Councils of Urgent Studies

Coordinating councils could focus and legitimize research on solutions of our major crises.

Richard A. Cellarius and John Platt

Scientists and business and political leaders in virtually every country are becoming increasingly aware that the human race is facing more crises than its social and political institutions can handle adequately. The crises are more complex and are arising more rapidly than ever before. The ultimate threat is nuclear annihilation. In addition, the population explosion, coupled with the demand for an improved standard of living, is creating incredible pressures on our environmental life-support systems, to the extent that some scientists fear that these systems may soon fail completely (*1*). The problems of responsive government and of social psychology, as well as the pressures of living together in a world of change, are more intangible, but just as serious.

Many important steps are now being taken to meet these problems. These steps, however, are often shaped to fit existing institutional patterns or to be politically or commercially expedient, while other measures of perhaps equal or greater importance have not yet been started. Moreover, the multitude of crises and their complexity and interactions so overburden the mechanisms that have been designed to handle them that there is a valid fear that these mechanisms will break down at the critical moment and make the disasters worse (*2*).

New mechanisms and perhaps new institutions are needed to cope with these crises. We need solutions that will substantially decrease the threat of nuclear war, that will lead us to ways of life in much greater harmony with our environment, and that will allow all members of the human race to progress toward realizing the potential which our genetic, cultural, and technological endowment makes possible. That potential is very great, but unless we can learn to manage these crises within the next few years, and to deal with problems before they become crises, we will never be able to realize it.

To accomplish this will require the concerted application of all the intellectual resources available to us. It will take not only political and social efforts, but new research and design and pilot studies on hundreds of thousands of different aspects of the problems that face us. The national and world problems are, in many ways, as complex and difficult as the fighting of a war, and they will require research effort on a scale hitherto seen only in wartime (*3*). This research effort will require interdisciplinary research teams and task forces able to deal not only with new scientific or technological solutions, but also with the social and political acceptability of these solutions and the methods of implementing them. Because no one group can be guaranteed success, several groups must be working on each problem. We need to examine multiple approaches, accepting the probability of many failures, without penalizing those who do not come up with the "right answer." The ultimate consumers—the public, government, or business—will need to be involved with the researchers from the beginning, in order that both groups will be aware not only of the potentialities, but of the physical, social, or political requirements that must be met.

Need for Councils of Urgent Studies

Much of this kind of research, especially in the physical and biological sciences and in engineering, is going on already, and many of the solutions may already exist. Several government agencies are now involved in planning, evaluating, and supporting research efforts in some important areas.

Nevertheless, we need a better mechanism, independent of existing agencies, for evaluating what is being done. We also need better mechanisms for handling several related problems: (i) identifying clearly the other areas and types of research that are still needed; (ii) encouraging well-qualified scientists to undertake that research; (iii) helping to assemble task forces with the right mix of different specialties to work together on the same problems; and (iv) helping those who may be interested in such research to locate appropriate funding sources in the government and elsewhere.

In short, what is needed is a group or groups to play the crucial role of bringing together the urgent research problems, the scientists, and the funds —a role similar to that played by Vannevar Bush and his staff in the Office of Scientific Research and Development (OSRD) in World War II.

To do these jobs well requires well-staffed and semipermanent coordinating committees—what might be called "councils of urgent studies"—working at the international level, the national level, and the local level. Such councils might be made up of a small number of well-established and concerned scientists and public leaders, with an adequate supporting staff. They would act in an advisory and coordinating capacity to work for the immediate, large-scale, and continuing attack on the problems of society. We have outlined here how such councils might operate: details of operation, of course, would need to be worked out by the councils themselves.

Mapping the Fronts

The first task of these councils will be the identification of problems and an analysis of their components. For example, nuclear war is a problem, but what are the components that can be worked on practically to strengthen the integrative and stabilizing systems in the world and thereby reduce the probability of war? Cities are a problem, but what technical or organizational studies might show how to restore the cities, create new cities more easily,

Dr. Cellarius is a member of the faculty, Evergreen State College, Olympia, Washington 98505. Dr. Platt is research biophysicist and associate director of the Mental Health Research Institute at the University of Michigan, Ann Arbor 48104.

or improve the quality of suburban and rural life? And so on for dozens of problem areas. There exist study groups, conferences, and reports in many of these areas, but in most cases there is no mechanism for an ongoing or adequate pursuit of the problems they have identified.

It is not enough to have the problems expressed in general terms, whether gloomy or hopeful; there must be lists showing what each branch of science can do. Thus it is clear that population control requires biologists working on reproduction, chemists working on the development of contraceptives and the structure of the biochemical compounds involved in human reproductive control, economists studying the costs and benefits of various approaches in all parts of the world, sociologists examining attitudes and the acceptability of various approaches in different cultures and groups, and educators and communications scientists looking for the most effective means of public information and policy making. To compare such a list with the "science as usual" research in most universities today is to see how far we are from mobilizing our resources for these urgent needs.

As an example of the type of analysis needed, we have classified (see Appendix) a range of urgent research studies by project areas, rather than by the external urgency and intensity of the problems. [The latter classification was used earlier in discussing what we must do (*3*).] The object is not to show just the gross outline represented by the usual lists of three or six or ten problems of human survival, but to show the more detailed anatomy of the hundreds of major research groups and task forces that are needed. Consistent with the wartime analogy, the Appendix is a "map of the fronts," in which we have indicated the present areas of alarm and effort, as well as many other areas where effort now might prevent new crises or might greatly improve our ability to manage problems. It is only by making such a list that we can see how to coordinate these fronts and what is needed in terms of money and manpower.

Items in the list are classified into six broad disciplinary groups, with 25 narrower areas, or divisions, modeled somewhat after the divisions of the National Defense Research Committee of the OSRD in World War II. It is not a map of basic research, but only of projects that may be relevant to the crises of the next 10 to 15 years. Obviously, many of the items represent our personal and idiosyncratic judgments of what studies might be important as catalysts. The divisions and subdivisions would need to be examined and resectioned much more carefully by interdisciplinary committees of experts in the fields involved, and other important divisions may need to be added. In the list here, a few areas have been subdivided more carefully, to serve as examples. Many subdivisions may represent potential multibillion-dollar industries whose beginnings can already be seen; others may represent almost intangible changes of attitudes or habits—changes equally important, if not more important, for survival.

We are not implying that these problems can be solved in general by a "technological fix," a technological solution that greatly simplifies the social and political difficulties (*4*). Such approaches should be examined, of course, and often a technological invention may be crucial to a solution; but we see councils of urgent studies as also stimulating research on social innovations (*5*) and as evaluating all of the combinations of approaches to a problem, including their acceptability to human beings, side effects, long-range consequences, and congruence or conflict with other solutions in other fields.

Perhaps one-third of the research areas in the Appendix have begun to be well supported by government, industry, and foundations in the last few years, with some subdivisions, especially those in the physical technology and biotechnology groups, receiving several hundred million dollars per year. But at the opposite end of the scale, probably one-third of the fields are badly neglected, especially in areas 16 through 18, 20 and 21, and 23 through 25, receiving less than 1 percent as much research support and sometimes with only one research group, or none.

A major function of councils of urgent studies might be to prepare and continually revise such lists (or at least the sections of greatest interest to them), comparing the lists with the research going on in the groups whose work they are coordinating and using the lists to monitor progress and new needs.

State of the Art and Plan of Attack

For each of the divisions and subdivisions of the Appendix, a careful inventory should be made of present knowledge, current local and national research efforts, and the scale of these efforts. A state of the art catalog, prepared and kept up to date by councils of urgent studies, would be extremely useful to scientists who want to know where to begin, as well as to businessmen or political leaders who want a detailed analysis of the directions of possible solutions. It would probably take advanced data-handling technology to manage the volume of material involved and to make it rapidly available.

A comparison of the problems with the state of knowledge would lead to lists of areas where more research and development efforts are needed. The councils might be able to identify promising, or even "far out," solutions that are being neglected. It would be useful to evaluate such solutions, in the form of estimated payoff, in dollars or in crisis-prevention potential. The councils would then recommend needed research efforts, appropriate funding agencies, and the necessary scale of support. Such inventories of needed research would guide scientists who are searching for pertinent problems to work on and educators who must define areas requiring more trained workers, new courses, and new staff. The inventories could also be used by government or other funding agencies as a guide to areas with high potential payoffs.

The preparation of such inventories would take a great deal of staff work and a number of conferences on the scale of the studies done by the National Academy of Sciences a few years ago on the prospects and needs of the various scientific disciplines (*6*). The 1-month study conference in 1970 that was initiated at the Massachusetts Institute of Technology and that resulted in the book *Man's Impact on the Global Environment* (*7*) is a good example of the kind of study needed in virtually all of the 25 divisions of the Appendix. This conference was primarily on area 9, with components in areas 1 and 2; it identified, specifically enough to be a helpful guide for scientists and research agencies, more than 70 problems needing urgent research, invention, or monitoring.

Catalog of Resources

In interdisciplinary areas, scientists often do not know that funds are available for a particular kind of research or how to go about getting such funds. Similarly, many agencies looking for research people to work on a particular project do not know how to identify scientists in related fields or younger scientists who would be well qualified. Councils of urgent studies could serve as clearinghouses for such information, taking the initiative in bringing together the problems, scientists, and funds, like a three-way marriage broker.

This role is particularly important in the case of complex problems requiring input from disciplines that have traditionally had little interaction —in the population problem, for example. In some cases, it will suffice to introduce to each other scientists from different departments in the same institution, or to arrange for frequent conferences or consultations between different centers. In other cases, it may be necessary to establish new research institutes where scientists from the necessary fields can work together on a daily and hourly basis closely enough to achieve a true interdisciplinary meeting of the minds.

Legitimization

Until recently, many scientists have wanted only to pursue basic research and have avoided problems of practical or social significance—except when paid to act as consultants to government or industry. Younger scientists in the universities are not rewarded for undertaking research applied to problems unless they result in the necessary number of publications in the "right" journals. Research on urgent problems, as in war research, is particularly hazardous to the researcher because many problems and solutions need to be studied in parallel, for completeness, even though some of them have a low probability of payoff or usefulness in the long run. This means a much greater rate of failure and the reluctance of scientists, especially younger ones, to risk their careers.

Councils of urgent studies could help overcome some of these difficulties and could greatly increase the number of researchers willing to work on these areas by lending their prestige to the identification of certain practical problems as legitimate areas of research and by helping to find funding. At the national level, they could catalyze the organization of needed annual meetings, new research societies, and new journals. Local councils of urgent studies could also help by acting as independent evaluators of the potential of scientists involved in such research when these scientists are being considered for promotion or tenure.

Marketing

Knowledge is not useful unless it is put to work. We not only need to have solutions in these problem areas, but solutions that the consumers know about quickly and can use in a practical way. Much useful information is buried in technical journals and forgotten. Councils of urgent studies might function as marriage brokers not only between the problems, the scientists, and the funds, but also in the marketing phase, between the research task forces and the consumers who will use the results—the public, businessmen, government officials, or international organizations. It is essential to have sound mechanisms for evaluating technical proposals and transforming them into policy. Intense and fruitful interactions among these groups must be kept up from the time a research project is conceived, through the testing and use of the solutions in the field.

Effective application will often be a political process requiring the buildup of mutual trust from the beginning. "Blue-sky" proposals, or pedantic and overelaborate projects that do not adequately consider feelings and prejudices, are worse than useless. The same is true of good solutions that cannot be tried because of a lack of personal trust or mutual respect between the individuals or groups involved, many of whom will approach these problems with very different backgrounds and assumptions. Such abortive efforts damage credibility, decrease hope for acceptable solutions, and lessen the likelihood of continued funding of other important projects. Alert councils could greatly decrease the chances of these kinds of failures by facilitating easy communication, assisting in the translation of research results into terms that are politically and socially meaningful, maintaining good relations among all the parties involved, and helping in the resolution of differences.

University Councils of Urgent Studies

At the university level, councils of urgent studies might consist of eight or ten faculty members, especially younger faculty, from different departments and schools, as well as well-informed and concerned community leaders. The members would have to be self-motivated and willing to spend considerable time and effort, but they would also need to have official appointments from their departments or organizations, or from the university administration, after being recommended by their departments. This would point out to colleagues the importance and legitimacy of work on these social problems, and it would acknowledge their own participation as an appropriate professional activity.

Such university councils could serve to identify areas of particular expertise within the university, as related to research needs cataloged by, say, a national council. They could facilitate interaction among scientists in different departments interested in working on similar problems. In many cases, they could catalyze the formation of needed interdisciplinary centers or academies for contemporary problems (in or near the university, but not of it), where academic personnel could work part-time on social innovations, applications, or policy studies not appropriate for university funding.

Local university councils could also sponsor conferences on problems, as well as meetings with those elements of the public who would benefit most from new scientific information, assessments, or proposals. They could commission the preparation of summary reports of research projects carried out at their institution, to be used by public agencies, business, or a national council of urgent studies. In many cases, such reports could be sponsored by the local council, but written by students interested in further work in these areas. The councils could help scientists locate funding sources for work in particular areas. Most importantly perhaps, they would help to identify and legitimize the efforts of other researchers who are working on problems outside of traditional department areas.

A university council of urgent studies could also help to identify interdisciplinary and problem-oriented areas of teaching not adequately covered by existing courses or graduate study.

Through independent seminars and research courses, it could introduce students to the research components of our urgent problems. Student projects might also provide valuable aid to a council in the form of data, computer simulations, or reports.

National Councils of Urgent Studies

A national council of urgent studies might consist of 10 to 15 relatively senior natural and social scientists and representatives of various sectors of the public, all committed to the idea that there is a need for greater scientific input into solution of national and world problems. Many of the objectives and functions of such a council are already represented in several government agencies, perhaps most explicitly in the National Science Foundation program of Research Applied to National Needs, as well as in some of the foundation's advisory committees and in some committees of the National Academy of Sciences and the AAAS. But it would seem important to have an ongoing council outside the government, as a body independent of changes of administration and government programs. Such a body could provide both a critique of existing programs and an important outside source of support for programs it regarded as valuable. The council should also be independent of any single foundation, in order that it may tap many sources of funds. While it might be important for the council to be recognized as an official advisory committee by the National Academy of Sciences or the AAAS, it should have a broad, interdisciplinary concern with urgent social problems and a role quite different from any of the committees of existing organizations.

The membership of a national council of urgent studies should include academic, industrial, and governmental natural and social scientists, as well as public leaders who understand the scientific issues and potentialities. The members of the council should probably not serve full time, but, because their problems are as complex and urgent as those of many high-level government advisory committees, they might meet once or twice a month. The term of service on the council should be 3 to 5 years, long enough to allow a member to understand and deal with problems in some depth.

The basic work of the council would need to be carried out by a full-time staff with scientific training. This staff might be composed of younger scientists, with previous experience in their disciplines, who are willing to spend 3 to 5 years in interdisciplinary analysis of information. This staff might be considered, in effect, apprentices to the members of the national council. Much of the staff might work full time in a central office, but others might work more closely, for varying periods of time, with individual council members, assembling information on particular areas of concern or research developments.

It is important that the staff members be technically trained scientists and not merely legal, clerical, or administrative personnel. Younger scientists will be closest to the most recent developments in many fields and will often be particularly concerned with the relevance of science to social problems. Younger and more fertile imaginations could also be good at bringing together ideas from different disciplines. Upon their return to academic or other institutions, these staff people could serve as catalysts, helping to produce, through their teaching and research activities, the next generation of scientists concerned with the ongoing problems of survival and human welfare.

The activities of a national council of urgent studies and its staff would include not only reviews of the available literature, interviews with research groups, and evaluations of projects, written reports, and inventories, but also the assembling and organizing of this data in files, systems analysis and problem simulation, the construction of lists of problem areas, and the identification of points where new research and development could be catalytic. The council would initiate workshops and conferences in neglected areas, both for analysis of problems and for wider public awareness. This would focus attention on these areas, and such conferences might result in reports or white papers detailing the status of problems, alternative approaches, and research needs—see, for example, the global environment report (*7*) or the predicament of mankind studies (*2*). In some cases, these could lead to the initiation of regular annual meetings, new journals, and national or international societies of workers in these fields.

Other state of the art conferences might help to inform and mutually educate the scientists and the consumers, such as social workers, administrators, businessmen, and officials. There might also be periodic reports to the government and the nation by means of television documentaries and other media.

International Councils of Urgent Studies

Many of the major problems that face us today are international in scope. There is a clear need for the coordination of research efforts in the various nations on these problems. An international council of urgent studies—supported by such various sources as the United Nations Educational, Scientific, and Cultural Organization, the World Health Organization, the Food and Agriculture Organization, the World Bank, national governments, international corporations, and private foundations—with a structure and mission similar to that of the national councils outlined above, could be a permanent mechanism for such coordination. Some groups today are already performing some of these functions, for example the Pugwash Conferences, the Club of Rome, the World Ekistics Society, and regional coordinating groups such as the Organization for Economic Cooperation and Development and the European Common Market. But most of these groups are limited in scope or approach and do not have the wide coordinating role that is becoming more and more necessary. An international council could serve the additional purpose of coordinating for developing countries the scientific resources necessary to their further progress, which is an essential component of world peace.

With sufficient funding, an international council of urgent studies could seek out and support the kind of research efforts on world problems that would be inappropriate—or suspect—if sponsored by national governments. This would include the search for adequate peace-keeping mechanisms, as well as the search for solutions to the problems of developing countries in ways that are consistent with the preservation of environmental life-support systems and that emphasize a worldview of natural-resource consumption and pollution applicable to rich and poor countries alike.

Funding

By current standards, it would probably take a minimum of several million dollars annually to support a national council of approximately 15 members and 30 staff in this country, including the cost of data processing and of any major conferences sponsored by the council. Because of travel costs, an international council might require more funds, even though it might not meet as frequently, at least at first. These are modest costs, far less than the support given now to some of the subdivisions in the Appendix, or the support of the planning committees alone in some fields.

A local university council of urgent studies would require much less money because the faculty time needed might be treated as an important committee assignment. The main costs would be for staff and student assistants, except in the case of special conferences.

Of course these sums would grow if such councils began to prove their worth in clarifying, coordinating, or solving important problems. It is to be hoped that this funding would come to be regarded as one of our most valuable investments, repaying the cost many times over to government, industry, the universities, and the public.

Relation to Present Institutions

A large number of organizations are concerned either with the coordination of the scientific establishment or with the solution of particular crises. We would hope that such organizations would be major supporters and sponsors of councils of urgent studies. Conversely, it would not be the mission of these new councils to replace or take over such organizations, but rather to strengthen and supplement their efforts, particularly in the many areas where problems are interconnected, and to provide services such as data bases and research inventories in related fields.

There is at present a bewildering multiplicity of efforts, small and large, in many of these problem areas. Some of these efforts represent parallel approaches that can check and confirm each other, and some represent a valuable diversity; but some represent a costly and unnecessary duplication. One valuable function of the councils would be to provide more coordination and focus in such areas.

It should be emphasized that these councils, particularly on the national and international levels, should not assume the status of policy-making bodies. Rather, they should serve as advisory agencies to the scientific establishment, on the one hand, and to public groups and the policy-making establishment, including industry and legislative as well as executive governmental bodies, on the other. They need to be apolitical, but they also need sufficient guarantee of support and freedom so that they can make critical assessments of national policy when their research indicates this to be necessary to reduce dangerous stresses or to defuse a crisis. These higher councils need to be composed primarily of established and respected scientists in order that their recommendations will have the force of recognized competence and responsibility.

Conclusion

Many thoughtful observers see the predicament of mankind today as a struggle for human survival in the face of these enormous and worldwide problems that have suddenly appeared. In such a situation, groups such as the councils of urgent studies described here might represent a kind of general staff for humanity. Because they would be concerned with all the fronts, they would be searching for fundamental solutions and designs that may be outside the purview of any present-day institution. They would constitute a realistic mechanism by which the efforts of many more scientists can be guided into work on our most urgent problems. It will take a massive effort of our best talent, and there is not much time. But we feel that the guidelines we have suggested could serve as the basis for establishing some form of councils of urgent studies locally, nationally, and even internationally within the current year.

These might become, within a short time, a focus of effort, a public demonstration of scientific concern and intent, and an important catalyst for new research. In some cases, they might have a visible effect on solutions to our problems within a very few years (*5*). The manpower and interest are available. What is needed is self-committed leadership, funding, and the necessary local, national, and international recognition of the crucial role that this new kind of institution could play.

Appendix

The following is a suggested classification of urgent research studies by project areas.

I. Physical technology and engineering (crisis-related)

1) **Energy sources**

- Nuclear power
  - Improved fission power
  - Breeder reactors
  - Fusion power
  - Nuplexes—agro-industrial complexes
  - Radioactive disposal
  - Small portable devices: nuclear batteries
  - Raw material extraction, processing
- Fossil fuels
  - Minehead gasification
  - Pollution reduction
  - Economics for various countries: substitutions
  - Low-level extraction
  - Forecasting
- Other sources and conversions
  - Nonfossil energy: wind, tidal, geothermal
  - Solar power
  - Liquid hydrogen fuel for vehicles
  - New batteries and fuel cells
  - Special solutions for poor countries
- Efficiencies of production and utilization
  - Utilization of waste heat
  - Location of power plants: multiple functions; transmission lines
  - Local and global limits on power production

2) **Material resources**

- Water supply
  - Conservation: regional ecology; management design
  - Nuclear desalination
  - Pollution: waste disposal; recycling; thermal pollution; monitoring
- Minerals
  - Recovery and recycling: systems analysis
  - Low-level extraction
  - Substitutions: needs in poor countries; ecological impact
  - Forecasting
- Land use
  - Classification: multiple use
  - Land resource management
  - Restoration and reclamation
- Air and climate
  - Pollution
  - Heat balance, local and global
  - Weather control: effects of thermal pollution

3) **Structures and replacement**

- Housing and architecture
- Public ways: roads; airports; rail lines; terminals
- City planning and regional planning
- Replacement of structures: speed and esthetics
- Special fast-building, low-cost solutions: do-it-yourself; domes
- Reduction of inefficiency: assembly lines; modules; systems approach

4) **Transportation**

- Auto: traffic; safety; pollution; noise; new engines and fuels

Air: adequacy; convenience; safety; short take-off and landing, vertical take-off and landing; noise
Rail: passenger restoration; speed; quality
Urban mass transit: speed of construction; service and convenience
Marine: new devices for speed and economy
Novel solutions: minibuses; dial-a-bus; systems approach

5) **Electronics and communications**

Cheaper communications and television for developing countries
Satellite education and world communication
New communications and printing methods: microlibraries
Large-scale data handling: management; census; researchers; banking; selling
Knowledge storage, indexing, and retrieval: access for the world
Applications to crime, rights, justice, and privacy
Special applications: person-to-person communications; medicine; household automation; identification and credit

6) **General physical and engineering problems**

Military technology
  Civilian applications
  Pollution and dangers: monitoring
Ocean resources and use
Disaster research
Reliability, maintenance, repair, and recycling: systems approach
Special technical problems in developing countries
Technological forecasting

II. Biotechnology

7) **Population problems**

Better contraceptive methods: blocks to research and testing; side effects; social and political and ethical aspects
Demography: ethnic groups
Genetic surveys: fertility
Mobilities of peoples: urban-rural; unused lands; immigration
Population pressure research
Forecasting

8) **Food and famine**

New grains and agriculture
Alternatives to fertilizers
Microbiological sources: food from petroleum
Food from oceans: fish farming; saline agriculture; ocean farming
Genetic copying of animals for higher yields
Novel sources: digestion of grass; new biology; systems approach
Forecasting

9) **Environmental problems**

Low-level monitoring of pollution: longitudinal surveys
Biological handling of pollution
Ecological survey: local; global; monitoring methods
Ecological control: improved methods in agriculture; fishing; hunting
Ecological education and philosophy: resource-conserving farms and cities
Ecological balance: systems analysis; forecasting

10) **Health—basic research**

Microbiology
Human genetics; eugenics
Development and differentiation: regeneration
Reproduction
Aging
Neurosciences, biopsychology, and behavior
  Optimum environment: crowding; change; artificiality
Theoretical biology: population statistics; evolution; systems theory
Biotechnological forecasting
Medical education: world health education and services; large-scale methods

11) **Health—therapy**

Disease research and cure: cancer; heart-stroke; neurological; aging
Low-level diagnosis: systems approach; continuous health optimization
Artificial organs and transplants
Psychopharmacology and drugs: world survey; long-range effects; poisons
Psychiatry and mental health: sanatoriums; new therapies
Emergency medical care
Nutrition: measurements; prenatal and infant
Public health: mass methods; health care delivery; hospitals; urban-rural
Food and drug monitoring
Large-scale health survey: forecasting
Special problems of developing countries

III. Behavior and personal relations

12) **Behavioral research**

Behavior modification research: social and political effects; ethics
Responsive-environment studies: responsive groups; responsive devices
Child development and training: early enrichment
Dimensions of personality: psychological testing
Psychotherapy: crisis management; rehabilitation
Behavior change and learning with interpersonal games

13) **Education**

Classroom teaching: new materials and methods; class management
Programmed instruction and computer-assisted learning
Educational testing
Special skills: language teaching; vocational
Universities: structures; communities; education for careers and change
Adult education: life problems; retraining; adapting to change; enrichment
Teacher education: community knowledge services; world education
Special problems of underdeveloped countries

14) **Small groups**

Methods of responsive living
Family and neighbor relationships: new community housing and institutions
Group interactions: schools; churches; small business; civic problems
Group-living experiments: religious; behavior-theory; group economics and law
Child-care communities: slums; suburbs; housing and organization
Theory and philosophy of individual-group relations, emotional health
Special new roles: confidant; economic adviser; group therapist; ombudsman

IV. National social structures

15) **Economics**

Inflation: removal without unemployment; relation to credit
Aids to urban restructuring: Urban Development Corps; reducing drain from ghettoes
Problem-solving inventions and organization
  Aids and incentives for the poor: guaranteed income; negative tax
  Financing education
  Aids to other problems: transport; pollution; crime
Steady-state economics: prosperity without consumption of nonrenewable resources; equitable distribution; goals
Economic methods and payoffs for needed governmental restructuring
Large-scale, long-range analysis and theory: simulation; normative

16) **Organizations**

New management methods: innovative-adaptive management; democratization
Improving information handling and decision making
Computerization
Participatory problems and humanization of organizations
Systems analysis: planning-programming-budgeting
Small organizations: business; unions; civic groups; schools; churches; co-ops
Special problems of developing countries

17) **Mass communications**

Press: networks; control; reporter rights; privacy; underground press
Radio-television: cable television; National Educational Television; violence; public feedback; children's programs; news
New media: records; films; neighborhood and small group publications
Mechanisms for increased diversity and freedom: lock-ins
Mass communications as community and world education
Role in change; adaptation of adults; images of change and future; amplification of crises
Cultural upgrading
Theory of effects: systems analysis; forecasting change

18) **Politics**

Improvement in public administration and management
Responsiveness: ombudsmen; participation; elites and checks on them

Incorporation of technical advice and planning: science-technology inputs
Party structures: lock-ins; minority control; instabilities
Political subdivisions: number, size, autonomy, and controls
Reduction of community hostilities
Acculturation: to adulthood; to urbanization; to rapid change
Education for tolerance and democracy
Information handling before and during crises
Mediation and crisis management
Social indicators of choice and stress: opinion polls
Mechanisms of stability and change
Constitutional redesign: checks and balances; nuclear control; welfare
Systems analysis and theory: long-range planning

19) **Urban and rural problems**

Structures: housing; streets; transport; zoning; planning
Inflow-outflow: people; food; water; garbage and sewage; communications
Creation of new cities: regional planning
Political and community structures: neighborhood structures and autonomy
Law and justice: crime prevention; community justice; police honesty; fast trials
Rural and farm problems: migration; economics; quality of life
General welfare: family helps; the good community
Esthetic and cultural requirements: funding; cultural diversity
Megalopolis-state-national relations: councils of governments

20) **Large-scale change**

Population pressures: mitigation; use patterns; redistribution incentives
Quality of life: recreation; esthetics; differentiation; minorities
Social indicators
Systems analysis: forecasting; theory of change; megalopolis-ecumenopolis
Analysis and philosophy of individual-group relationships in modern society
Law and justice in high-interaction world: prisons; police; systems analysis of social patterns with rewards instead of punishments
Special problems in developing countries
Reward systems for social inventions and improvements

V. World structure

21) **Peace-keeping structure**

United Nations revisions
Crisis damping
New feedback-stabilization mechanisms: fast information; feedback to elite
Non-zero-sum game theory research
Contingency plans for possible new peace-keeping mechanisms
Local war mediation and control methods: arms reduction
Arms control and disarmament
Military-industrial lock-ins to policy: conversion to new roles
Systems analysis of alternative world structures

22) **Economic development**

Mechanisms of investment and growth
International monetary stabilization
Large-scale housing for the world
Managerial education and skills
Transition to steady-state consumption: dedevelopment; goals; equity
Special problems of the developing countries: goals of growth; unemployment
Systems analysis

23) **Developing countries**

Population leveling: policy; methods; education; economics; optimization
Food
Health
Power
Education, large-scale: local and world language; television
Easing of change: preservation of values; independence
Damping of racial and national hostilities: education; commercial payoffs
Governmental and political restructuring
Mechanisms of change
Pressures of technology
Education for democratic management
Systems analysis and forecasting: new planning structures; simulation

VI. Channels of effectiveness

24) **Political and economic support of urgent research**

Case studies of social innovations: support; payoffs
Government support of studies
Organization of interdisciplinary centers for urgent studies
Support and coordination of nongovernmental studies: coordination structure
Political and economic channels for application, policy, and action
Technical advisory services to legislatures, industry, and public groups
Self-supporting research developments: new businesses and industries
Contacts and education for broad support: public relations; something for all

25) **Systems analysis**

Mapping of problem areas and studies: resources; progress; feedback
Theory of organization, structure, and growth of urgent studies
Large-scale, long-range systems analysis: world dynamics; hierarchical jumps; the global ecosystem; ecumenopolis
Match of new innovations to long-range directions
Match of new innovations to long-range directions and self-determination
Democratic theory of group and social choices, and checks and balances in the process of complex change
Philosophical structure integrating these changes and studies: long-range evolutionary; normative; personal-behavioral; human benefit and self-fulfillment

References

1. R. A. Falk, *This Endangered Planet* (Random House, New York, 1971); P. R. Ehrlich and J. P. Holdren, *Science* **171**, 1212 (1971).
2. J. Forrester, *World Dynamics* (Wright-Allen, Cambridge, Mass., 1971); D. L. Meadows, D. H. Meadows, W. W. Behrens III, J. Randers, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (Universe Books, New York, 1972).
3. J. Platt, *Science* **166**, 1115 (1969).
4. A. M. Weinberg, *Univ. Chicago Mag.* **59** (No. 1), 6 (1966); A. Etzioni and R. Remp, *Science* **175**, 31 (1972).
5. K. W. Deutsch, J. Platt, D. Senghaas, *Science* **171**, 450 (1971).
6. Committee for the Survey of Chemistry, *Chemistry: Opportunities and Needs* (National Academy of Sciences, Washington, D.C., 1965); Division of Physical Sciences, *Physics: Survey and Outlook—Reports on the Subfields of Physics* (National Academy of Sciences, Washington, D.C., 1966).
7. Study of Critical Environmental Problems, *Man's Impact on the Global Environment: Assessment and Recommendations for Action*, C. L. Wilson and W. H. Matthews, Eds. (M.I.T. Press, Cambridge, Mass., 1970).