IIASA ANNUAL REPORT

INTERNATIONAL INSTITUTE
FOR
APPLIED SYSTEMS ANALYSIS

ANNUAL REPORT
1973

Laxenburg, Austria

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MEMBERS OF THE INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

ADHERING PROFESSIONAL INSTITUTIONS	COUNCIL REPRESENTATIVES
The Academy of Sciences, Union of Soviet Socialist Republics	Dr. J. M. Gvishiani
The Austrian Academy of Sciences, Austria	Dr. L. Schmetterer
The Committee for the International Institute for Applied Systems Analysis, Canada	Dr. J. R. Whitehead
The Committee for the International Institute for Applied Systems Analysis, Czechoslovak Socialist Republic	Dr. T. Vaško
The French Association for the Development of Systems Analysis, France	Mr. J. Lesourne*
The Academy of Sciences, German Democratic Republic	Prof. H. Koziolek
The Japan Committee for the International Institute for Applied Systems Analysis, Japan	Dr. H. Arisawa
The Max Planck Society for the Advancement of Sciences, Federal Republic of Germany	Dr. F. Schneider
The National Centre for Cybernetics and Computer Techniques, People's Republic of Bulgaria	Prof. L. G. Iliev
The National Academy of Sciences, United States of America	Prof. H. Brown
The National Research Council, Italy	Prof. A. Faedo
The Polish Academy of Sciences, Poland	Prof. R. Kulikowski
The Royal Society of London, United Kingdom	Sir Kingsley Dunham

ORGANIZATION

THE COUNCIL

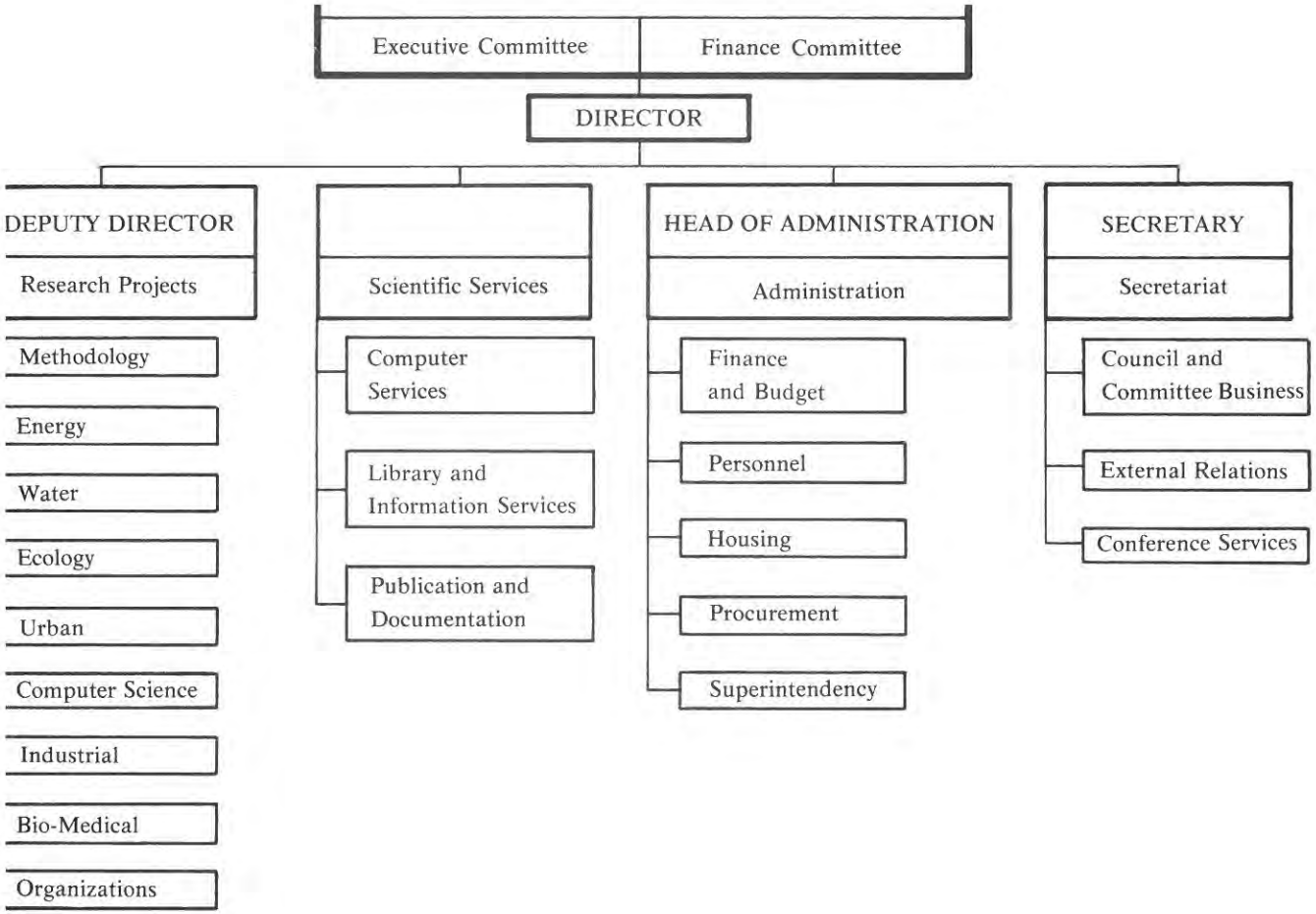
"The Council is the governing body of the Institute and shall be responsible for establishing relations with governments and multi-national bodies; for determining financial and managerial policies, and subject areas for research of the Institute; for settling disputes among the membership; and for ensuring that the activities of the Institute are in line with its objectives, the provisions of this Charter and the interest of member institutions." (Charter of the Institute, Article VI, Section 1)

Council Officers:	Dr. J. M. Gvishiani, Chairman
	Prof. H. Koziolek, Vice Chairman
	Mr. J. Lesourne, Vice Chairman
Secretary of the Institute:	Dr. A. Bykov

COMMITTEES

"There shall be an Executive Committee of the Council composed of the officers of the Council and such additional representatives of the members as may be elected every three years at the time of the annual meeting of the Council pursuant to the provisions of Article VI (10). The Executive Committee may meet upon call of the Chairman and will be authorized under specific instructions from the Council to act on its behalf in carrying out established Council policies between sessions of the Council. Although not a member of the Executive Committee, the Director shall be entitled to participate in its deliberations. The Executive Committee shall report its actions to the Council." (Charter of the Institute, Article VII, Section 2)

Executive Committee of the Council:	Dr. J. M. Gvishiani, Chairman
	Prof. H. Brown
	Prof. H. Koziolek
	Mr. J. Lesourne
	Dr. F. Schneider


Executive Committee
Finance Committee
DIRECTOR
DEPUTY DIRECTOR
Research Projects
Methodology
Energy
Water
Ecology
Urban
Computer Science
Industrial
Bio-Medical
Organizations
Scientific Services
Computer Services
Library and Information Services
Publication and Documentation
HEAD OF ADMINISTRATION
Administration
Finance and Budget
Personnel
Housing
Procurement
Superintendency
SECRETARY
Secretariat
Council and Committee Business
External Relations
Conference Services

"There shall be a Finance Committee composed of the Chairman of the Council and three additional members elected every three years at the time of the annual meeting of the Council, pursuant to the provision of Article VI (10). Although not a member of the Finance Committee, the Director shall be entitled to participate in its deliberations. The Finance Committee shall be responsible for ensuring that the Council is kept informed of all financial matters pertaining to the Institute and, upon appropriate authority of the Council, shall exercise supervision over matters of accounting and audit, annual payments of member institutions, realization of royalties and other revenues, and annual financial reports." (Charter of the Institute, Article VII, Section 3)

Finance Committee of the Council:

Prof. H. Brown, Chairman
Sir Kingsley Dunham
Dr. J. M. Gvishiani
Dr. T. Vaško

DIRECTOR AND DEPUTY DIRECTORS

"The Director shall be the chief executive officer of the Institute and its legal representative. He shall be responsible for the formulation, management and administration of all programmes, projects and other activities of the Institute. He shall have authority to prepare an annual budget and research programme for submission to the Council; to select research projects within the research programme approved annually by the Council; to enter into contracts and agreements subject to policy guidelines and annual budget authorisations established by the Council; to disburse funds; and, under the guidance of the Council and its Chairman, to represent the Institute in its relations with governments and multi-national bodies. In the performance of his duties, the Director shall give due consideration to the objectives of the Institute, the provisions of its Charter and the interests of all member institutions." (Charter of the Institute, Article IX, Section 1)

"The Director shall appoint, and may dismiss, in accordance with Article VI (10), two deputy directors who will exercise such responsibilities as may be assigned by the Director." (Charter of the Institute, Article IX, Section 2)

Director: Prof. H. Raiffa
Deputy Director: Prof. A. Letov

I. EXPLANATION, REVIEW, AND CONCERN: THE DIRECTOR'S MESSAGE

Howard Raiffa

EXPLANATION

The purpose of the IIASA Annual Report is to summarize the important individual events and overall progress in one calendar year. It presumes a knowledgeable audience whom it addresses not to win over or to excite but to inform in a precise and useful way*.

That this report will come out well into 1974 is regrettable but reflects the internal debates that we have held upon the format and upon the wisdom of producing an account of our first full year. It has been argued that 1973 was so exceptional — having begun without staff or home and lacking until the waning months of the year sufficient scientists to initiate on a moderate scale our research program — that preparation of this annual report was inappropriate. We decided in the end that three principal considerations in favor of a 1973 report outweighed those against:

1. A continuous series of annual reports would constitute a valuable recapitulation of our history and omission of our first full year would pare away a vital part of that history;
2. A record of our first year — although exceptional — is highly important since many Council decisions were made and many procedures initiated that will shape our activities for years to come; and
3. Commentary of our Council Members upon the format and substance of a 1973 Annual Report will provide valuable guidance for subsequent reports.

Howard Raiffa
Director of IIASA

* For readers unfamiliar with IIASA, the IIASA Background Information brochure is recommended as first reading.

REVIEW

Given our present bustling Institute, it is easy to forget that as recently as May 1973 our staff comprised no more than a handful of groundwork-laying administrators housed in one small Baden pension. An important feature of this report is the documentation of our amazing growth:

1. from fewer than a dozen staff members on the first of the year to eighty-six by the end;
2. from a group that in June boasted no scientists to seventeen by December;
3. from twelve to thirteen Council Members as the Austrian Academy of Sciences joined the Institute; and
4. from a small suite of rooms generously put at our disposal by the International Atomic Energy Agency, to a Baden Pension, to an overflowing of the first renovated sections of Schloss Laxenburg and the rapid construction of our Lodge.

These dramatic external signs of growth derived from a series of decisions by the Council which met in January and December of 1973. At the former meeting two momentous decisions set the initial slate of research areas for IIASA and decreed that research should begin in the summer of 1973, guided by a series of planning conferences. The fall Council Meeting digested a tremendous amount of material from the conferences and our research planners and indicated how our Proposed Research Strategy should be restructured as the Research Program for 1974.

The Finance and Executive Committees of the Council each met four times during the year to give commentary and guidance for our progress and to play major roles in formulating policies for approval by the November Council Meeting.

The scientific side showed a continuously better definition of our program:

— through the nine planning conferences attended by NMO representatives and other participants;
— through the autumnal preparation of our Research Strategy for Council consideration;
— through the commentary received upon the Strategy from the Council members;
— through the initiation of research which began to indicate better than any planning could justify which areas were feasible and promising and which were not.

By the end of the year four of our projects — in ecology, energy, methodology, and water — were well under way and had begun to produce results.

CONCERN

I have here dealt, and the body of this report will in the manner of annual reports continue to deal, with the positive aspects of our first full year. In the interests of presenting a fuller picture as a reference point for the future contemplation of our achievements and problems, I should risk a candid admission of our worries at the end of the year:

1. Money. The formal and informal devaluation of the U.S. dollar — in which all our dues contributions are pegged — and a voracious inflation have already seriously threatened the economic viability of IIASA. All our successes in getting a first-rate research program under way faster than anyone thought possible are now jeopardized by the imminent shortage of financial resources.
2. Interdisciplinary program balance. By the end of 1973, our staff was concentrated in the disciplines of economics and in the narrower mathematical fields of systems analysis. I should not be too negative since by many standards we had achieved broad coverage; yet to be fully effective we must do better and strengthen especially the areas of organization science, sociology, law, and medicine.
3. Geographical program balance. Scientists from certain of the national research communities which joined together to found the Institute were still underrepresented at the end of the year. We must keep in mind that genuinely productive cross-cultural cooperation is a cornerstone of the scientific success of IIASA.
4. Scientific support services. It remains to be seen whether our computer and library sections can satisfy the difficult demands that the work at the frontiers of systems science already is placing upon them. The computer section is hampered by our monetary problems which may prevent purchase of the most appropriate machinery, by local problems such as the inadequacy of telecommunications facilities, and by the distance to major computational centers. Our library cannot afford to acquire or maintain extensive archives of our subject areas and must hence devise an innovative information network to expedite needed materials to our scientists. I must record my satisfaction with the competence of the staff we have recruited to lead these areas and with the creativity and energy with which they have set out to resolve their welter of problems. It is, nevertheless, premature to suppose or to announce that all impediments to fully adequate scientific support can be overcome.
5. Our role in international scientific liaison. The Council has repeatedly urged that IIASA develop innovative ways — truly without precedent — to collaborate with scientific institutions around the world. This was reflected in our Provisional Research Strategy which recommended inter-institutional cooperation, information exchange, and conference direction as roles for IIASA. Despite our initial success in getting our in-house research program under way, activity in these allied areas has lagged behind. We intend that the establishment of in-house research serve as the foundation for working out other fruitful modes of international scientific liaison.

The success of this presentation as an initial experimental effort depends upon your frankness in giving us your impressions of it. Please do not hesitate to tell us what has pleased and displeased you, where your curiosity was thwarted by omissions, or where your interest was sated with detail, in this, the first Annual Report of IIASA.

II. COUNCIL ACTIVITIES

OCTOBER 1972 MEETING

The Council of the Institute met three times during the initial fifteen months of IIASA's existence. Its inaugural meeting took place in London on 4 October 1972; the Institute Charter was signed at that time. The Council elected Professor Jermen Gvishiani as its Chairman. Dr. Helmut Koziolek of the Academy of Sciences of the German Democratic Republic and Dr. Maurice Lévy of the French Association for the Development of Systems Analysis were elected Vice-Chairmen of the Council. These officers, together with Professor Harrison Brown of the United States National Academy of Sciences and Dr. Friedrich Schneider of the Max Planck Society of the Federal Republic of Germany, assumed membership on the Executive Committee of the Council. Professor Brown (Chairman), Sir Kingsley Dunham of the Royal Society of London, Professor Gvishiani, and Dr. Tibor Vaško of the Czechoslovak Committee for IIASA were chosen to serve on the Finance Committee of the Council.

The Council approved the nomination of Professor Howard Raiffa of Harvard University for a three-year renewable term as the first Director of the Institute. Professor Raiffa's nomination of Professor Alexander Letov of the Soviet Academy of Sciences as Deputy Director was accepted unanimously.

The main order of business at the first Council meeting was to establish IIASA as a going concern. The Council voted to assess member contributions at the maximum rate sanctioned by the Charter: $ 3.5 million annually. The members further agreed to pay at the rate of ¼ of their annual contributions for the final months of 1972 to enable the Institute to begin operations immediately. The bulk of budget surpluses accumulated during the early months was earmarked for pending capital expenses. The Council further authorized Professor Raiffa to establish IIASA on a sound legal basis in Austria, to acquire administrative staff, to negotiate leases with the host country, to open a IIASA bank account, and to initiate renovation of Laxenburg Palace. The Austrian government had pledged to contribute $ 5 million to restore this former summer residence of the Habsburgs ten miles south of Vienna, and to render it a suitable home for the Institute. The Council gratefully acknowledged this generosity.

The Council directed Professor Raiffa to draft a proposed research program and encouraged him to form a scientific advisory committee to help him. The proposed research program would be presented to the Council at its next meeting.

On the practical side, the Council announced its intention that IIASA scientists should have convienent and comfortable living accommodations for their families, an attractive and congenial working environment, and all modes of scientific support services to facilitate their work.

The Council thanked the Royal Society of London for hosting the meeting and expressed appreciation to Lord Zuckerman for his efforts as Convenor.

JANUARY 1973 MEETING

The Council next met on 15 – 17 January 1973 in Vienna. Its central concern was to determine broad subject areas for IIASA scientific research and to formulate a plan of action for the research activities in 1973. Discussion was based upon reports from the Executive and Finance Committees, upon the Proposed Research Strategy submitted by Professor Raiffa, and upon a planning document presented by the USSR member organization. In order better to define the directions of IIASA research, the Council decided to sponsor a series of planning conferences to be held during the summer and early fall of 1973. The Council expressed its concern that methodological research (mathematical, informational, and organizational analysis) proceed to the greatest extent possible from concrete systems analysis problems arising in the applied projects. At the same time, however, the Council felt that theoreticians should have the opportunity to pursue research not directly connected to applied problems.

H. Raiffa, J. M. Gvishiani, and A. Bykov
at the second IIASA Council Meeting

The Council and the Director concurred that IIASA should avoid duplicating research efforts in progress throughout the world and should not embark upon work which could be performed equally well by non-international institutes. Cooperation with other organizations was, nonetheless, essential for IIASA's productivity and effectiveness. The structure of IIASA's research program was likened to a wheel with spokes radiating from the center: the hub of activities would be Laxenburg Palace and the major spokes would reach out to the national member organizations which in turn have at their disposal enormous research networks.

The Director noted the great variety of analytical methods for systems research. Institute methodologists could call attention in dispassionate and constructive terms to those analytical methods that need clarification and thus help to direct scientific efforts (primarily done elsewhere) toward areas which require more work. A handbook on the current state-of-the-art of systems analysis could be one expression of this effort. A chart depicting a provisional organizational structure for IIASA which had been drafted by the Executive Committee was presented to the Council. The chart proposed a division of the Institute into four departments: research, secretariat, scientific services, administration. The Council and Director voiced their great desire that IIASA keep a lean, flexible, non-bureaucratic structure.

In his report to the Council, the Director raised problems of housing, schooling, and office space. The Council approved the establishment of an Institute Housing Authority to acquire residential units, renovate and furnish them, and lease them at reasonable rates to scientific and professional staff. The Council encouraged the Director to take positive action to ensure that the children of Institute scientists would be able to attend schools.

Since the first suite of IIASA offices in Laxenburg Palace would not be ready for occupancy until June, the Council authorized the Director to have temporary office accommodation constructed so that the research program could begin as soon as possible. Professor Raiffa reported that Mr. Stoegerer had been engaged as chief architect for renovation, with Dr. Meitinger of the Max Planck Society (Munich, FRG) acting as the principal architectural consultant and Mr. Forman

The Signing of the Agreement
between the Federal Republic of Austria and IIASA, January 1973

from Austria as architectural assistant.
The Council expressed approval of the general principles underlying administrative regulations established by the Director for IIASA operations (salaries, financial regulations, organizational structure) and approved the proposed budget and the lease agreement negotiated with Austria. In concluding the meeting, the Council and the Director first voiced their gratitude to the International Atomic Energy Agency for generously providing free office space and for consistent help and cooperation. The Austrian Academy of Sciences, which had already given support und guidance, was then invited to become the thirteenth member institution.

NOVEMBER 1973 MEETING

The third Council meeting was held on 27 - 28 November 1973 in Vienna. The most important topic on the agenda was a review of the Director's proposed plan of action for scientific research. This plan, the culmination of discussion by the Director, Deputy Director, and IIASA research scholars about information presented during planning conferences held between June and October, included a research strategy and scientific manning schedule for 1974.
After lengthy discussion and close consideration the Council provisionally approved the research strategy with the understanding that it did not yet constitute, in scientific or budgetary terms, a definite research program. A more concrete, detailed version was to be worked out in the coming months with the collaboration of the Executive Committee. The Council also desired that accountability procedures be devised for IIASA scientific activity. The Director expressed appreciation for the Council's thorough evaluation of the research strategy.
The Council approved a concise budget statement for the coming year and a new scheme for salary increases and provisional financial and staff regulations. The largesse of the Ford Foundation, which granted $ 275,000 to the Institute for housing, schooling, and the Director's discretionary fund, was gratefully noted.
The Austrian Academy of Sciences was welcomed as the thirteenth IIASA member organization, and the Council adopted guidelines for admitting additional member organizations in the future.

III. THE RESEARCH PROGRAM: FROM RESEARCH STRATEGY TO CONCRETE PROGRAM

During the first year of its existence, IIASA moved from the statement of broadly defined research interests toward a more definite but flexible scientific program. By the close of 1973 the Institute had become a center where outstanding scientists from many countries were attacking specific research problems through the systems approach.

PLANNING THE RESEARCH PROGRAM

Research planning conferences held during the summer and fall of 1973 contributed to this progress. Their role was not to generate specific proposals but rather to encourage a free exchange of ideas. More than three hundred distinguished scientists participated in these conferences to help the Institute leaders to identify and discuss research possibilities in nine broad areas.

Planning Conference	Chairman
1. Water Resources	A. Letov
2. Design and Management of Large Organizations	J. Bower and B. Milner
3. Energy Systems	W. Häfele
4. Urban and Regional Systems	M. Rousselot
5. Medical Systems	W. Schwartz
6. Ecological Systems	C. S. Holling
7. Computer Systems	G. Capriz and V. M. Glushkov
8. Automated Control of Industrial Systems	A. Cheliustkin and I. Lefkowitz
9. Organization and Control of Complex Dynamic Systems	G. Dantzig

This series of planning conferences also helped IIASA to begin contacts with a wide variety of institutions, to accumulate information about ongoing research in relevant fields in member countries, and to facilitate recruitment of scientific personnel.

As a supplement to the planning conferences during 1973, seminars and workshops at IIASA provided the Director with suggestions for possible projects and sub-projects. These sessions varied from informal brainstorming to detailed presentation of research in progress. The scientists could thus not only share their current research results, but also enjoy feedback from their colleagues in the ensuing discussions.

RESEARCH POLICY

In 1973 IIASA had not only to determine the substance of its research program but had also to develop a research policy, to define its overall approach to scientific study. The conference experiences and discussions aided the Executive Committee's decisions about a basic approach to implementing the Institute research program. The Committee's resolution — reproduced below — was endorsed by the Council at its November meeting.

"Conclusions of the Executive Committee on the Research Strategy and the Research Program (Annex to Resolution A of the Fourth Executive Committee)

The Executive Committee and the Director together agree that the implementation of the Research Program should:

i. give attention to the problem of concentrating Institute research into few enough project themes, selectively chosen, that its efforts shall not become diffused and thereby weakened, and if necessary relegate certain of the approved broad areas of Institute research temporarily to non-active status with regard to staffing;
ii. seek to identify and develop the unique competence of IIASA, thereby consciously avoiding duplication of the tasks performed by other organizations;
iii. take steps to promote closer linkages between IIASA and other scientific institutions performing allied research — especially on the Institute Council — and, whenever possible, identify research tasks which may be recommended or assigned to such institutions normally without remuneration from Institute funds; and
iv. develop a more explicit strategy for linking and balancing the roles of the Institute as a center for in-house research, as a collaborator and catalyst with other organizations, and as an information agency;

and recognize:

i. that many project areas urgently require outstanding leaders before they can go forward, for which reason the recruitment of such leaders now is a matter of great urgency;
ii. that the quality of scientific staffing for the Institute is a matter of critical importance and urgently requires that the National Member Organizations render all possible assistance to the Directorate by informing and organizing systems researchers within their nations so that capable candidates may readily be recruited;
iii. that vital attention must be given to ensure the cohesiveness of the Program across its various disciplines and projects and the temporal continuity of the research strands beyond the short lifetime of certain projects and the limited appointments of many scientists;
iv. that the proposed Research Strategy for IIASA should include identification and substantial analysis of overlapping areas of the Research Projects and should propose the ways of close scientific cooperation between different groups of IIASA scientists in those areas; and

v. that the Director should appoint, taking into account suggestions by National Member Organizations, small expert advisory committees reporting to himself and to project leaders of the Institute; these advisory committees may: evaluate the progress of certain projects or within certain broad research areas, assist in formulating or in carrying out the research program, report to the Council, and provide counsel upon future project directions."

To implement these conclusions, the Director took a number of steps. These included:
1. creation of a Scientific Advisory Committee composed of Institute scholars;
2. formulation of periodic reporting procedures to record the progress of research activities; and
3. formation of external advisory committees for liaison with IIASA.

In approaching research, IIASA wishes to preserve a healthy attitude toward failure, as not all projects will yield ideal results. A dead end can be a valuable experience if it is perceived in good time and accepted for what it is. IIASA will maintain flexibility in its projects, cutting commitments to unpromising areas and expanding those with appealing potential.

RECRUITMENT

Before strategy and philosophy could materialize as an active program, IIASA needed scientists. From the beginning of the Institute it was a firm tenet that to attract the top stratum of scientists desired it was essential to achieve a necessary "critical mass" of expertise. Without this, the Institute's level of distinction and morale would decline. It is important, moreover, that those who come to do research at IIASA should not have narrow interests but should have demonstrated an ability to do interdisciplinary work. Otherwise many years of acculturation might be required to blend effectively the disparate talents and interests of the scholars.

Four categories of scientific appointments were established:
1. visiting associates for terms of roughly one year;
2. scholars whose tenure was limited to two years;
3. research scholars for shorter periods of time, at least two-thirds of whom would come from member organizations and who would constitute the main corps of IIASA scientific workers; and
4. junior fellows — promising scientists without final degrees, able to complete their academic requirements and simultaneously work on applied projects.

During 1973 recruitment posed certain difficulties because many prospective project leaders and scientists had other commitments. Nonetheless, the first scholars arrived in June. By the end of 1973, thirty-nine scientists were in residence with an additional thirty-four scheduled to arrive during 1974 - 75. The Head of Scientific Recruitment helps the Director and project leaders to identify and recruit scientists from the member countries. An attempt is made to achieve a balanced representation, although this balance may not necessarily be reflected within each project.

STATUS OF THE PROGRAM BY DECEMBER 1973

By the end of 1973, despite predictable growing pains, the IIASA research program comprised nine separately led but closely cooperating projects:

Biological and Medical Systems
Ecology and Environmental Systems
Energy Systems
Industrial Systems
Water Resources
Urban and Regional Systems
Computer Science
Methodology of Applied Systems Analysis
Design and Management of Large Organizations

The format of the final program conception can be expressed as a two-dimensional matrix: on one axis all the applied tasks of IIASA projects, on the other the support projects, including primarily the sectors of computer science, methodology, and organization. Specialists in the support projects were also free to devote a portion of their time to research on theoretical topics to enable them to remain at the frontiers of their various disciplines.

Despite these divisions, IIASA's program was designed to avoid segmentation. The year of planning and discussion revealed a number of significant integrating themes uniting the efforts of those at work on all projects. These themes include environmental standards, technological forecasting, hierarchical systems and control, management involvement in modelling, decision and implementation, technology transfer, risk evaluation, general systems theory, and multiple objectives and value tradeoffs.

At year's end the Director could express satisfaction with the gathering momentum of in-house research, especially in Energy, Environment, Water Resources, and Methodology. As a result of this progress, proportionally more effort can be spent in the coming months to develop IIASA's other roles as a collaborating institution, as an information clearinghouse, and as a conference sponsor. The presence in Laxenburg of many distinguished scholars engaged in meaningful systems research at IIASA will constitute a basis for success in these varied endeavors.

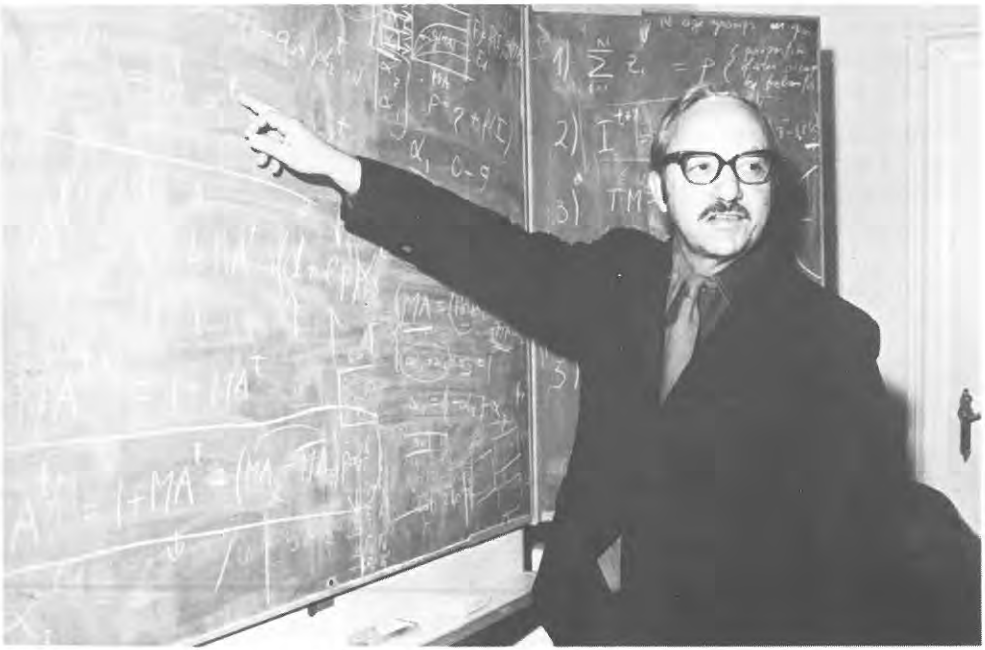
IV. IIASA RESEARCH PROJECTS

History in the future tense is an unusual phenomenon but appropriate to a first annual report. During 1973 a great deal of what IIASA accomplished scientifically was planning what would take place in the coming years. Indeed, if applied systems analysis is to be successful, it must begin with recognizing, defining, and bounding an appropriate problem or constellation of interconnected problems amenable to study. In the course of the year the Institute projects specified their goals with different degrees of exactitude. Some areas had not acquired the necessary leadership or staff by the end of the year; the descriptions of activity in these "seed-phase" areas are thus both briefer and more general than descriptions of the more advanced projects.

PROJECTS IN PROGRESS IN 1973

Methodology of Applied Systems Analysis

Concern for the role of methodology in IIASA's total research program was considerable from the first days of the Institute's existence. Professor G. B. Dantzig, who eventually assumed leadership



G. B. Dantzig, Methodology Project

of the Methodology Project in the fall of 1973, prepared a paper for the Director about research possibilities on total systems models for IIASA as early as December 1972. Discussion at the first and second Council meetings stressed the importance of methodological research in seeking to pursue solutions to problems which the applied projects would generate. As the year advanced, the expectation that various project areas would confront large-scale optimization problems with linear, non-linear, integer, network, and stochastic aspects was confirmed. The methodology research plan thus committed scientists to collaborate with the applied projects. They helped to construct models and to develop software, and worked with computer services to enrich its software library and its computer network capacity. Specific areas of inquiry included linear programming, dynamic programming, decision analysis, and econometrics. All intertwine with current IIASA research, particularly where they clarify and effect improvements in problem areas of simulation models. Further methodological work is done by scholars of the applied projects.

Linear Programming

In the Energy Systems and Water Resources Projects it is possible to represent many of the relations in a model as large systems of linear inequalities, thus opening the way for use of linear programming techniques. The reactor strategy model of the Energy Project, for example, has been reformulated as a linear program. The large number of variables and inequalities in energy scenario optimizations for time horizons extending into the next century requires innovative modelling techniques. The team has obtained and adapted for this purpose special software packages which generate the requisite vast number of matrix input coefficients. Other research in progress aims at refining a method for solving staircase structure linear programs and at creating a variant of a previously successful program for solving block angular systems. Investigation also continues into the use of a continuous form of the simplex method for solving linear control problems with side constraints on the state variables.

Dynamic Programming

Research progressed on methods of prevailing over the "curse of dimensionality" which restricts the use of dynamic programming as a methodological tool. The approach being developed employs polynomials to approximate the pay-off surfaces. This is being tested on a large scale eco-system model for forest management — a joint effort with the Ecology Project. Should the approach succeed, optimal forest management policy will be able to take proper account of the statistical characteristics of weather patterns.

Decision Analysis

Decision analysis topics were investigated, including both multiple objectives and the way time affects evaluation of consequences. Other research — connected with the Energy Project —

included work on stochastic decision models of energy in which the precise availability date of future new technologies is unknown. Risk analysis, particularly as it pertains to safeguards for nuclear reactors and other nascent technologies, is another topic linking methodological study to a concrete application in the Energy Project. A special stochastic model applicable to water resources management is also being developed, together with an algorithm for solving the equivalent non-linear program.

Econometrics

Work in this area included the study of how to approximate or to replace an infinite time horizon problem by one involving a finite horizon. The possible synthesis of two types of models used to study the production possibilities of an industry or even of an entire economy — i.e. models using process analysis with those using production functions — will also be investigated.

Additional work in the Methodology Project included study of control problems and of the use of integer programs for tackling large-scale applied problems with discrete variables.

As a complement to in-house efforts, IIASA has proposed that National Member Organizations set up their own System Optimization Laboratories for the practical testing and comparison of algorithms to hasten the development of efficient techniques for solving large-scale systems. The objective of this development effort is to provide an integrated set of computer routines for systems optimization. The Institute offers to serve as both coordinator and clearinghouse. A first activity might be the completion of a macrolanguage for organizing and calling routines in the software package; this could be largely an extension of a macrolanguage, the Mathematical Programming Language (MPL), being developed at Stanford, California. A second major activity could be the programming, testing, and documentation of algorithms for decomposition and special structures. Computer routines would be thoroughly documented, tested on standard problems, and written in a format compatible with and callable by the macrolanguage.

Energy Systems

This project, under the leadership of Professor W. Häfele, is focused on the systems aspect of energy problems. By and large, this means that not the sum of the components but the structure of the entire problem must be understood. Traditionally this is done by first working through all the details and recognizing only at the end what the structure of the problem as a whole is.

This fragmented approach is not used at IIASA because, among other reasons, it requires extensive manpower. Instead, a systems approach is used to identify and analyze the energy problem in order

1. to understand early the structure of the problem and its implications, and
2. to articulate a number of discipline-oriented scientific and technical questions to be resolved by discipline-oriented research groups.

A zero-order approach to explain the scope of energy systems was made on the occasion of the IIASA Planning Conference on Energy Systems in July 1973 (cf. Proceedings of the Planning Conference on Energy Systems, IIASA-PC-3). Perhaps the most striking feature of the energy problem is its drastic change in nature in the course of time. In the past as well as today the energy problem has been largely one of resources and of the distribution of scarcities, while in the long run there will be virtually inexhaustible resources for the production of energy, such as the fast breeder or solar power. Perhaps the most crucial systems aspect of energy, therefore, is to evaluate the timing of the energy problem: Which problem comes first, and when does what problem come in? This approach stresses the need for establishing and evaluating strategies to support and expedite the understanding necessary for actual decision making.

W. Häfele
Energy Project

Reactor Strategies

It is along this line that the work on reactor strategies has proceeded. The nuclear option for the long-range supply of energy is best understood and much information is available there. The work on reactor strategies studies the conditions for the transition from fossil to nuclear fuels. Of particular interest is the interaction between the limited resources for oil and gas, cheap uranium, and the requirements for reactor construction capacity. The approach is to consider model societies of 250 million people in 1970. This makes it possible to eliminate the open-ended question whether the model adequately reflects the details of existing societies, so that the problems of transition can be concentrated upon and dealt with more directly.

In the work on reactor strategies, discounted total costs have been used as an objective function in the linear programming model. It is obvious that for an assessment of the nuclear option as a whole it is necessary to describe the other aspects of this option comprehensively — for example appropriate levels of reactor safety or long-term waste disposal safety. Considerations of that kind as well as the comparison of the nuclear and the solar energy option will be the subject of further work.

Summary of the Energy Systems Project

GENERAL AREA	SPECIFIC AREAS	SPECIFIC FOCUS	OTHER COOPERATING IIASA PROJECTS	COOPERATING OUTSIDE INSTITUTIONS
A) Availability of natural resources for energy production	a) Mineral b) Geothermal c) Renewable	Literature review; exploitation histories; production costs	—	IAEA ECE (Geneva) OECD Institute for High Temperatures, c/o The USSR Academy of Sciences
B) Energy modelling	a) Analytical comparison of energy sector models b) Computerized information retrieval c) International market models d) Data bases e) Uncertainty and time discounting f) Energy demands and conservation	Comparison of models built in the last 5 years; development of in-house models for different aspects; basis for scenario writing	Methodology, Water	BNL (USA) Kernforschungszentrum, Karlsruhe (FRG) Department of Industry and UKAEA (UK) EdF, CEA (France) Hochschule für Ökonometrie (GDR) Institute for Control Problems, c/o The USSR Academy of Sciences
C) Climate and Water	a) Impact of waste heat b) Hydrological consequences of changed pattern of rain cycle c) Energy, balance of atmosphere d) Solar power and changes of albedo	Understanding of the relation: energy-water-climate in case of large-scale use of energy	Ecology, Water, Urban Systems	British Meteorological Office (UK) NCAR (USA) Hydrometeorological Service, Moscow (USSR)
D) Synthetic hydrocarbon fuels	a) Technological review b) Energy modelling for R&D priorities c) Secondary energy partitions d) Transition into hydrogen e) Energy transport f) Reactor strategies	The medium-range phase of the energy problem, requirements and priorities for R&D in the next 10 years	—	Institute for High Temperatures, c/o The USSR Academy of Sciences General Electric, EPRI (USA) Kernforschungsanlage Jülich (FRG) The Japan Atomic Power Company
E) Reactor siting in a large-scale nuclear economy	a) Zero radioactivity release b) Separation of Pu from the ecosphere c) Waste disposal d) Transports e) Physical protection	Development of scenarios, starting with the case of nuclear energy	Methodology, Urban Systems	IAEA MIT (USA) Kernforschungszentrum Karlsruhe (FRG) Energetics Research Institute (CSSR) Reaktorzentrum Seibersdorf (Austria)
F) Risk evaluation	a) ICRP and other literature studies b) More specific viewpoints c) Quasi laws d) Literature research on life values e) Cultural differences f) Perception of technological risks	Quantification; risk benefit ratios	Ecology, Methodology, Urban Systems	IAEA ICRP? MIT (USA)
G) Accountability	a) Monograph on safeguards accountability b) Generalized application of accountability	Unified presentation of results obtained and application to other areas	Ecology, Methodology	IAEA Kernforschungszentrum Karlsruhe (FRG)
H) Standards and public acceptance	a) Standards for a given toxin b) Comparison of standards for toxins c) Relating standards and risks	Requirements and feedback to society	Ecology, Methodology, Urban Systems	IAEA ICRP?

Resources, Energy Embedding, and Material Accountability

If one wants to deal with energy problems it is mandatory to deal with the question of resources. The deeper one gets into this problem the more complex it becomes. An effort is under way to compile data, incorporating as many countries and regions as possible. We also hope that it will thus become possible to identify systems effects of the use of energy resources, such as pollution, waste, land use, interaction with the hydrosphere, and others. Work on this topic is still in its infancy.

At the Energy Planning Conference the aspect of energy embedding was brought to the forefront; the handling of waste heat was of particular interest. The Energy Group has established contacts with the British Meteorological Office (BMO) and the National Center for Atmospheric Research in Boulder, Colorado (NCAR); it is intended to consider a few typical cases of global circulations, and specifically the problem of placing large primary energy parks in the open ocean. Problems of siting and land use will be examined in collaboration with other IIASA projects.

Finally, a smaller, somewhat more permanent effort is being devoted to the problem of nuclear material accountability verification.

Water Resources

Under the leadership of Professor A. Letov, Deputy Director of IIASA, the Water Resources

A. Letov
Deputy Director of IIASA
Water Project

Project began operation in June 1973. The Project recognizes that improvements in the methodology of water resource design and management can be made only through long-term interdisciplinary research. This requires the interaction of economists, hydrologists, ecologists, mathematicians, and political scientists; the effective use of systems analysis can provide a framework for integrating them. This approach is widely accepted among water resource planners and is promoted in many countries, but has not met wide success in applications to large systems.

Water Resource Development

Two main streams of research are planned for the Water Resources Project. One focuses upon the implementation of large-scale water resource development. Special emphasis will be given to the complex interaction among the physical (hydrological), economic, legal, and political constraints which affect these developments.

Cooperation between IIASA and Poland (the Vistula River) and between IIASA and Hungary (the Tisza River) has been initiated in the area of modelling for large-scale systems. The role of IIASA is to provide a supporting consultative role concerning either specific methodological questions or a general framework in which decision analysis can take place. The areas of cooperation have been agreed upon through meetings between the IIASA Water Resources staff and the appropriate representatives in Poland and Hungary.

Specific Methodological Topics

The other stream of research focuses upon specific methodological issues.

Water Mechanics The mechanics of the movement of water plays an important role in the analysis of proposed flood control systems. The project will study the operation of a (hypothetically) existing water resource system of reservoirs and interbasin transfers which satisfies operational goals such as water demands. Particular emphasis has been given to short-term operating decisions.

Long-Range Resource Planning Problems affecting long-range water resource planning include many factors outside the narrow technical issues. One is the formulation of planning objectives which often follow social or political preferences rather than clear economic preferences. Such planning objectives require the analysis of the reliability or resilience of the proposed system. Another problem is the analysis of the competition for water among users. Such competition may be among objectives (for example power, irrigation, and flood control), or among users (regions or countries). Long-term planning must consider this competition for the use and operation of the system in order to evaluate the tradeoffs in benefits and costs. The proposed research will be embedded within a decision-theoretic framework that will account for the competition for water and for its associated benefits. Applications to the Tisza River in Hungary and to the Puglia-Basilicata regions in Italy are planned. Institute methodologists with special skills in decision theory under conflict will participate in this work.

Water Resource Policy Water resource developments are being studied as instruments of regional or national development policy. The analysis of institutional infrastructure and the political constraints that affect the performance of proposed or existing systems will soon be undertaken.

Environmental Standards The project will examine the role of water resource techniques and issues in establishing environmental standards. Particular attention will be paid to energy generation (nuclear or fossil) and to the siting of primary generating facilities. Another aspect of standards centers on ecosystem management; active collaboration with the Ecology Project has already yielded useful results.

Many of the areas of methodological investigation require collaboration with scientists in other Institute projects. The Water Resources Project is collaborating with the Methodology Project in the study of optimization models and public expenditure theory, and plans collaboration with the Urban Project in the area of regional development.

Ecology and Environmental Systems

The Ecology and Environmental Systems Project was something of an experiment for IIASA. While conferring about the Institute's future with the Canadian IIASA Member Organization, Professor Raiffa approached Professor C. S. Holling who was doing ecological research at the Institute of Resource Ecology, University of British Columbia. It was felt that IIASA might furnish ideal conditions for precipitating results from research he and his group were then engaged in; Professor Holling thus accepted a one-year appointment at the Institute, accompanied by several co-workers. The group brought with them a variety of potential research topics, of which a small number was selected as particularly suited to IIASA's program. By the end of the year this "experiment" — playing host to a team of scientists who, during their stay at IIASA, expand upon previously formulated research — had proved successful.

Management of ecological systems must derive from an understanding of their response to disturbances. Such systems fluctuate widely and are weakly damped. They also demonstrate a high but not infinite resilience, i.e. a capacity to absorb change without structural collapse. A theory based on sound data that 1) succeeds in quantifying relative measures of stability and resilience, 2) copes with the problem of high dimensionality, and 3) takes account of spatial heterogeneity would provide a strong base for a science of environmental management. The Ecology Project is committed to working toward such a theory.

Research has focused on a set of models including a detailed model of an ecological process (predator/prey), a complex simulation model of an applied ecosystem problem (management of the budworm pest in north-temperate forests), and a land-use simulation model of regional recreational development. A version of this last model will provide the foundation for a study of alpine area development. This work is of interest to Italy, France, Austria, and others, and may furnish a modest but useful case study for the large-scale computer model being developed by the

Water Resources Project. All these models have been used to define ways of collapsing state variables, converting them to dimensionless numbers, and generating relative indicators of stability and resilience. The indicators are being illuminated by analysis of well-documented studies of ecological, anthropological, hydrological, and transportation systems. This theoretical analysis has led to a specific framework for establishing environmental standards and for defining optimum management procedures to meet such standards.

C. S. Holling
Ecology Project

The Ecology and Environmental Systems Project has been especially interested in developing approaches which integrate ecological research and modelling with the management process. In this context, the Ecology and Methodology Projects are at present applying techniques of dynamic processing and decision theory to several case study situations. A methodological sub-project has concentrated on establishing a bridge between ecological models and policy analysis. This has required the development of techniques to analyze and simplify existing ecological models and to extend optimization techniques such as dynamic programming to cope with the complex systems encountered in resource management. The Ecology and Methodology Projects are concentrating on a computer model of available data on the spruce budworm. The goal is to provide examples of problems in regional ecological management that combine the best of ecology, modelling, policy analysis, and decision theory.

As a related activity, the ecologists recently designed techniques to develop simple functions of certain key ecological processes which have been shown to have great generality when tested against real data. This raises the possibility of developing a library of "ecological modules" that can be used, as hydrologists now use diffusion equations, as key building blocks for environmental systems models. A report will be completed by late 1974, and a conference should be held in 1975 to establish the protocols for such modules. The following chart shows the overall work plan for the Ecology and Environmental Systems Project.

Summary of Projects and Personnel, Ecology and Environmental Project

GENERAL AREA	SPECIFIC FOCUS	FUNCTION	PRESENT GROUP (UNTIL AUG. 74)	OTHER COOPERATING IIASA PROJECTS	COOPERATING OUTSIDE INSTITUTIONS
Single Species Management	Budworm	Planning and Implementation	Jones (Eco.) Rashid (Eco.) C. Winkler (Meth.) R. Winkler (Meth.)	Methodology	Environment Canada Inst. of Resource Ecology, Canada 1. U.S. Nat. Res. Council Cttee. on Pest Management 2. A USSR analogue?
	New Problem	Planning	Holling (Eco.)		WHO
		Implementation	—	Methodology Biomedical	Imperial College (UK) Institutions in target countries
Ecosystem Management	Alpine Areas	Planning	Holling (Eco.)	Water	4 Italian Institutions 1 Austrian MAB France? OECD Water Mngmt. Institute of Resource Ecology, Canada USSR (Lake Baikal Group)?
		Implementation	—		
Environmental Management	Pollution/ Resource System	Planning and Implementation	—	Industrial Water Energy	Inst. of Applied Cybernetics, Poland Kyoto Univ., Engineering Dept. +?
Behavior of Ecological Systems	Resilience and Stability Measures	Planning and Implementation	Holling (Eco.) Jones (Eco.) Clark (Eco.) Rashid (Eco.) Fiering (Water)	Urban Water	
Indicators	Ecol. ind. and indices	Planning and Implementation	Clark (Eco.)	Urban Water	SCOPE, UNEP
Standards	Resilience and Standards	Planning and Implementation	Fiering (Water) Avenhaus (Eng.) Holling (Eco.)	Water Energy	SCOPE, UNEP
Methodology	Optimization, Modules	Planning and Implementation	Methodology and Ecology Groups	Methodology	
Project Direction and Development	Ecol. and Environ.	Planning and Implementation	Holling (Eco.) 1973/1974	IIASA Scientific Advisory Committee	External Advisory Committee

PROJECTS IN THE "SEED PHASE"

Urban and Regional Systems

At the first Council meeting many members expressed the intense interest of their member organizations in an applied systems approach to municipal affairs. Throughout 1973 IIASA therefore conducted an intensive search for a project leader. The appointment of Dr. H. Swain whose tenure begins in January 1974 promises rapid acceleration of project development.

H. Swain
Urban Project

Two streams of work are planned, one at the level of national urban systems and policies, and the other at the level of the metropolitan region and its key components.

National Urban Policy Problems

Most advanced nations have urban or settlement policies for the spatial distribution of population and economic activities. These are concerned not with individual cities but with the dynamics of a whole system of places, large and small, together with their functional relationships, spatial structure, and territorial specialization. As formulated at present, most such policies seek to moderate growth of the largest places in favor of accelerating the development of the medium-sized areas, often with emphasis on redressing regional economic imbalances. Work at IIASA will concentrate on three areas of inquiry:

1. The theoretical basis for spatial objectives is weak and fragmentary, and needs a multi-disciplinary synthetic approach. In particular, the relation is undeveloped between spatial

distribution objectives at national and macro-regional scales and commonly accepted non-spatial goals — e.g. economic growth and development, social mobility and opportunity, equity and justice, environmental quality. An explanation of the causal links between indicators of the state of economic development and the spatial structure of the economy in both socialist and market economies is fundamental to understanding the larger process.

2. To set the stage for this long-term work, the first step will be a descriptive inventory of national settlement policies in member nations, enumerating goals, rationales for and against policy alternatives, and the tactical instruments or levers being used to implement these policies.
3. Simultaneously, a review paper will be prepared about work to date on theoretical and operational models of national urban systems.

Metropolitan Management

At the level of the city or urban region, the conceptual approach to settlement systems and the opportunity of working with other IIASA projects have suggested specific activities:

1. The demand for management tactics in the supply of urban public goods indicates that this project's contribution to an applied systems analysis handbook could consist of methods for handling location, routing, and scheduling problems along with case studies of actual applications stressing implementation tactics.
2. Urban form in the energy economy of the future is liable to be radically different from the present form. It is anticipated that joint studies with the Energy Systems Project will deal with energy-conservative urban design, and with conflict resolution in the siting of energy production and transmission facilities.
3. A related problem is to broaden the criteria for the design of urban form and organization to include resilience concepts in the resulting system: translation into urban planning terms of the powerful concepts being formulated in the Ecology Project.

Computer Science

IIASA's early research strategy sought to combine computer services and computer science. Many people, however, questioned the wisdom of attempting to merge the two. Computer services staff members and computer systems scientists have different functions and bring to bear their own viewpoints and methodological expertise. They should cooperate closely to seek mutual support and guidance, but should have sufficient autonomy to pursue their separate goals efficiently.
In the absence of a project leader the choice of research targets in Computer Science has proceeded gradually. Initial discussion identified three possible areas of concentration:

1. forecasting the development of computer systems,
2. computer networking, particularly the examination of objectives and principles for the design and management of large-scale systems of communicating computers, and

3. artificial intelligence, especially semantic aspects of interactive systems.

While these topics will all be explored in the coming years, research in artificial intelligence has been deferred. This is due, in part, to the lack of an adequate computer installation at IIASA (a PDP 10 appears indispensable); moreover, it is not yet clear how to integrate the research in artificial intelligence with the rest of the IIASA research program. A small working group will be convened in 1974 to examine whether it is feasible and desirable for IIASA to enter this field intensively. Professor B. Raphael (Stanford Artifical Intelligence Center) and Dr. A. Butrimenko will prepare a basic paper for the working group.

The technological forecasting methods presented at the Computer Systems Conference by Professor Glushkov seemed to be applicable to a broader subject area than technological forecasting of computer systems. It was therefore considered expedient to coordinate forecasting activity with the Methodology Project. Close collaboration in this field is anticipated with the Institute of Cybernetics in Kiev (USSR).

Because of the explicit interest of at least six national member organizations, computer networking has assumed prominence in computer science planning. IIASA hopes to develop a systems analysis approach to designing and managing computer networks, rather than to concern itself with the technical problems approach now dominating the attention of most institutes involved in the area. The networking project is also relevant to the practical task of developing a IIASA computer network which would connect the Institute's computer center with those in national organizations.

Industrial Systems

Outlines of numerous possible projects were presented and discussed at the Planning Conference in October 1973. It soon became clear that resources would permit only a small number of these to be actively pursued in the immediate future. By the end of 1973, Professors S. A. Cheliustkin and I. Lefkowitz had been designated joint project leaders; they will take up their appointments in mid-1974. Mr. D. H. Kelley will join the project early in 1974.

Initial study will concentrate on the iron and steel industry and upon the machine-building industry, with some attention given also to the chemical industry. In the three main project phases, IIASA scholars will:

1. study and collate the current state-of-the-art;
2. test and compare approaches (especially as between different industries), highlighting the strengths and weaknesses of various systems used in specific circumstances. This work may well give rise to specific research projects, e.g. on the character and operation of hierarchical control systems;
3. publish guidelines for integrated industrial systems design and implementation.

Biological and Medical Systems

Despite all efforts no project leader could be appointed in 1973. On the substantive side, a number of attractive possibilities for IIASA involvement in the area were identified during the Planning Conference in August. Delegates specified six criteria for IIASA bio-medical research:

1. reasonable a priori chances of attaining scientific results;
2. reasonable chances of achieving significant practical results;
3. a time horizon not unduly long;
4. non-prohibitive staffing requirements;
5. suitability for an analytic multi-disciplinary approach; and
6. importance of the problem areas to many nations.

Subsequent consultation with various regional and national authorities led to the selection of four areas for IIASA activity:

1. development of pollutant risk indices,
2. analysis of health care planning procedures,
3. quantitative physiological modelling, and
4. study of Chagas disease.

The World Health Organization expressed interest in collaboration with IIASA and appointed a distinguished British bio-statistician, Dr. Norman Bailey, to coordinate liaison with IIASA. Dr. Bailey will moderate a conference on health care planning in 1974 which will address the problems of projection of demand, allocation of resources, institutions, organizations and management, and health care planning in conjunction with other public activities. It is intended to produce a reference document for the subject as a whole after the conference.

A pilot sub-project on aid to the partially sighted was begun in 1973.

Design and Management of Large Organizations

The overall goal of the project is to apply a systems approach to the design and management of large organizations. Traditional methods for solving organizational problems have been based largely on the expert approach, which depends upon the experience and intuition of managerial specialists and decision makers who apply management principles derived from case studies. The systems approach will apply general systems ideas, mathematical methods, computer simulation, information processing, cybernetics, and control sciences to organizational design and management.

It is already possible to distinguish three broad areas where the input of organizational specialists will be necessary:

1. investigation of the organizational environments whose qualities will determine implementation of the projects;
2. diagnostic analysis of organizations, improvement of existing decision making systems, and design of new organizations for the ASA sub-projects; and

3. organization of research techniques within IIASA.

To determine the internal assistance role of the Organizations Project, the planners will:

1. identify the organizational needs of the IIASA projects on the basis of a questionnaire (February-March 1974);
2. select the most urgent of the problems described, especially those with short-term payoffs in 1974, and set concrete tasks of problem-solving for IIASA organizational specialists (March-April 1974); and
3. analyze all identified organization needs of the IIASA projects and find subjects for co-operation among organizational and other IIASA specialists.

Handbook on the State-of-the-Art of Systems Analysis

Discussion of a IIASA handbook on the state-of-the-art of applied systems analysis began in earnest in January 1973 at the second Council meeting. Such a handbook would include retrospective case studies of planning efforts and an annotated bibliography. Dr. Roger Levien of the Rand Corporation drafted a skeletal design for such a handbook, covering the content, format, and editorial policy:

"The state-of-the-art and the content of applied systems analysis are continually changing. Therefore the format of the product should be such as to facilitate its frequent updating and expansion. Furthermore, the scope of ASA is so broad that if no part of the product were to be available until all were complete, the delay until publication would be very great. Consequently, we propose that the product take the form of four series:

Art of Systems Analysis
Theory of Systems
Methodologies
Applications.

Each series would have extensive cross-reference to the others, and each would comprise a (potentially) large number of individual chapters. These chapters would be published and bound separately (perhaps in a soft cover, punched to fit a series binder). Chapters would be revised as appropriate to reflect changes in the state-of-the-art (every 2, 5, 10 years, depending on the rate of change).

Each chapter should be addressed to the practicing systems analyst, but should take whatever form is appropriate to its purpose: tutorial, case history, 'recipe' for action, state-of-the-art review."

It was agreed to budget the Handbook project for 1974 under Methodology. The Executive Committee planned to discuss Dr. Levien's document before editors and an editiorial review board are appointed.

IIASA SCHOLARS

Month of Arrival		Name	Origin	Project	Term
June	*	Letov, A.	USSR	Water	2 years
		Avenhaus, R.	FRG	Energy	2 years
		Nomoto, A.	Japan	Methodology	1 month
July	*	Häfele, W.	FRG	Energy	2 years
		Miller, J.	USA	Bio-Medical	2 months
		Winkler, R.	USA	Methodology	6 months
		Miyasawa, K.	Japan	Organizations	1 month
August	*	Holling, C.	Canada	Ecology	1 year
		Jones, D.	Canada	Ecology	1 year
		Clark, W.	USA	Ecology	1 year
		Rashid, Z.	Pakistan	Ecology	1 year
September		Bell, D.	UK	Methodology	2 years
		Fiering, M.	USA	Water	9 months
		Manne, A.	USA	Energy	1 year
		Ponssard, J.-P.	France	Methodology	1 year
		Koryavov, P.	USSR	Water	2 years
		Belyaev, I.	USSR	Water	2 years
		Rozanov, Yu.	USSR	Water	2 years
	+	Trappl, R.	Austria	Bio-Medical	4 months
October		Dantzig, G. B.	USA	Methodology	9 months
		Kourochkin, N.	USSR	Energy	1 year
		Feldman, J.	USA	Computer Science	1 month
		Rabar, F.	Hungary	Methodology	3 months
		Hammond, R.	USA	Energy	2 weeks
		Kulikowski, R.	Poland	Methodology	2 weeks
		Patzak, R.	Austria	Energy	1 year
November	+	Bruckmann, G.	Austria	Methodology	15 months
		Charpentier, J.-P.	France	Energy	1 year
		Kiss, I.	Hungary	Organizations	2 months
		Moiseev, R.	USSR	Methodology	2 weeks
		Winkler, C.	Chile	Methodology	1 year
		Tokhadze, V.	USSR	Water	1 year
December		Gambrelle, J.-M.	France	Urban	1 year

* Project Leader + Part-time or consultant

INTERNAL SEMINARS

July	10	K. Miyasawa	Hierarchical Systems
	12	A. Letov	Vector-Valued Optimization
	24	R. Avenhaus	Optimal Allocation of Safeguards Effort: Part I
	26	J. G. Miller	General Theory of Living Systems: Part I
August	2	J. G. Miller	General Theory of Living Systems: Part II
	28	A. H. Murphy	The National Center for Atmospheric Research and Environmental Problems
	28	H. A. Kellner	A Meteorogical Satellite System and its Data Processing
September	7	S. B. Harvey	Data Communications
	7	G. Cogar	Distributed Data Processing
October	9	C. Marchetti	Hydrogen and Energy
	11	R. Kulikowski	Optimization of Pollution Control
	16	E. Beltrami	Routing and Scheduling in New York and Elsewhere
	18	W. Häfele	Aspects of Systems Analysis in the Development of Fast Breeders
	23	A. Manne	Electricity Investments Under Uncertainty: Waiting for the Breeder
	30	R. Avenhaus	Optimal Allocation of Safeguards Effort: Part II
November	6	M. Fiering	The Rise and Decline of Systems Analysis in Water Resources Planning — An Exercise in Storage Yield Analysis
	8	R. Winkler	Probabilistic Forecasting in Meteorology
	13	J.-P. Ponssard	The Value of Information in Competitive Situations
	14	V. Yevjevich	Characteristics of Inputs and Outputs and Methods of Solving Storage Problems in Water Resource Systems
	15	H. Raiffa	Analysis of Decisions with Multiple Objectives
	20	G. Thompson	Generalized Transportation Problems
	21	D. Meadows	World Dynamics
	27	N. Moiseev	Extension of the Theory of Optimal Control
	29	D. Bell	The Art of Integer Programming — Relaxation
December	4	Yu. Rosanov	A Few Methodological Remarks on Maximum Random Cost Functions
	6	M. Thompson	Program Evaluation

V. SCIENTIFIC SERVICES

IIASA's Scientific Services embrace computer services, library and information services, and publication and documentation. The multi-national character of the Institute, the inter-disciplinary nature of IIASA research, and the short duration of scientific appointments make provision of effective scientific services a challenging proposition. The framework established by the end of 1973 promises to provide the type of efficient support necessary for Institute activity.

COMPUTER SERVICES

At a planning meeting held in May 1973, experts from the member nations discussed IIASA's specific situation in relation to computer services. Since the scientists would begin to arrive in June 1973, it was essential that adequate arrangements be made in this respect. Moreover, the standard of such facilities should be high enough to ensure that the research work of the scientific staff not be hampered.

It was generally accepted that until the demands of the projects could be more firmly expressed, the Institute should adopt an extremely flexible policy. In particular, advantage should be taken of several different types of computer facilities in the Vienna area to cope with as much of the immediate requirements as possible. It was a general consensus that an important part of IIASA's function was to develop liaison with computer facilities, primarily in Austria but also in neighboring countries, so that if a particular need arose it could be met quickly. It was also agreed that there was no case at the moment for buying or renting of a large IIASA machine. That decision should be made only when sufficient experience had been gained to evaluate project needs in the light of the relative economics of different ways of meeting them. In both its computer staffing policy and in acquisition policy IIASA should be service-oriented.

Hardware

The Institute installed three interactive terminals in the GE/Honeywell-Bull Mark II network. These terminals (two Hazeltine displays with cassettes and one Terminet teletype) also permitted a dial connection to a Univac 1106 at the Economic and Social Sciences Research Center in Vienna. Capacity to run batch jobs on a CDC 6600 at a data center in Frankfurt was provided. For this, a CDC 732 terminal at Laxenburg was operated over a dedicated line at 2400 baud to Control Data Vienna, thence via a time-multiplexer to Frankfurt. A possible future link may be use of the CDC 732 with a Cyber 74 machine to be installed at the Technische Hochschule in Vienna. Successful cooperation with Austrian telecommunications authorities was found to be essential for effective computer support.

Additional equipment obtained in the latter part of the year included a Hewlett-Packard 9830A desk calculator with plotter and printer. A PDP 11/45 mini-computer was ordered for delivery in the spring of 1974.

Software

It was clear that initially the Institute scientists would be bringing software previously developed for specific machines. The computer planning experts thus felt that in the area of software, as in staffing policy and hardware acquisition, the Institute should be service-oriented. The central computer facility at IIASA should maintain a sufficiently strong programming staff to give the project teams all possible assistance in their software problems. The project leaders were encouraged to bring their own computer experts, familiar with the necessary information and liaison to enable these specialists to solve their problems.
Early planning for equipment purchases and overall policy absorbed much of the time and energy of the Computer Services planners. Nevertheless, discussion began
1. about collaboration with the scholars of the planned project in Computer Science,
2. about computer networking plans for 1974, and
3. about the development of a software clearinghouse function for IIASA.

LIBRARY AND INFORMATION SERVICES

An information services planning meeting convened on May 17. The participants concluded that the Institute should not attempt to amass ASA archives, but rather should make extensive use of available information and library facilities.
Throughout 1973 the hopes of occupying permanent quarters were frustrated by unavoidable delays in renovation. While waiting to move to its permanent quarters, the library was located in cramped working space which imposed serious restrictions upon normal development. Its installation, in January 1974, in the Kronprinz Rudolf suite of Laxenburg Palace should enable the library to make up for lost time quickly.

Acquisitions and Storage

At the close of 1973 the library held 500 books, with 700 more ordered, and was subscribing to 182 periodicals; additional periodicals, reports, and reprints were on order.
It was decided to use the micro-form medium both to store reports and periodicals and to meet requests for IIASA publications from external sources, and the requisite equipment was purchased.
The economics of scientific publishing has been a problem. The escalating price of serials and

books in 1973 was alarming; in many instances subscription prices rose by twenty per cent and book prices increased apace. Since booksellers often cannot afford to hold large stocks, the time lag between ordering and receiving books is considerable. Similar delays occur with journal subscriptions.

In an attempt to reduce these delays, IIASA responded to a suggestion of participants at the October meeting of NMO librarians to try blanket purchasing of publications in IIASA-related fields. The French NMO would make the first trial purchase.

Catalogs

During the year work progressed on a simple computer-based library catalog that will also serve as an information retrieval tool and can be used for accounting. Entry is by optical character recognition, using a Vienna-based bureau; output is flexible, allowing each IIASA project to have its own tailor-made catalog.

Information Services and Abstract Journal

In the absence of a suitable in-house data bank, outside data banks were used to satisfy IIASA's information needs.

A feasibility study for an IIASA Abstract Journal has been made. Much discussion within and outside the Institute must precede final assessment.

Liaison with National Member Organizations

A meeting of NMO-designated librarians was held in late October 1973 at Laxenburg. Participants agreed to help IIASA acquire library material and obtain international loan privileges. They also engaged to furnish lists:

1. of specialist library and information centers,
2. of organizations and individuals at work in IIASA-related areas with whom report exchanges could be arranged, and
3. of nationally important standard reference books, monographs, and handbooks.

Referral Center

Contacts were made with other research organizations to obtain report and publication lists. IIASA plans to explore the utility of a KWIC index which might be helpful in establishing the Institute's referral center role. In this context, collaboration with the Smithsonian Institute, which runs an index of ongoing research, is being explored.

Cooperation with Austrian and Other Libraries

During 1973 local libraries were helpful although their holdings did not aways meet IIASA's needs. Non-Austrian libraries extended help. The copying service of the National Lending Library in the U.K. managed to give IIASA a response time of eight to ten days. The Bayrische Staatsbibliothek and Universitätsbibliothek Frankfurt granted IIASA direct borrowing privileges. In addition a link was forged with VINITI, Moscow; a visit of IIASA's librarians to the USSR, moreover, produced generous contributions in the form of many publications donated to the Institute, and an offer to provide free search facilities. An offer was also made to provide IIASA with a terminal for teletransmission of documents in the network to be established by the USSR State Library. Collaboration with the Royal Society of London and the US National Academy of Sciences has also been arranged.

As a further link with outside information services, the IIASA library became a member of the International Federation of Documentation (FID), Aslib (the Austrian Library Association), and the Austrian Documentation Association.

PUBLICATION AND DOCUMENTATION

The principal accomplishment of Publication and Documentation was editing and issuing the nine proceedings volumes of the IIASA Planning Conferences. Additionally, a brochure containing background information about the Institute and a volume on the Institute's provisional research strategy were produced.

In an effort to establish the Institute publications policy, a study was presented to the Executive Committee at its November meeting. The following series of publications are to be issued:

1. Working Papers, informal documents for internal circulation only;
2. Research Memoranda, describing partial or tentative results, for circulation to NMO's and to a limited number of individuals and institutes collaborating with IIASA or working on parallel projects; and
3. Research Reports, for wide circulation or for publication in journals.

Scientific Publications

1. Research Reports

RR-73-1 Häfele, Wolf. "Energy Systems", July 1973.

RR-73-2 Winkler, Robert L. and Barry, Christopher B. "A Bayesian Approach to Portfolio Selection and Revision", August 1973.

RR-73-3 Reprint — Holling, C. S. "Resilience and Stability of Ecological Systems", September 1973.

RR-73-4 — Winkler, Robert L. "Bayesian Statistical Analysis of Experimental Data", September 1973.

RR-73-5 — Häfele, Wolf. "The Fast Breeder as a Cornerstone for Future Large Supplies of Energy", September 1973.

RR-73-6 — Avenhaus, Rudolf and Häfele, Wolf. "Systems Aspects of Environmental Accountability", September 1973.

RR-73-7 — Bell, David E. "Evaluating Time Streams of Income", October 1973.

RR-73-8 — Winkler, Robert L. "A Bayesian Approach to Nonstationary Processes", October 1973.

RR-73-9 — Winkler, Robert L. and Barry, Christopher B. "Nonstationary Means in a Multinormal Process", October 1973.

RR-73-10 — Dantzig, George B. and Manne, Alan S. "A Complementarity Algorithm for an Optimal Capital Path with Invariant Proportions", November 1973.

RR-73-11 — Winkler, Robert L. and Matheson, James E. "The Elicitation of Continuous Prohability Distributions", November 1973.

RR-73-12 — Winkler, Robert L. and Barry, Christopher B. "Nonstationarity and Portfolio Choice", November 1973.

RR-73-13 — Häfele, Wolf and Schikorr, W. "Reactor Strategies and the Energy Crisis", November 1973.

RR-73-14 Reprint — Häfele, Wolf. "Hypotheticality and the New Challenges: The Pathfinder Role of Nuclear Energy", December 1973.

RR-73-15 — Winkler, Robert L. and Murphy, Allan H. "On the Generalizability of Experimental Results", December 1973.

RR-73-16 — Winkler, Robert L. and Murphy, Allan H. "Subjective Proability Forecasting in the Real World: Some Experimental Results", December 1973.

RR-73-18 — Ponssard, Jean-Pierre. "Zero-Sum Games with 'Almost' Perfect Information", December 1973.

RR-73-20 — Dantzig, George B. "Drews Institutionalized Divvy Economy", December 1973.

RR-73-21 — Dantzig, George B. "A Generalized Programming Solution to a Convex Programming Problem with a Homogeneous Objective", December 1973.

RM-73-1 Holling, C. S. "Description of the Predation Model: Predator-Prey Functional Response", September 1973.

RM-73-2 Winkler, Robert L. "'Risk' and Energy Systems: Deterministic versus Probabilistic Models", September 1973.

RM-73-3 Holling, C. S. "Development and Use of Ecological Modules in Resource Development Simulation", October 1973.

RM-73-4 Bell, David E. "A Group Cut for the Traveling Salesman Problem", October 1973.

RM-73-5 Bell, David E. "Improved Bounds for Integer Programs: A Supergroup Approach", November 1973.

RM-73-6 Charpentier, J.-P. "World Energy Consumption", December 1973.

RM-73-7 Rosanov, Yuri A. "A Few Methodological Remarks on Optimization Random Cost Functions", December 1973.

RM-73-8 Rosanov, Yuri A. "Some Approaches to the Water Project", December 1973.

VI. ADMINISTRATION

FINANCES*

At the end of 1973, National Member Organizations' contributions had lost 60% of their purchasing power in 1968, when the cost calculations for IIASA were originally made. Inflation and the decline in the parity of the US dollar had eroded the value of the IIASA dues contributions, which were fixed at the signing of the Charter at $ 3.5 million for each of the first three full years. The establishment of the Institute in 1973 entailed substantial capital expenses, of which the largest was the temporary office building, the Lodge, built in June for $ 180,000. Other major non-recurrent costs included office furniture, equipment, vehicles, and late in the year, the Digital Equipment Corporation PDP 11/45 mini-computer.

While capital expenditure was $ 500,000, and estimates for 1974 and 1975 total $ 1.8 million, projections show a reduction in 1976 and 1977 to $ 500,000 annually. In contrast, revenue expenditure, of which 85% is accounted for by salaries, will continue to increase proportionately to Institute development. If the Institute continues to expand at the rate foreseen by its founders and reaches the full 75 scientific man-years planned for 1975, it is likely to be in a deficit position by the end of that year.

Taking the Institute's current revenue as 40% of 1968 values, and adjusting it to restore those values, one arrives at an annual dollar budget of 8.75 million. At a dollar to schilling ratio of 1:18, this figure (AS 157 million) is only AS 6 million more than projected 1976 spending. Seen in these terms, projected spending is not far off the initial target.

Julyan Watts
Head of Administration

* For the 1973 auditors' report see Section VII

FORD FOUNDATION GRANT

In 1973, the Ford Foundation approved a grant to IIASA totaling $ 275,000. This enabled the Institute to embark on housing and schooling projects. It also provided a Director's Discretionary Fund which the Director, acting in concert with the Finance Committee, can use to provide for a wide range of IIASA needs during the early years that are not specific to its scientific program.

THE HOME OF THE INSTITUTE

Schloss Laxenburg as seen from the Park

Laxenburg Palace, a summer residence of the Habsburgs fifteen kilometers south of Vienna, fell into disrepair after the Second World War. Having survived for centuries, it might have crumbled past reclaim had not the Austrian Government, together with the Province of Lower Austria and the City of Vienna, offered to restore it at a cost of $ 5 million as the home of IIASA. Renovation of the Blauer Hof is being directed by a leading Austrian architect in collaboration with the Federal Office of Monuments. They are preserving the late Baroque theme while adapting the interior to the demands of a modern scientific institute.

As renovation began, so did the Institute's affairs. Scientists, consultants, and lawyers first met for planning sessions at the Director's apartment in Vienna. The International Atomic Energy Agency

generously lent a suite of offices to the Institute. It became apparent that only limited space in the Palace would be ready in the near future. Consequently, the Director received permission to build the Lodge, a pinewood prefab of thirty-seven offices, a conference room, and a temporary library. The Lodge enabled the Institute to begin its work months earlier than had been thought possible. From March until completion of the Lodge in June, Haus Rosenauer, a former "Pension" in Baden, was rented to accommodate the small Institute staff.

Entrance Hall and One of the Historical Rooms
Before and After Renovation

In June, seventeen beautifully renovated rooms in the Palace were handed over to the Institute; five additional rooms were completed in December 1973. In January 1974 the Library will be ready for occupancy, and computer facilities will be installed. By the end of 1974 the entire Blauer Hof will be completed. (See Section VII.)

The Finance Committee also agreed that offices be rented in Vienna for the Purchasing Department and conferences in the city. Until these premises were found the IAEA generously continued to let IIASA occupy its offices at Traungasse in Vienna.

SUPPORTING SERVICES

The distance from Vienna and the shortage of local facilities have obliged IIASA to provide many in-house services with an expanded support staff (transport, catering, cleaning, and maintenance). During the first month of residence in Laxenburg, for example, cleaning was contracted out at a cost of $ 1,400. Subsequently, IIASA bought modern equipment and hired local cleaners, and now does the job for under $ 600 monthly. In transport, too, substantial savings were made. In a typical month during which two conferences took place, the 5000 kilometers driven by IIASA drivers cost $ 843. The same distance traveled in taxis would have cost three times as much.

Lunch arrangements for IIASA staff were also a problem. A room in the Lodge was turned into a kitchen, and each day for two hours the Lodge conference room becomes a cafeteria. Staff members pay AS 15 for a simple meal; the Institute contributes AS 5 per person and pays the salaries of the cooking staff. The Institute probably benefits from this arrangement as much as the staff, for most people take a half-hour for lunch, have a relaxing stroll in the park, and then resume work. A long-term solution to the catering problem must nevertheless still be devised.

Repair and maintenance of building and equipment have not been a problem since everything is new. So long as the Palace remains a building site, there are workmen about who can help in an emergency. This situation, however, is changing. In addition to the Blauer Hof, IIASA has the Lodge and rented premises in both Laxenburg and Vienna, and so must maintain a total of over 100 rooms by the end of 1974. IIASA's Technical Services will have a workshop to cope with repairs and maintenance.

At first glance the number of administrative support staff may seem high. In fact, however, IIASA has been spending less than had been anticipated by employing its own staff, pursuing a policy of economy through self-help and flexibility in functions.

SALARIES

A salary scale based on the United Nations system was approved at the first meeting of the Finance Committee. It was set in US dollars, but staff were paid in local currency. After the dollar was devalued, the Finance Committee approved a new salary scheme based on the Austrian schilling.

ADMINISTRATIVE SERVICES

Housing

An early problem which the Institute confronted was housing. As an interim solution, a housing service was created to locate, rent, and in some cases furnish apartments for Institute scientists.

This measure not only saved the Institute an estimated $ 100,000 in installation allowances and related costs during 1973, but also spared non-local staff the burden of hunting for a place to live in a strange city.

Haus Rosenauer in Baden is an integral part of the IIASA housing service. Formerly a "Pension", then Institute offices, it is often the first home of staff members before moving into their own apartments. Usually at least a half-dozen nationalities are housed there at a given time. The community spirit and camaraderie that characterizes Haus Rosenauer has helped many new arrivals over initial difficulties in the new environment.

As the Institute grew, the need for a more permanent solution to the problem of inexpensive, comfortable housing became apparent. The Finance Committee therefore authorized the Director to rent several apartments and houses for the professional staff. Moreover, as a long-term solution, the Finance Committee approved the establishment of a Housing Authority as a separate entity within the IIASA organizational structure. The Housing Authority has its own funds to buy land and build housing for the Institute staff.

Seventy-five thousand dollars of the Ford Foundation grant was to be contributed to the assigned capital of the Housing Authority, with a matching amount supplied from Institute funds. The Austrian authorities have shown sympathy for IIASA's housing needs and are committed to financial assistance with the first major housing project.

Schooling

Foreign-language schools in Vienna were overcrowded and unable to accommodate even the small number of IIASA scientists' children who would seek admission. In June, the Finance Committee authorized the creation of an experimental school with equipment purchased with another portion of the Ford Foundation grant. The valuable experience gained persuaded the Director and the Finance Committee of the viability of an international primary school, and plans are proceeding to establish such a school.

General

From the beginning, it has been IIASA policy to do everything possible for those arriving at the Institute. To make the scientists and their families feel welcome and their stay pleasant with freedom from inconvenience and worry, the Housing and Personnel offices provide numerous services. In addition to help with housing and schools, and shopping for furnishings, they extend visitors' visas, register newcomers with the police, clear personal effects through customs, and offer advice on duty-free import privileges. Moreover, Institute members have shopping discounts of five to forty percent at over eighty shops. It is now possible to bank on IIASA premises, to make travel arrangements, and to buy tickets for cultural events. Russian, English, and German language courses are available for staff and their families.

Staff Association

In accordance with IIASA staff regulations a Staff Association exists to promote the interests of personnel. A particularly popular activity of the association was the weekly noontime presentation of current research topics by IIASA scientists for non-scientific staff. Both speakers and audience responded to the communications challenge with relish.

During 1973 the Staff Association planned excursions ranging from walks in the Vienna Woods, to gallery visits in Vienna, to a weekend trip to Budapest. A number of concerts and social events were staged in the historical rooms of the Palace. (See list of these events in Section VII.) In addition, a ski club was formed and winter weekend ski trips were organized for IIASA families.

Reception at IIASA

Chamber Music at Schloss Laxenburg

VII. APPENDICES

APPENDIX A

REPORT OF THE AUDITORS TO THE MEMBERS OF
THE INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

We have examined the annexed financial statements of the Institute for the year ended December 31 1973 and report that, in our opinion, they give a true and fair view of the state of affairs of the Institute at December 31 1973 and of its income and expense for the year then ended.

(Signed) Whinney Murray Ernst & Ernst

March 21, 1974

Expressed in Austrian schillings
and U.S. dollars — Note B

THE INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

BALANCE SHEET
December 31, 1973

	AS	US $
GENERAL FUND		
Balance at January 1, 1973	19,185,347	829,996
Excess of income over expenditure for the year	56,821,400	3,016,345
	76,006,747	3,846,341
REPRESENTED BY:		
NON-CURRENT ASSETS		
Property and equipment, at cost	9,679,562	507,543
less: allowances for depreciation — Note B	(515,622)	(26,902)
	9,163,940	480,641
HOUSING AUTHORITY — Note D	3,000,000	151,057
CURRENT ASSETS		
Cash and bank balances	3,292,845	165,803
Fixed term deposits	79,732,072	4,014,707
Contributions due from member institutions	4,220,250	212,500
Other receivables and prepayments	1,309,074	65,915
TOTAL CURRENT ASSETS	88,554,241	4,458,925
TOTAL ASSETS	100,718,181	5,090,623
less: Payables and accrued charges	3,478,005	175,126
Amount due to Housing Authority	1,373,429	69,156
Members' contribution paid in advance	19,860,000	1,000,000
	24,711,434	1,244,282
NET ASSETS	76,006,747	3,846,341

See notes to financial statements

Expressed in Austrian schillings
and U.S. dollars — Note B

THE INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

STATEMENT OF INCOME AND EXPENDITURE
Year ended December 31, 1973

	AS	US $
INCOME		
Contributions from member institutions — Note B	80,902,500	3,500,000
Interest on deposits	4,139,651	211,520
Grant from Ford Foundation — Note C	3,409,000	175,000
	88,451,151	3,886,520
EXPENDITURE		
Salaries and related costs	11,449,288	597,145
Conference and council expenses	3,313,249	171,194
Consultants' fees and expenses	1,769,260	91,832
Travel expenses	1,017,487	52,905
Administrative and general expenses	3,340,794	174,023
Depreciation — Note B	515,622	26,902
TOTAL OPERATING EXPENDITURE	21,405,700	1,114,001
Exchange loss — Note B	10,224,051	—
Gain on translation into U.S. dollars — Note B	—	(243,826)
TOTAL EXPENDITURE	31,629,751	870,175
EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR	56,821,400	3,016,345

See notes to financial statements

Expressed in Austrian schillings
and U.S. dollars — Note B

THE INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS

HOUSING AUTHORITY — BALANCE SHEET
December 31, 1973

	AS	US $
ASSIGNED CAPITAL —		
LOAN FROM GENERAL FUND	3,000,000	151,057
EXCESS OF INCOME OVER EXPENDITURE		
FOR THE PERIOD		
OCTOBER 1 to DECEMBER 31, 1973		
Interest income	26,922	1,420
less: depreciation	(17,092)	(425)
	9,830	495
	3,009,830	151,552
REPRESENTED BY:		
NON-CURRENT ASSETS		
Household furniture and equipment, at cost	306,656	15,440
less: allowances for depreciation	(25,584)	(1,288)
	281,072	14,152
CURRENT ASSETS		
Fixed term deposit	1,253,050	63,094
Guarantee deposits	102,279	5,150
Balance due from General Fund	1,373,429	69,156
	2,728,758	137,400
	3,009,830	151,552

See notes to financial statements

NOTES TO FINANCIAL STATEMENTS
December 31, 1973

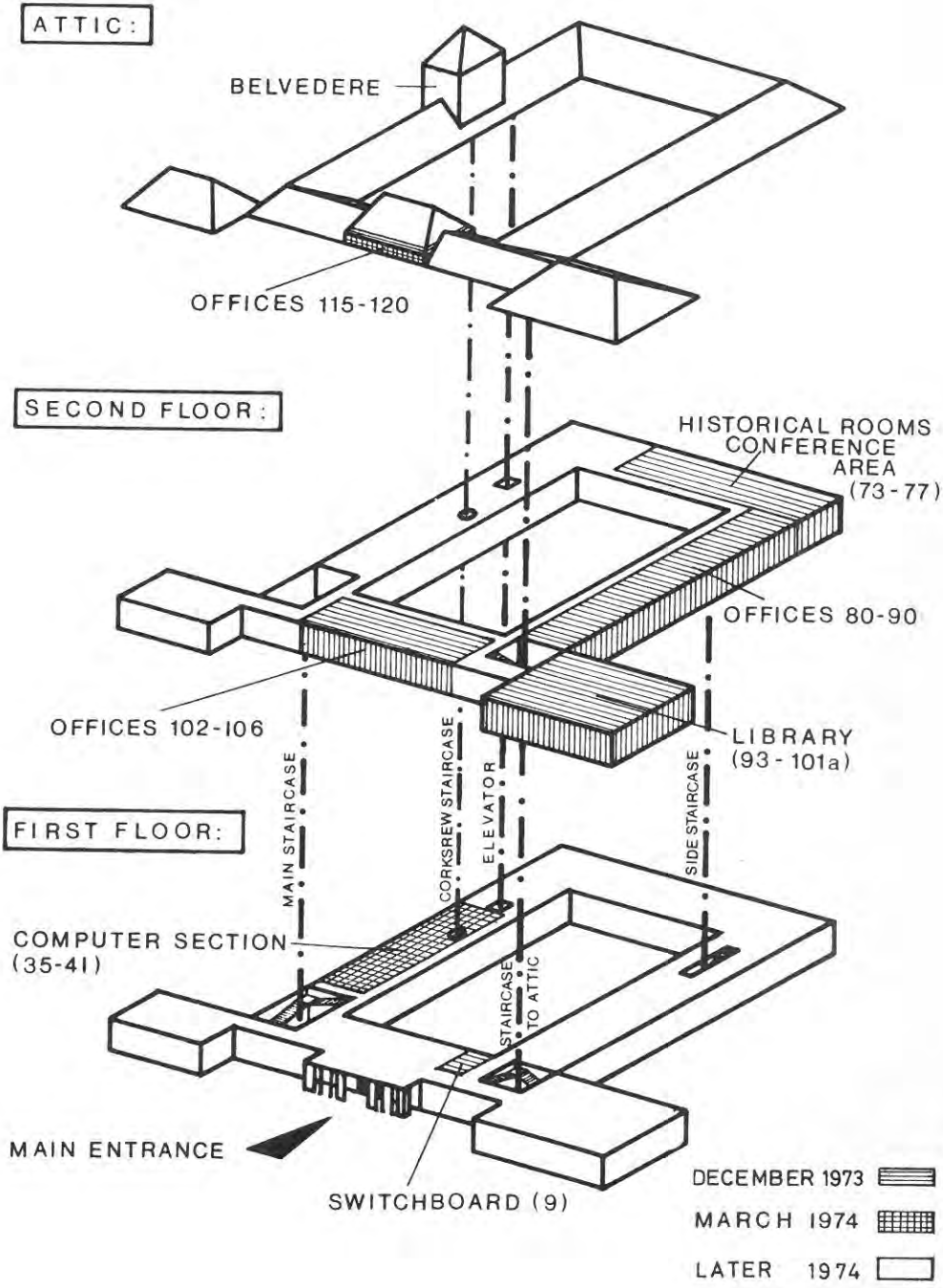
Note A — General

The Institute was formed by charter on October 4, 1972 as an autonomous non-profit institution for the purpose of initiating and supporting collaborative and individual research in relation to problems of modern societies arising from scientific and technological development.

Note B — Accounting Policies

1. General
   The accompanying financial statements have, with the exception of the grant received from the Ford Foundation (see Note C), been prepared in accordance with the accrual method of accounting.
2. Contributions from member institutions
   Contributions from member institutions are recorded as income in the applicable year of assessment.
3. Translation of currencies
   The books of the Institute are kept in Austrian schillings. Transactions in other currencies have been translated into schillings at the following rates:
   Current assets, principally fixed term deposits, at the rate in force on December 31, 1973.
   Contributions from member institutions — which are expressed in US dollars — at the rate applicable on the due date of such contributions.
   Other income and expenditure at rates approximating the actual rates on the dates of the relevant transactions.
   The exchange loss of AS 10,224,051 resulted from fluctuations in the parity of the US dollar against the Austrian schilling.
4. Translation into US dollars
   For the convenience of the reader the accompanying financial statements are also expressed in US dollars, translated at the following rates:
   Current assets and liabilities at the rate in force on December 31, 1973.
   Non-current assets and related depreciation at the rates in force when such assets were acquired.
   Contributions from member institutions at actual US dollar amounts due.
   Other income and expense (except depreciation) at the weighted average rate for the year.
   The gain on translation of $ 243,826 is shown as a separate item in the statement of income and expenditure.
5. Depreciation
   Depreciation is provided by the straight line method at rates based on the estimated useful lives of the relevant assets.

APPENDIX B — BLAUER HOF: PRESENT STATUS



Note C — Ford Foundation Grant

In 1973 the Institute was awarded a grant of US $ 275,000 for specified purposes over a three year period, of which US $ 175,000 (AS 3,409,000) has been received and recorded as income. Expenditure from these funds to date amounts to $ 900.

Note D — Housing Authority

The Institute has established a separate fund for the purpose of providing residential accommodation for its staff. The assigned capital of AS 3,000,000 is to be regarded as a long-term non-interest-bearing loan to the fund.

APPENDIX C
VISITORS, RECEPTIONS, CULTURAL EVENTS

VISITORS

June	9—11	Dr. Hiromi Arisawa, IIASA Council Member from Japan
July	23	Mr. Benjamin Read, German Marshall Fund of the USA
August	13	Dr. Henry Owen, Brookings Institution, USA
	21	Dr. Henry Fischbach, Food and Drug Administration, USA
	23	Dr. William Pendleton, Ford Foundation, USA
September	7	Dr. Slobodan Ristic, ETAN, Yugoslavia
	24	Mr. John N. Warfield, Battelle Institute, USA
	26	Dr. Bodo Bartocha, National Science Foundation, USA
	28	Dr. Ralph Gomory, Chairman of IIASA Sub-Committee of US National Academy of Sciences
October	8	Visit by representatives of the European Coordination Centre for Research and Documentation in Social Sciences, Vienna (OESS) (Prof. Schaff and others)
	11	Mr. R. Talpaert, CISAM, Brussels
	12	Dr. F. Frenkiel and Dr. R. E. Munn of SCOPE
	12	Prof. Arne Jensen, former President of IFORS
		Mr. H. Schirmer, Ambassador of the Federal Republic of Germany to the Federal Republic of Austria
	20	Sir David Martin, Royal Society, UK
November	12	Official visit of members of the Board of the International Atomic Energy Agency, Vienna (Dr. Sigvard Eklund and others)
	20	Messrs. Quinn and Craig, Environmental Protection Agency, USA
	21	Prof. Dennis Meadows, University of Hawaii
	30	Dr. J. Seetzen, International Institute for the Management of Technology (IIMT), Milan
December	3	Dr. O. A. Mikhailov, Director of Department of Documentation, Libraries and Archives of UNESCO
	3	Dr. Charles Dennison, of US National Academy of Sciences, Board of Science and Technology for International Development
	6—7	Mr. Marshall Robinson, Ford Foundation, USA

RECEPTIONS

August	25	Open House at Laxenburg for participants of the International Statistical Conference, held in Vienna
November	26	Official IIASA 1st Anniversary Celebration: Reception at Laxenburg Palace for Vienna Diplomatic Corps and distinguished foreign guests

CULTURAL EVENTS

July	20	Clavichord and Keyboard Music of the Renaissance, Lecture-Recital by Bernard Brauchli, Switzerland
October	6	IIASA 1st Anniversary Celebration for all staff and families: Concert of Chamber Music (Mendelsohn, Haydn) by the New Quartet, Vienna
November	7	Celebration of USSR National Holiday: songs and dances from the Soviet Union, by members of the IIASA staff
December	14	IIASA Christmas Party, for all staff and their families: Recital of Christmas Songs by The IIASA Singers

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