changing international research en-

vironment. The aim was to identify emerging issues that should be considered for IIASA’s future research program. The Conference also reviewed IIASA’s record of past achievements.

Achievements

Professor Kai Lee described one of these accomplishments, in his presentation on the world’s most extensive program of ecological restoration, to rebuild the salmon fisheries of the Columbia River Basin in the Northwest United States. Directed and financed by the Northwest Power Planning Council, the program represents an annual investment approaching \$100 million and is based entirely

on the approach of adaptive environmental management pioneered at IIASA.

In the same vein, Mrs. Deng Nan, daughter of Deng Xiaoping, spoke of the IIASA project to develop, jointly with Chinese researchers, software to be used in planning for integrated economic development in China’s Shanxi Province. Along with efficiency and environmental concerns, limited water and transportation resources constrain development and dictate a careful appraisal of options. Human “experts” are in limited supply and IIASA software is expected to play the major role in guiding investments in high energy consuming industries, coal-chemical works, and generating plants.

15th ANNIVERSARY

The second day of the Conference concentrated on outstanding methodological problems and emerging issues in the areas of environment and society, technology and management, and international affairs.

On the methodological front, both Professor Jacques-Louis Lions (President, Centre National d'Etudes Spatiales, France) and Professor Herbert Simon (Carnegie-Mellon University, USA) remarked on the modeling of large and complex systems. Stressing that systems can be orders of magnitude more complex than any possible model, Nobel Laureate Professor Herbert Simon sought ways to bring the computational demands of modeling within acceptable bounds. His talk outlined some ways forward, including appropriate question posing and a refocus on prescriptive approaches. A novel proposal was to develop methods for symbolic modeling that, Professor Simon suggested, may be particularly appropriate for the analysis of individual and group behavior.

Emerging Issues

Both speakers on environmental and social issues, Professors Thomas Rosswall of the International Geosphere-Biosphere Program and Evgeni Shigan of the World Health Organization, began by acknowledging IIASA's past contributions. Professor Rosswall went on to urge IIASA to help fill gaps in scientific understanding over how the earth functions at global scale. As an example, he pointed to scientists' failure to predict recent rapid depletion of stratospheric ozone. "Our understanding of the effects of man's activities on atmospheric chem-

istry and processes is poor and the possibility of making predictions of global change, including climatic change, currently non-existent. IIASA could make a major impact by selecting a few, key and well-focused issues for analysis of both the natural and social science aspects".

Professor Evgeni Shigan reported that WHO already uses IIASA models in its work. Models for estimating morbidity rates and the incidence of disease are used in estimating resource requirements for national programs of disease prevention and control, and the Organization employs cost-effectiveness models for comparing alternative modes of prevention, diagnosis, therapy, and health care. Models developed in association with IIASA's Population Program are used for medical and demographic planning. He identified the need to assess risk factors in specific diseases, and to develop models for assessing organizational aspects of preventative and curative health care, as outstanding research issues. Coronary heart disease, cancer, diabetes, AIDS, and mental disease featured high on his list of priority health problems.

The speakers on Technology and Management viewed technological development as a twin-edged blade, capable not only of solving problems but of generating others. Information technologies have enormous implications for society, said Dr. Rashko Anguelinov (Bulgarian Committee on Information Technologies). They hold the potential to bring nations to high levels of development or to cause further polarization. Hitting a similar warning note, Professor Hans C. Runge (Technical University of Clausthal, FRG) denounced current complacency over energy

futures. Reliance on liquid fuels of ever higher quality, he said, was bound to lead to greater use of unconventional fuels. Though technological solutions exist for making liquid fuels from unconventional raw materials, these have several economic, societal, and environmental drawbacks. The present oversupply of petroleum-based fuels obscures the trend, but its effects will be felt within the next 25 years. "The issue needs to be addressed now", he said.

North-South

Secretary-General of the South Commission, Dr. Manmohan Singh, opened the session on international issues with a plea for greater North-South accord on sustained development in the Third World, warning of the economic, environmental, and political consequences for the North of neglecting its southern neighbors. He urged IIASA to harness its resources to an understanding of the processes and strategic

Dr. Manmohan Singh – a plea for greater North-South accord.

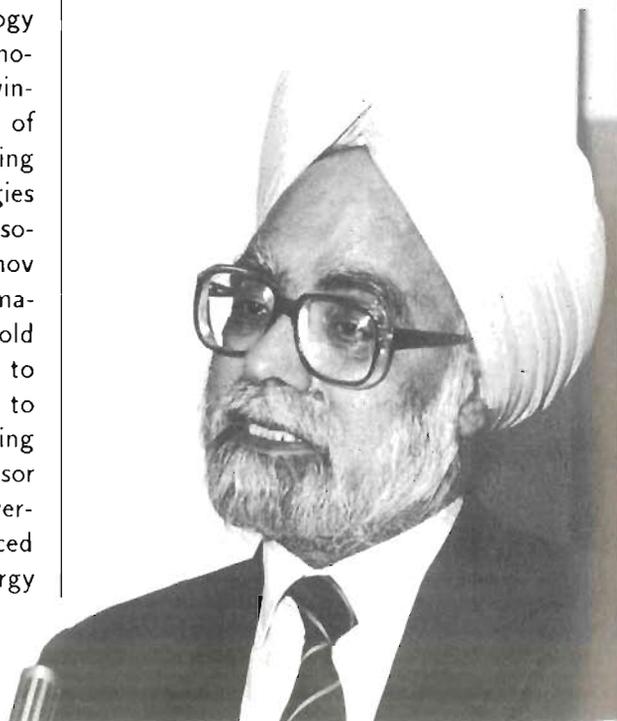


Foto Sündhofer

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factors of Third World development: investment, debt, the role of international financial institutions, trade, education, health care, and the balance between agriculture and industry.

Professor Andrei Kokoshin (Soviet Institute for USA and Canada Studies) followed with a challenging address on the subject of East-West relations. His theme was that systems studies of military capabilities can help negotiators phase disarmament along a path that preserves strategic balance. He cited their value as a means of building understanding through common languages and software for weapon system appraisal. Urging IIASA explicitly to undertake work in this area, Professor Kokoshin revealed that techniques and software developed at IIASA for other purposes, and which contributed generally to the repertoire of systems analytical procedures, had already influenced the development of software used in the recent disarmament negotiations between the USSR and the USA.

Chernobyl

The topicality of Professor Kokoshin's address was matched by a suggestion from IIASA Council Chairman, Academician Vladimir Mikhalevich, to use data on groundwater radiation levels collected during and after the Chernobyl nuclear accident to calibrate models of radioactive contamination and diffusion. These would then be available to countries in both East and West for use in developing appropriate containment strategies and contingency plans in the event of future incidents.



Foto Sündhofer

Phasing disarmament along a path that preserves strategic balance. Professor Andrei Kokoshin urges system studies of military capabilities.

The panel discussion that closed the Conference was highly charged with ideas and emotions. Everyone acknowledged that in a rapidly changing world, already very different from that in which the Institute was founded, adaptation and forward planning are the keys to IIASA's future effectiveness and utility.

Many participants regarded IIASA's capacity for multidisciplinary and interdisciplinary work as a particular strength. They argued for reinforcing IIASA's networking activities, and for putting emphasis on integrative, holistic studies, and on the development of methods to dismember problems and synthesize solutions. IIASA's only weakness in this area was seen as a current underrepresentation of economic aspects in some of its work. Consensus was to boost the economic treatment through closer liaison with economists and economics institutions. Professor Umberto Colombo, President of ENEA (the Italian National Commission for Nuclear and Alternative Energy Sources), stressed that the solution was not to develop specialist in-house economics capabilities, which would inevitably involve adherence to a particular school of economic thought.

IIASA's role as a communicator was seen as another key asset, and one of growing significance in a world where problem-solving demands concerted actions. Several participants urged the Institute to help fill outstanding communication gaps: those between different scientific disciplines, cultures, political systems, and national blocs; and those between researchers and research users. IIASA's task could be to develop standardized scientific languages and consistent approaches to ease communications. Dr. Pry spoke of initiatives already underway to try to establish a consistent and more meaningful set of national economic indicators. Further work in this area was planned. Improved liaison with research users was already a priority issue. IIASA's existing "policy exercises" might be a model for more extensive future work, Dr. Pry explained. Key aims were to find ways of establishing clients' real needs, of appropriate question posing, and of packaging research products to increase their effectiveness.

New Opportunities

Some concern was expressed that the internationalism that had characterized the Institute, in particular its East-West aspect, was no longer unique. The emergence of new, specialist institutions – the Institute for International Environment and several institutions for promoting joint ventures and researching risk – could threaten IIASA's established research niche. Dr. Pry, however, saw opportunities in the new situation. IIASA was not out to preserve an established intellectual domain, he argued, but to help resolve real

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problems. To this end, new institutions were to be welcomed and it was part of IIASA's role and responsibility to support such initiatives. IIASA had already provided guidance in helping establish the new Institute for International Environment in Stockholm and the prospect looked bright for future collaborative research, perhaps with IIASA supplying methodology to help structure and guide substantive research.

Another concern arose from the difficulty of attracting policy makers' and public attention to issues within the Institute's research program that are examined in the long term. The problem is made more acute since the turnaround time for remedial action, especially on environmental issues, can also be long. Although there might be no immediate penalty for current inactivity, the long-term price can be high. Strategies for enhancing awareness were discussed, including using currently topical issues, such as ozone depletion, to draw attention to long haul issues, such as the CO₂ problem.

As to topics, several participants urged the Institute to take up Professor Kokoshin's challenge, although sensitivities dictate that any contribution to security questions should be pursued obliquely. A greater involvement in the general area of international negotiations processes was advocated by Dr. Pry. How best to design and use negotiations support software was cited as an example. "Our aim should be to emphasize the common ground rather than the adversarial, conflict issues", Dr. Pry stated. He saw new opportunities in the outcome of a recent conference held by the East-West Securities Institute. Their conclusion, that the question of security is no longer simply one of disarmament but has large economic and environmental components, holds promise that the Institute can contribute to security issues in the future without getting involved in bilateral negotiations.

In his closing remarks, Academician Mikhalevich affirmed the Council's support to the long-term planning initiative, stressing that

the Council, too, had recently discussed strategies toward the Institute's future. A pragmatic approach, recognizing the realities of the situation, was needed. IIASA's resources are small so the task is to use them to best advantage. IIASA needs to strengthen its scientific component. IIASA must attract distinguished senior scientists and talented young researchers. In addition, it must strengthen links with other international organizations, and reinforce its role as a research coordinator. IIASA's record of past achievement is impressive, but its future depends on how well it can realign to a new research reality. He endorsed an earlier suggestion from Academician Gvishiani that the Institute should prepare a strategic planning document, embracing suggestions made at the Conference and covering the next 10-15 years. ■

A report on the Conference is in preparation and will be available from the IIASA Publications Department at the end of December.

Taking questions from the floor – the panel discussion that closed the Conference.



IIASA ACHIEVEMENTS

Water Resources Research

influencing the methods and mindsets of policy makers



The research carried out by IIASA in successive projects on water resources has had a profound influence on the day-to-day thinking of policy makers responsible for water resources management, argues Dr. Kazimierz Salewicz, leader of IIASA's Large International Rivers Project. It has also influenced the tools and methods currently used by water managers in many countries. In addition, IIASA has given direct help in solving real-world water management problems such as the eutrophication of Lake Balaton and flooding along the shores of Lake Como.

Methodology

To understand IIASA's methodological contribution, the work has to be placed in the context of changing awareness over the importance of water management; an awareness that has developed as water demands have begun to approach the limits of readily available supplies, and with the appreciation that water is part of a natural system on which we all ultimately depend. Whereas, 30–40 years ago, there was little scientific interest in questions of demand management or conflict resolution, these are now everyday issues. Resolving them depends

Waste-water from a power plant, pollutes adjoining water courses.

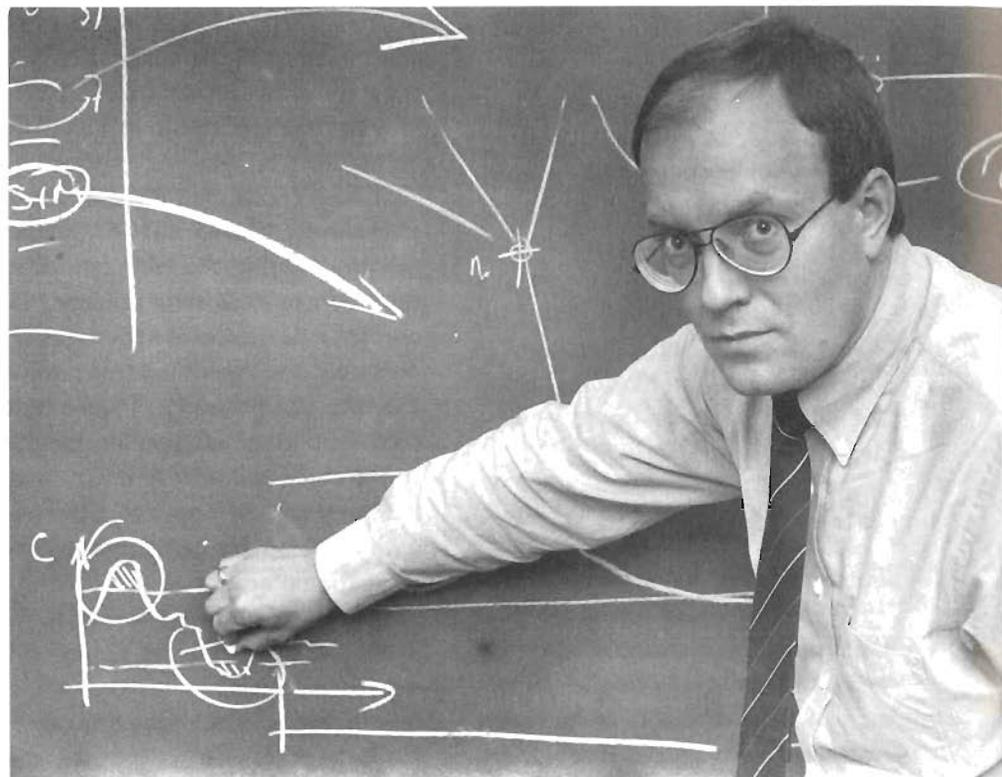
IIASA ACHIEVEMENTS

on appropriate methodology and mindsets. On the one hand, this needs more precise analytical tools. On the other, it demands that we look at problems from new perspectives.

In helping meet these needs, IIASA has achieved some notable firsts. Some of the earliest work focused on modeling water demands and relates back to the issue of perspective. Do we really need to meet every demand for water as it arises, or should we question whether the demand is really justified in technological, environmental, and economic terms? IIASA helped create awareness that the problems of water supply can be analyzed not only from source, but from the perspective of rational use, developing methods to calculate how much water is actually needed in different situations. Tested in Poland, Sweden, and Bulgaria, the methods have since been used in cost-benefit analyses of irrigation schemes and for evaluating the impact of heat discharge standards and waste water discharge fees on the water consumption of generating plants.

Three IIASA scientists, Dr. Tsuyoshi Hashimoto, Professor Daniel Loucks, and Professor Jery Stedinger, were the first to use concepts of resilience in relation to water management. Adapted from ecology, these methods and concepts are now widely used for analyzing risks and uncertainties in water resource system design and operation, exposing the system's weak points and quantifying its vulnerability to changes in policy or to rare events.

Similarly, Academician Zdzislaw Kaczmarek and Dr. András Szöllösi-Nagy were among the first to apply the Kalman filter technique to the analysis of hydrological systems – a technique for



Dr. Kazimierz Salewicz, leader of IIASA's Large International Rivers Project.

forecasting flows originally developed in control engineering and used, for example, for aircraft and rocket control. Again, this is now a widely accepted tool of hydrology.

Research on lake eutrophication (detailed below) broke new ground. At a conceptual level, its achievement was the linked examination both of lake processes and of socioeconomic activity in the surrounding lake region. At a technical level, a key contribution was a model for simulating resuspension processes that occur in lakes and that contribute significantly to eutrophication. This has since been applied to studies of eutrophication in South and North America, and in Europe.

Similarly, IIASA's work on reservoir management has been important in developing theory and approaches to difficult storage control problems. The study of the Lake Como system in Italy (de-

tailed below) made novel use of a real-time management model for the lake system, not only to define operational possibilities for the lake, but to evaluate options for releasing the most critical constraints.

Recently, IIASA's key contributions have been in developing and evaluating decision support methodology for use in water resource management; especially for helping to resolve conflicts over water use when these constitute major issues in regional planning and development. Studies in the Netherlands and the German Democratic Republic have provided valuable insights into the ways in which conflicts arise between various interest groups, the different possible institutional arrangements for their management and eventual reconciliation, and the efficacy of decision support technologies for helping resolve these problems. ►

IIASA ACHIEVEMENTS

Case Studies

IIASA's methodological contributions are additional to its direct help in solving real and often pressing water management problems. Highlights, in this regard, are the case studies of Lakes Balaton and Como. In both cases, the situations faced – eutrophication in Lake Balaton and flooding along the shores of Lake Como – were deteriorating rapidly.

Lake Balaton

Eutrophication is a natural process in the aging of lakes that becomes a problem only when accelerated artificially by the infiltration of large amounts of inorganic nutrients – introduced through discharges of sewage or agricultural runoff. By robbing the water of oxygen, the additional nutrients distort the natural balance of the lake chemistry and biota, encouraging blooms of algae and organic matter. This destabilizes the lake ecosystem; the water turns foul, fish are killed, and reedbeds destroyed.

At the beginning of the Balaton study, in 1978, the lake was already showing signs of accelerated eutrophication. A ten-to-twenty-fold increase in tourism, increasing fertilizer use, and a host of other factors over the previous 20 years had contributed to "hypertrophic" levels of nutrient pollution in the most affected parts of the lake. Prompted by environmental concerns and the lake's significance for the Hungarian economy, various domestic institutions were already investigating the problem and had collected a considerable amount of data before the Institute began its studies. Essential to determining effective control measures was to establish precisely the causes

of eutrophication. Which nutrients were most to blame? What were the most important sources? Where were the problems most severe?

IIASA's study showed that phosphorus played the dominant role in polluting the lake, and that the main sources were sewage (33 percent), agricultural activities (27 percent), and runoff processes near the lake (22 percent). The overall contribution of sewage discharges to the algae-available nutrient-load was even higher: about 50 percent, with most of this being released in recreational areas.

The long-term solution was to divert sewage from the region, an expensive undertaking impossible before the 1990s. But the need for urgent action called for interim measures. IIASA's direct contribution was to investigate different control options; the balance between investments of different types, the timing and siting of facilities, and the most cost-effective total level of investment. Existing proposals for halting eutrophication (which had been tabled before the study) were evaluated and compared with alternatives representing investments of similar sums. A key conclusion was that solely to build a prereservoir at the mouth of the Zala River, as had been planned, was far from the best solution.

By following IIASA's advice to concentrate investments at the western end of the lake and to begin by building a tertiary sewage treatment plant at Zalaegerszeg, the largest city on the Zala River, the eutrophication of Lake Balaton was effectively halted, pending longer-term engineering solutions. Moreover, actions were taken that prevented a rapidly deteriorating situation from becoming irrevocable. In this case, IIASA's real

contribution was not just that it recommended effective actions, but that it acted in time.

Lake Como

There was a similar degree of urgency in the Lake Como work. A problem had begun to emerge



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there in the 1960s and was getting worse year-by-year at an accelerating pace. Probably as a result of overpumping from an underground aquifer, the main square in

A carpet of foam on the Upper Rhine – a visible sign of discharged waste-water.



the town of Como, which edges onto the lake at its most southerly point, began to subside. By 1980, just before IIASA's study, the square was 60cm below its level of 1946 – the year in which a dam had been built at Olginate to control water storage in the lake. The implication of the subsidence became clear in the 1970s. In combination with higher levels of water maintained in the lake by the dam, the danger of flooding in Como town had increased dramatically. Whereas in the first 25 years of the dam's operation only three floods in the town had lasted more than five days, between 1972 and 1981 there were 10 such floods.

Building the dam in 1946 and maintaining high water levels in the lake had greatly benefited downstream water users. However, when the square in Como began sinking, criticism inevitably mounted – the dam manager was caught between the conflicting interests of the residents and authorities in Como, who faced the threat of flooding, and the farmers and utility companies downstream, whose profitability depended upon water conservation within the lake.

IIASA's contribution was to advocate a more active water management policy that made more intensive use of the lower part of the reservoir's active storage, and would open the dam gates fully before the upper limit was reached. It was found that this would both reduce flooding and increase the water available for irrigation. In 1982, the improved operating rule was programmed onto a micro-computer and the model has since been used by the reservoir manager to support his daily decision on water release.

Nonetheless, given the then current constraints, neither flooding nor water deficits could com-

pletely be avoided. On average, at least four days flooding and an annual agricultural water deficit of 45 million cubic meters were inevitable. Furthermore, these were independent minima, not attainable simultaneously. So, IIASA's second contribution was to develop cost-effective proposals for removing some of the more restrictive constraints.

The first proposal was to reduce the statutory upper limit of the active storage by 30cm, since this would be a convenient and relatively low-cost way of reducing the threat of floods without incurring unacceptable consequences for agriculture.

The other proposal was for capital investment to raise both Como town square and the lake-side road. The extent of the necessary reconstruction was determined using the model and past data on hydrological conditions. It was found that, were the square to sink further, flooding would increase dramatically whatever operating rules were used to manage the water in the lake. Twenty days under water each year would be unavoidable were the square to subside a further 20cm. Alternatively, by raising the square to its 1946 level and by following the new operating rules, flooding could be limited to an average of less than one day per year.

The Italian Ministry of Public Works acted on IIASA's recommendations. Como is still subject to flooding during bouts of extreme weather, but even then, the depth of flood water and the duration of any flooding have been greatly reduced. The outstanding feature of IIASA's proposals and operating procedures was that, in a conflict situation, they had the peculiar merit of benefiting all parties. ▶

IIASA ACHIEVEMENTS

Conclusion

Continuity and progression have been major factors in assuring the relevance of IIASA's past water resources work. Over time, it has been possible to increase the scale of the problems addressed from small watersheds within a single political jurisdiction to large watersheds encompassing multiple countries. The same goes for the depth and range of the analysis.

These have been extended to include socioeconomic and political, as well as physical and technological aspects. As a result, IIASA has been able to tackle ever more significant problems.

The working style has also played a part. The work has mostly been done in cooperation with institutions responsible for planning or operating water systems and storage facilities, providing the blend of reality and abstraction necessary for developing and test-

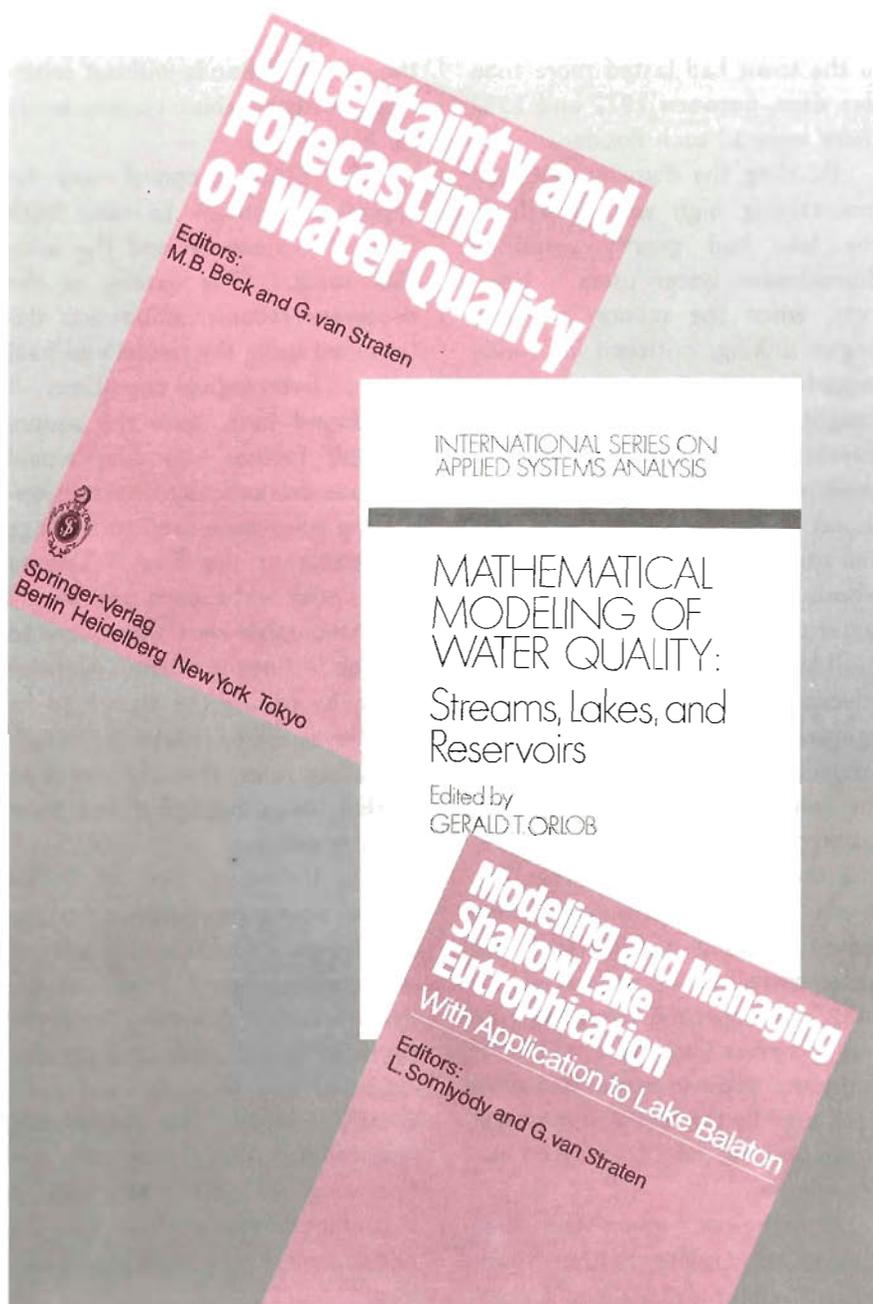
ing methodology. Having data on real problems and working closely with practitioners has injected the work with relevance and utility. Salewicz points out, for example, that the model for Lake Como was among the first to be developed in conjunction with the ultimate user; and that was in 1981.

The process is continuing today. Part of IIASA's role, says Salewicz, is to project where future problems might lie and work alongside key actor groups to have ready the tools and contingency plans that might avert or defuse potential crises.

International conflicts over water rights, especially in the Middle East, are seen by some analysts as potential sources of unrest. More generally, the lack of international agreements over the use of the vast majority of shared rivers could threaten both the environment and international peace.

Only 61 of the world's 214 international rivers are subject to regulatory treaties and most of these deal only with navigation. Hardly any deal with issues such as pollution or the use of water for irrigation, yet these are of growing importance when scarce resources come under increasing pressure for different uses and from different users – hence, the rationale for IIASA's latest water resources project on the management of shared rivers, and the source of Salewicz's hope for continuing the tradition of achievement in water resources research. ■

A recent summary paper on IIASA's water resources work, which has an extensive reference section and gives details about the scientists involved, is now available from Dr. Kazimierz Salewicz of IIASA's Environment Program.



GLOBAL WARMING

Winners and losers from climate change

There will be both winners and losers in world agriculture as a result of atmospheric warming from the greenhouse effect, according to a unique study produced jointly by the International Institute for Applied Systems Analysis and the United Nations Environment Program.

The Climate Impacts Project, the first international study of its kind, conducted a set of case studies in 11 regions of the world to measure the impact on agriculture of long-term climate warming due to carbon dioxide, and the effects of short-term disasters such as drought, flood, and pestilence.

The study proposes the following as plausible scenarios:

- the climate in Canada's fertile, wheat-growing prairie provinces will become as dry and windy as the disastrous "dustbowl" period of the 1930s;
- destructive levels of precipitation over northern regions of the USSR may drastically reduce agricultural production;
- in association with warmer weather, production of already highly subsidized rice in Japan could double, with little prospect of exporting the surplus;
- longer growing seasons will greatly benefit agriculture in Finland and Iceland.

These and other scenarios of how a warmer climate will affect agriculture were derived by simulating possible future conditions on sophisticated computer models. The four-year project, led by Dr.

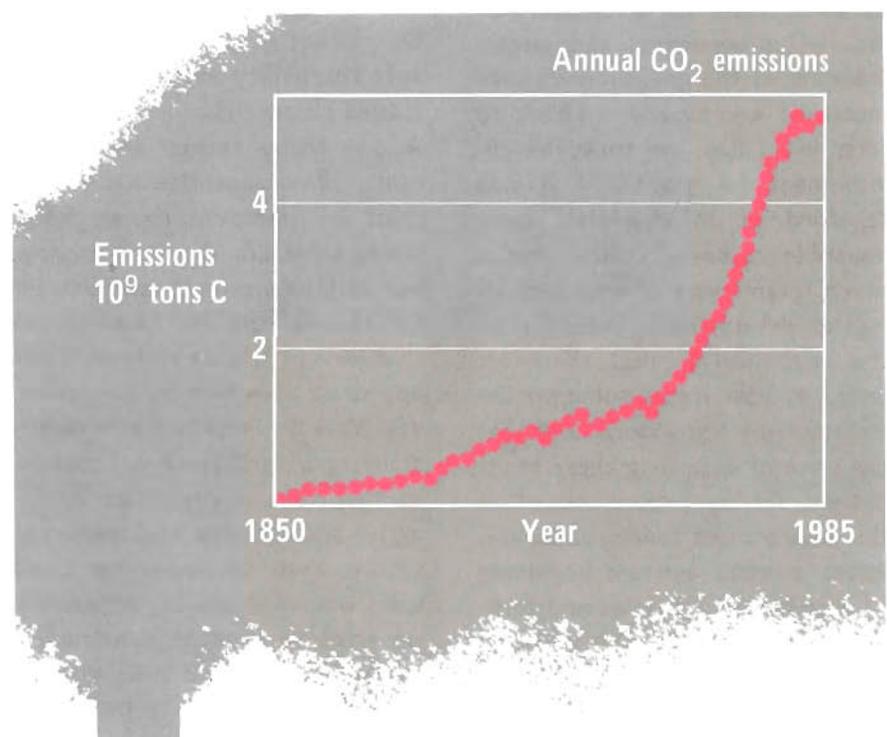
Martin Parry, at IIASA, involved the participation of over 70 scientists in the 11 countries used as case studies.

Results from the study (full details on back cover) have been published by Kluwer Academic Publishers in two volumes under the title *The Impact of Climatic Variations on Agriculture*. Volume one (subtitled *Assessments in Cool Temperate and Cold Regions*) examines the possible effects of long-term carbon dioxide induced atmospheric warming on agriculture in Iceland, Canada, Finland, Japan, and the northern regions of the USSR. Volume two (subtitled *Assessments in Semi-Arid Regions*) deals with the impact on agriculture of short-term disas-

ters such as drought, flood, and pestilence. Case studies were conducted for Ecuador, Brazil, Kenya, India, Australia, and southern regions of the USSR.

The reports conclude that the long-term warming trend, combined with short-term disasters, will produce significant changes in the agricultural potential of many regions of the globe. These changes will bring about geographical shifts in growing patterns, agricultural practices, and policies.

In addition to presenting a plausible picture of how the various regions may be affected, the authors advance recommendations on policies that might be implemented to diminish the negative impacts. ■



Fossil fuel combustion has released increasing amounts of CO₂ into the atmosphere.

INTERVIEW

Prof. Bo Döös

IIASA's established Environment Program will soon be led by the prominent Swedish meteorologist Professor Bo Döös. Professor Döös has extensive experience in international scientific circles and most recently has been a visiting scientist at the US National Climate Program Office in Washington, DC. From 1980 to 1982 he was Director for the WMO World Climate Program in Geneva, and from 1982 to 1986, was manager of the UNEP/WMO/ICSU international assessment of the role of CO₂ and other greenhouse gases in climate change. The following extracts are from an interview held in September.

Q... How has the context for environmental research changed over your lifetime as an environmental scientist?

A... Our awareness and understanding of the environment have increased enormously. Thirty to forty years ago, we took the environment for granted. It was regarded as an absolutely inexhaustible resource. Now, we're much more aware of how technological development impinges on the environment, that there are limits to how much pollution the environment can absorb, and that the price of exceeding these limits is high. We know more about how the environment reacts under different stresses and are beginning to accept that life-styles and technological development have to be adjusted.

Q... What have these changes meant for research?

A... First, they've meant an enormous increase in the volume of environmental research as gaps in our knowledge and the need to fill them have become more apparent. Second, environmental research has become truly interdisciplinary to take account of the interrelation between different factors. Chemists, physicists, meteorologists, and biologists used to work independently. Now, for example, to understand how pollutants interact in the atmosphere we have wholly new disciplines such as atmospheric chemistry; in connection with climate change, meteorologists interact with biologists and agronomists. Third, the research emphasis has changed. It's no longer sufficient just to observe developments. The question being asked is "what can we do?"

Q... What must be done to ensure the utility and relevance of future research?

A... Many things are important. Environmental monitoring must be improved so we know where we stand. We must improve our ability to project environmental change and its impacts, so that we can provide early warnings and draw attention to key issues. We have to improve our understanding of environmental change, so that we can formulate meaningful and efficient responses and ensure that developments don't get "out of hand". Above all, we have to propose constructive solutions. There's also a communication problem to be solved. To increase awareness and achieve positive actions, we have to find



“It's no longer sufficient just to observe developments. The question now being asked is, what can we do?”

ways to express findings in terms policy makers and the public can understand.

Q... Environmental scientists often talk about "sustainable development". Is this just a concept or an attainable goal?

A... There are always limits to ecosystems, both biological and human. So we'd better try to find out both how far we can proceed with development and how we can adjust development so that

INTERVIEW

“There are several things we can confidently initiate now that will buy valuable time – I’m cautiously optimistic.”

we have something to leave to our children. I’m personally reluctant to use the term “sustainable development” since this means different things to different people. We have an important message to get across to nonscientists and need to be much more open and explicit about what we’re doing. Terminology can obscure the message.

Q... But do you think solutions can be found that don’t jeopardize living standards?

A... Many things we do that damage the environment are unnecessary. We waste energy and, in this connection, must remember that energy produced by fossil fuel combustion is the major contributor to pollution. Equally, we waste materials and end up throwing many materials away, creating other environmental problems. Concern for the environment shouldn’t be interpreted as a threat either to development or to living standards. It’s more an opportunity for being imaginative and creative, to explore the possibilities for improving efficiency. We must also remember that the quality of environment is one of those things we appreciate; a component of our living standard.

Q... What do you consider as important continuing and emerging research issues?

A... Climate change is important; the more so because we cannot exclude the possibility of an accelerating development and because of the long lead times, both to enact response measures and for these to show up in the environment. There’s also the related impacts on forests, ecosystems, water resources, and economic activities. Concern continues over environmental acidification and the effects on lakes and forests.

Q... Are you optimistic about the future?

A... Awareness and interest are accelerating, and there are promising developments. The recent global convention on chlorofluorocarbons (the Montreal Protocol) indicates that countries are taking environmental problems seriously and can reach agreements if constructive options are tabled. It won’t be long before governments recognize that many more global conventions are needed. On climate change, there are some positive developments. A newly established intergovernmental panel on climate change will meet in November, and the agenda includes discussion of possible actions. Of course in the case of chlorofluorocarbons, replacement substances were available. It will be more difficult in situations where no obvious single replacement exists, but we shouldn’t think the problem too difficult. There are opportunities for action. On CO₂, for example, emissions could be cut by reducing use of fossil fuels (through efficiency and conservation measures), using gas in preference to coal, and by halting deforestation. Many of these positive steps could be motivated even in the absence of climatic change and are possible using only existing technology. At the same

time, we must remember that the characteristic time scale for environmental change is approximately of the same order as for a response action to take effect. The clear implication is that, where we foresee dangerous developments even several decades in the future, the time to act is now. It’s certainly not premature and we mustn’t waste time, for example, by postponing action until all scientific questions are resolved. There are several things we can confidently initiate now that will buy valuable time. I’m cautiously optimistic.

Q... What role can IIASA play?

A... IIASA has a very important role. I have already said that we can no longer just observe developments. Our responsibility now is to propose solutions. There’s no simple straightforward answer. Solutions require a great deal of research and cooperation between disciplines. At IIASA are gathered together experts and scientific knowledge on population, energy, technology, and economics, as well as environmental issues. If we are to have any good long-term strategy with constructive proposals for action, we will need inputs from all these disciplines. Hardly any other institute in the world has this cross-boundary type of knowledge. At the same time, I might say, this is good for IIASA because it will force the different Programs to work together even more closely. IIASA also has a role in facilitating international cooperation and has a project devoted to questions of international negotiation. This will be important in speeding the process of achieving agreements between countries and obtaining much needed global conventions, although I must emphasize that the absolute base for this is to have constructive proposals. ■

RESEARCH

East-West Joint Ventures

An Inter-Secretariat meeting took place in Paris, France, 1 August, to discuss the potential cooperation of several international organizations in the area of East-West joint ventures. Initiated by IIASA and attended by representatives from UNIDO, UNECE, and OECD, the meeting was aimed at rationalizing work in this area, and improving information flow between the organizations involved. It was agreed that the ECE would begin issuing a newsletter, and that organizations would inform each other of impending meetings and publications at the planning stage, with a view to cosponsorship.

AIDS

The spread of Acquired Immuno-deficiency Syndrome (AIDS) has generated worldwide interest, with a corresponding explosion in the number of publications on the subject. The number of such articles is estimated in excess of 100,000. There has grown a corresponding need among decision makers to be able to access and analyze information about AIDS, in order to make decisions based upon the expected social and economic impact of the disease. To help meet this need, IIASA is engaged in a project to create a unique decision-making software that can be used by social scientists, demographers, economists, physicians, and policy makers. A joint undertaking of the Population Program and the System and Decision Sciences Program, the project will involve several IIASA scientists and be led by Dr. Gerhard Heilig (Population) and Professor Ronald Mohler (System and Decision Sciences).

The final software product will consist of an epidemiological database on AIDS for use on a Personal Computer.

RAINS: Further Applications

IIASA's Acid Rain Project has recently fulfilled a contract on behalf of the Institute for Applied Systems Research and Prognosis (ISP) in Hannover, FRG, to help model air pollution concentrations in urban and industrial areas. A model for estimating the contribution to SO₂ concentrations from local sources was developed by ISP. The contribution from more distant sources was estimated by IIASA using a version of RAINS (the **R**egional **A**cidification **I**nformation and **S**imulation model) that incorporates a long-range transport model developed at the Norwegian Meteorological Institute.

The model is also soon to be implemented in Hungary by the Institute for Economic and Market Research and Informatics (KOPINT), who will organize workshops to teach policy makers and their staff from a wide variety of government agencies, including the National Authority for Environmental Protection and the Ministries of Industry and Transport, how to use the model. The work, which will involve modifying the model to include a detailed description of Hungarian emissions and pollutant deposition, is part of an evaluation exercise focused on practical aspects of implementation.

Developments in Forestry Research

Also in association with KOPINT, Dr. Gabor Kornai, former IIASA research scholar and programmer of the original Forest Products Global Trade Model, will supervise the improvement and reprogramming of the model for implementation on a PC. The PC version, complete with documentation and a user's manual, is expected to be ready by end 1988. A further agreement, with the Academy of Sciences of the GDR, calls for preparation of a custom-built database on the forest resources of the GDR and of their decline. This will be used by IIASA's Forest Study Group.

Soils and Salinization

Agreement has been reached with the Hungarian Committee for Applied Systems Analysis for collaborative research on the vulnerability of European soils and groundwater to salinization. Research is to focus on three important sources of salinization: increasing irrigation, a shift in climate, and rising sea levels. The study, to be carried out by the Hungarian Research Institute of Soil Science and Agricultural Chemistry, will run until November 1988.

Y S S P

Applications for 1989

Each year, from June to September, IIASA holds a work-study program for young scientists. The program offers an opportunity for a small group of exceptional students, mainly from countries with member organizations, to take part in an international exchange of experience and ideas on the development and application of systems analysis. Applications for the 1989 program are now invited from students with interests in the following areas of IIASA research:

Acid Rain; Advanced Computer Applications; Ecologically Sustainable Development of the Biosphere; Population; System and Decision Sciences; and Technology, Economy, and Society. Applicants should be graduate students expecting to gain Ph.D. or equivalent degrees within the next two years. A good knowledge of spoken and written English is essential.

Further details from: **Ms. Margaret Traber, YSSP Coordinator, IIASA.**

Energy and Technology Initiatives

IIASA's Technology, Economy, and Society Program has been awarded two sponsored research contracts. The first, from the Austrian Electricity Board, is for an analysis of developments in energy systems. The work, to be undertaken in association with the Technical University of Graz, will focus on the changing structure and architecture of future energy systems, in Austria and internationally. The second contract, signed with the European Atomic Energy Community (represented by the Commission of the European Communities), is for research on problems associated with introducing major new technologies and ways of overcoming them.

Optimization Research

Agreement has been reached between IIASA's Adaptation and Optimization Project and the Computer and Automation Institute of the Hungarian Academy of Sciences to extend for a further year existing research on interconnected power systems, which incorporates state-of-the-art mathematical techniques to calculate loss-of-load-probabilities. A contracted study agreement has also been signed with the Mathematics Section of Humboldt University, Berlin, GDR, for mathematical investigations on model sensitivity to changes in underlying assumptions about parameter values or model structure. Three areas are highlighted by the present proposal, all of which complement and strengthen the project's ongoing activities: stability analysis in nonsmooth optimization, distribution sensitivity for chance constrained models, and applications of continuation methods for one-parameter nonlinear programs to multiobjective problems.

CONFERENCE CORNER

Recent Conferences

Analysis and Optimization of Systems, Antibes—Juan Les Pins, France, 8–10 June.

Over 170 participants from 21 countries attended this meeting on recent developments in systems analysis and control. Discussion focused on: control of nonlinear systems, optimization and optimal control theory, stochastic systems, and signal processing. The proceedings, edited by A. Bensoussan and J.L. Lions, have been published by Springer-Verlag in its Lecture Notes in Control and Information Sciences, Volume 111.

International Energy Workshop, Honolulu, Hawaii, USA, 14–15 June.

Cosponsored by IIASA, the first Pacific Basin meeting of the International Energy Workshop was organized and hosted by the East-West Center. Papers were presented on the international oil outlook from the long-term perspectives of both Pacific Basin countries and countries in eastern and western Europe.

Effects of River Barrages on the Water Quality of the Danube, Budapest, Hungary, 15–17 June.

Questions have been raised by environmentalists, water quality experts, and representatives of water supply companies about the effect of new and existing barrages on the impounded and downstream river sections of the Danube. This meeting, sponsored by the World Health Organization and IIASA, provided a forum for experts involved in the Danube hydrocomplexes to exchange information and propose common actions.

Dynamic Stochastic Optimization: Approaches and Applications, Sopron, Hungary, 10–15 July.

Participants from 12 countries met to compare two different approaches to optimize decision making under uncertainty, stochastic control, and stochastic programming.

Computer-Integrated Manufacturing: Future Trends and Impacts, Stuttgart, FRG, 18–20 July.

Hosted by the Fraunhofer Institute of Production Technology and Automation, and cosponsored by Carnegie-Mellon University (USA) and the Japanese Committee for IIASA, the second annual workshop of IIASA's Computer-Integrated Manufacturing Project was aimed at analyzing technology trends, diffusion patterns, and social and economic impacts of computer-integrated manufacturing, as well as reviewing the work done by IIASA and its collaborators. Fifty-two participants from 18 countries and four international organizations attended the event.

Forthcoming IIASA Conferences

January 16 – 18: Policy Responses to Large Accidents, Laxenburg, Austria (contact: Dr. Gerhard Krömer of IIASA).

February 20 – 22: "ENVIROTECH '89" – The First International ISEP (International Society for Environmental Protection) Conference on Environment and Technology, Vienna, Austria (contact: Dr. Kurt Fedra of IIASA).

June 20 – 22: International Energy Workshop, Laxenburg, Austria (contact: Dr. Leo Schrattenholzer of IIASA).

Other forthcoming Conferences

April 11 – 14: Seventh Conference on the Meteorology of the Middle Atmosphere, San Francisco, California, USA (contact: R.A. Madden, NCAR, POB 3000, Boulder, CO 80307, USA).

August 14 – 18: International Conference on Soils and the Greenhouse Effect, Wageningen, The Netherlands (contact: A.F. Bouwman, Conference Secretary, tel: 31-8370-19063).

NEWS

IIASA joins IFIAS and SCOPE

IIASA has been accepted as a member of two major international research networks, IFIAS and SCOPE. Launched in 1972 on the joint initiative of the Nobel and Rockefeller Foundations, IFIAS, the International Federation of Institutes for Advanced Study, is an association of almost 40 independent research institutions, which both develops and facilitates international research. Its current program covers human responses to global change, coastal resources management, complex systems, urban risk, science and technology in global economic change, and responses to desertification. SCOPE, the Scientific Committee on Problems of the Environment, is aimed more specifically at providing channels for international and interdisciplinary cooperation in understanding change in the global environment. IIASA's affiliation to the two associations should especially benefit the work of the Environment Program.

Honors and Awards

Three former and current members of the IIASA Council have recently received honors and awards. Professor Howard Raiffa, from the Graduate School of Business Administration at Harvard University in Cambridge, Massachusetts, USA (Founding Director of IIASA, and former US Representative to the IIASA Council), was awarded the honorary degree of Doctor of Laws from Carnegie-Mellon University, Pittsburgh, Pennsylvania, USA. Professor Dr. Fritz Paschke, the Austrian representative, was awarded the Erwin Schrödinger Prize of the Austrian Academy of Sciences, and Professor Wouter Tims, the Dutch representative, has been appointed a foreign member of the V.I. Lenin Academy of Agricultural Sciences of the USSR.

Leader of the Environmental Monitoring Group and Chief Scientist of the Environment Program, Professor Mikhail Antonovski, has been awarded the *Nicolai Copernicus* Medal of the Polish Academy of Sciences, in recognition of his contributions toward the promotion of scientific research and

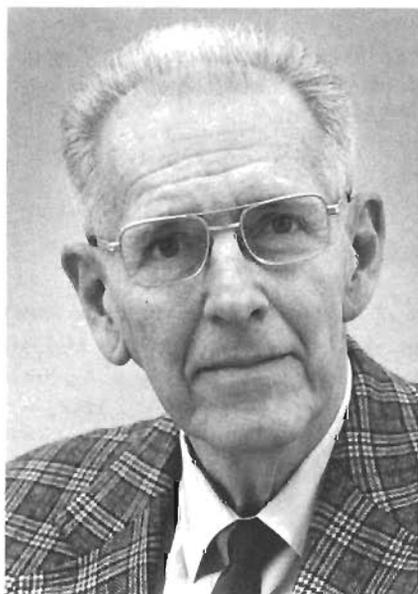
the advancement of Polish scientific activities.

Professor Nathan Keyfitz, Leader of the Population Program, has been appointed an honorary member of the Czechoslovak Demographic Society and, from the same Program, Dr. Wolfgang Lutz has been awarded the advanced academic degree "Habilitation" in *Demography and Social Statistics* by the University of Vienna, an essential step to becoming full professor. The degree was awarded for work on distributional aspects of human reproduction.

New Appointments

Four key appointments have recently been made. Professor Dr. Friedrich Schmidt-Bleek is the new Leader of IIASA's Technology, Economy, and Society Program, joining IIASA from the Society for Radiation and Environmental Research in Munich, FRG. Prominent Swedish scientist, Professor Bo Döös is to succeed Professor Robert (Ted) Munn as Leader of IIASA's Environment Program. Professor Döös, currently a visiting scientist at the US National Climate Program Office in Washington, DC, takes up his new duties from November. The new Secretary to IIASA is Dr. Alexei Koltsov, from the Central Economic and Mathematical Institute (CEMI) of the Academy of Sciences of the USSR, and head of the newly formed Office of Communication is Mr. Jean-Guy Carrier (Canada), formerly senior consultant for the international firm Golin-Harris Communications.

IN MEMORIAM



One of the fathers of systems science – the late Professor Edward S. Quade

Two former members of IIASA's Council, a member of the scientific staff, and a distinguished alumnus have recently died. Professor Dr. Wilfried Nöbauer, the Austrian representative to the IIASA Council since March 1987 and a member of its Research Committee, died in Vienna, Austria, 12 February. The death was also announced of Professor Hiromi Arisawa, the first Japanese representative to IIASA's Council and Chairman of the Japan Committee for IIASA until July 1985. Academician György Kovács, Leader of IIASA's Large International Rivers Project since August 1986, died in Budapest, Hungary, 21 April, and Professor Edward S. Quade, one of the fathers of systems science, died 4 June

Summer Students

This year, 41 new students and one returning Peccei scholar, representing 17 different countries, participated in IIASA's Young Scientists' Summer Program, which ran for three months, beginning mid-June. Students undertook individual and joint research on topics linked to current Institute research.

PUBLICATIONS

Books

Twelve new IIASA books are now off press. Two are products of IIASA's work on the impacts of climate change, and three detail results from the Food and Agriculture Program.

The Impact of Climatic Variations on Agriculture – Volume 1: Assessments in Cool Temperate and Cold Regions. M.L. Parry, T.R. Carter, and N.T. Konijn, editors. Kluwer Academic Publishers: Dordrecht, Boston, London, 1988. ISBN 90-277-2700-7 (cloth), ISBN 90-277-2701-5 (paper).

The Impact of Climatic Variations on Agriculture – Volume 2: Assessments in Semi-Arid Regions. M.L. Parry, T.R. Carter, and N.T. Konijn, editors. Kluwer Academic Publishers: Dordrecht, Boston, London, 1988. ISBN 90-277-2718-8 (cloth), ISBN 90-277-2720-1 (paper).

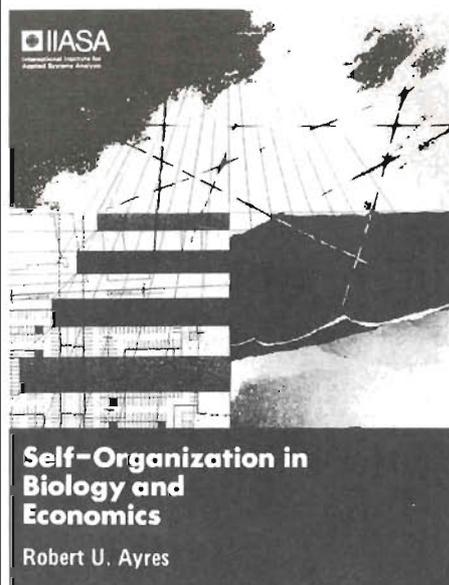
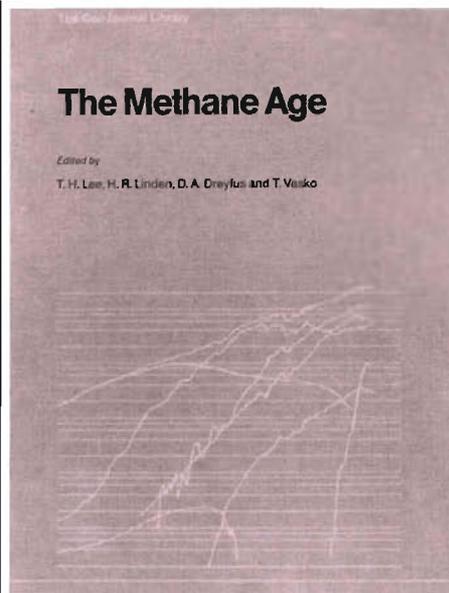
Towards Free Trade in Agriculture. K.S. Parikh, G. Fischer, K. Froberg, and O. Gulbrandsen. Martinus Nijhoff Publishers: Dordrecht, Boston, Lancaster, 1988. ISBN 90-247-3632-3.

Linked National Models: A Tool for International Food Policy Analysis. G. Fischer, K. Froberg, M.A. Keyzer, and K.S. Parikh. Kluwer Academic Publishers: Dordrecht, Boston, London, 1988. ISBN 90-247-3734-6.

Sustainable Development in Agriculture. J.K. Parikh, editor. Martinus Nijhoff Publishers: Dordrecht, Boston, Lancaster, 1988. ISBN 90-247-3642-0.

The Methane Age. T.H. Lee, H.R. Linden, D.A. Dreyfus, and T. Vasko, editors. Kluwer Academic Publishers: Dordrecht, Boston, London, 1988. ISBN 90-277-2745-7.

International Trade in Forest Products. A. Nagy, editor. AB Academic Publishers: Berkhamsted, 1988. ISBN 0-907360-12-2.



Theory of Suboptimal Decisions: Decomposition and Aggregation. A.A. Pervozvanskii and V.G. Gaitsgori. Kluwer Academic Publishers: Dordrecht, Boston, London, 1988. ISBN 90-277-2401-6.

World Mineral Exploration: Trends and Economic Issues. J.E. Tilton, R.G. Eggert, and H.H. Landsberg. Resources for the Future, Washington, DC, 1988. ISBN 0-915707-28-4.

Discrete Event Systems: Models and Applications. P. Varaiya and A.B. Kurzhanski, editors. Proceedings of the IIASA Conference, held in Sopron, Hungary, 3-7 August, 1987. Springer-Verlag: Berlin, Heidelberg,

New York, London, Paris, Tokyo, 1988. ISBN 3-540-18666-2 and ISBN 0-387-18666-2.

Proceedings: Seminar on Remote Sensing of Forest Decline Attributed to Air Pollution. S. Nilsson and P.N. Duinker, editors. Electric Power Research Institute, Palo Alto, California, USA, EA-5715, Research Project 2661-19, 1988.

Modeling and Adaptive Control. Ch.I. Byrnes and A. Kurzhanski, editors. Proceedings of the IIASA Conference, held in Sopron, Hungary, July 1986. Springer-Verlag: Berlin, Heidelberg, New York, London, Paris, Tokyo, 1988. ISBN 3-540-19019-8 and ISBN 0-387-19018-8.

All the above are available from your regular book supplier or from the publisher.

Reports

In addition, the following IIASA reports are now available:

Self-Organization in Biology and Economics. R.U. Ayres, (RR-88-1, 43 pp, US \$6).

Acidification in Europe: A Simulation Model for Evaluating Control Strategies. J. Alcamo, M. Amann, J.-P. Hettelingh, M. Holmberg, L. Hordijk, J. Kämäri, L. Kauppi, P. Kauppi, G. Kornai, and A. Mäkelä. Reprinted from AMBIO, Volume 16, No. 5 (1987). (RR-88-2, 17 pp, US \$10).

Water Quality Modeling: A Review of the Analysis of Uncertainty. M.B. Beck. Reprinted from Water Resources Research, Vol. 23, No. 8 (1987), (RR-88-3, 53 pp, US \$7).

Building Bridges and Tunnels: The Effects on the Evolution of Traffic. C. Marchetti (SR-88-1, 106 pp, US \$15).

All of the above can be obtained from IIASA's Publications Department at the price indicated. For further details contact Robert McInnes.

IIASA Books

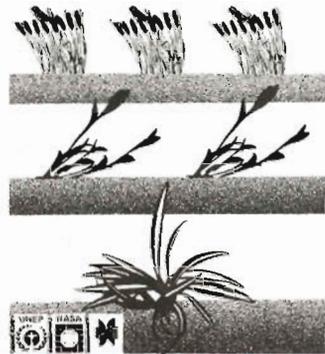
IIASA BOOKS are available from your local bookseller or directly from the publisher.

USA and Canada:
Kluwer Academic Publishers
101 Philip Drive,
Norwell, MA 02061

All Other Countries:
Kluwer Academic Publishers Group
P.O. Box 322
NL-3300 AH Dordrecht
The Netherlands

The Impact of Climatic Variations on Agriculture

VOLUME 1: ASSESSMENTS IN COOL
TEMPERATE AND COLD REGIONS
M.L. Parry, T.R. Carter, N.T. Konijn (Editors)



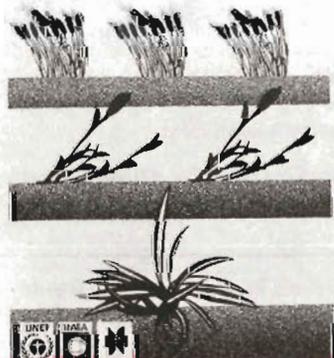
Kluwer Academic Publishers incorporates the publishing programs of D. Reidel, Martinus Nijhoff, Dr W. Junk, and MTP Press.

The Impact of Climatic Variations on Agriculture – Volume 1: Assessments in Cool Temperate and Cold Regions. 1988, 888 pp. ISBN 90-277-2700-7 (cloth), \$99; ISBN 90-277-2701-5 (paper), \$44.

The Impact of Climatic Variations on Agriculture – Volume 2: Assessments in Semi-Arid Regions. 1988, 776 pp. ISBN 90-277-2719-8 (cloth), \$89; ISBN 90-277-2720-1 (paper), \$39.

The Impact of Climatic Variations on Agriculture

VOLUME 2: ASSESSMENTS IN
SEMI-ARID REGIONS
M.L. Parry, T.R. Carter, N.T. Konijn (Editors)



Towards Free Trade in Agriculture. 1988, 368 pp. ISBN 90-247-3632-3 (cloth), \$67.

Linked National Models: A Tool for International Food Policy Analysis. 1988, 227 pp. ISBN 90-247-3734-6 (cloth), \$78.

Sustainable Development in Agriculture. 1988, 395 pp. ISBN 90-247-3642-0 (cloth), \$105.

Sustainable Development in Agriculture

J.K. PARIKH
editor

International Institute for
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