III. TASK FORCE REPORTS

Following the presentation of tutorial papers, the attendees were organized into five task forces, to consider problems related to the subject of the conference. There were five such topics, and each task force spent one day on one topic and a second day on another, so that ten task force reports were produced.

The following pages present in sequence the terms of reference of the tasks, a short summary of the task force reports. and the ten reports in full.

Task One: THE MANAGEMENT OF MATERIALS INFORMATION

What can be done to improve the availability of pertinent, timely, reliable, and adequate information in all aspects of the materials life cycle to those who need this information in the conduct of materials programs, projects, application, and policy formulation?

Rationale

Decisions on the management of materials depend on the collection and analyses of many kinds of information. Global management of materials implies many kinds of information from many countries. Many systems of materials information have been established, such as the Canadian resources inventory, the ACS and ASM abstracts, journals, technical evaluation centers, translations, critical tables, standards and specifications, materials characterization, alloy tables, process data, state-of-the-art reports, corrosion and deterioration data, and reports of materials research completed and in progress. The volume of all these data is increasing at an exponential rate. Access to needed information is becoming more difficult, even while the literature becomes more abundant and duplicative.

Questions

1. What technical information should be available to users?
2. Is it possible to approach on a systematic basis the problem of consolidating and codifying materials data and information?
3. How can this body of knowledge be structured for storage, analysis, and access for retrieval to be more efficiently responsive to established consumer needs?
4. What methods of information management could ensure the international compatibility and exchange of materials information?
5. What first steps would be most cost/effective toward a global system for materials information management?
6. What would be a reasonable and feasible set of long range goals for materials information management?
7. Where should the initiative be located for a positive program in this field?

Task Two: THE INCREASINGLY INTERNATIONAL CHARACTER OF MATERIALS ISSUES

What is the scope of materials issues shared in common by the nations of the world for which there exists or could develop a broad motivation for cooperative effort at solution?

Rationale

The impact of national materials decisions on the industrial and economic health of other nations has been dramatized by the Arabian management of petroleum and by the inevitable chain reaction of shortages of other materials. Large-scale materials interactions are increasingly an element of international transactions. Concern for international transfers of technology from developed to developing countries has been a major concern of U.S. policy since before 1950. Questions about the complex role of international corporations are of more recent origin, but are of growing importance. Petroleum and mineral resources of the seabed will require international agreement for their orderly exploitation. Science is traditionally international in character, and technology is increasingly becoming so. How can the further development of science and technology, across the total spectrum of materials management, be conducted to the mutual advantage of all nations?

Questions

1. What are the goals of international cooperation in materials science and technology?
2. Can existing institutions be better used and are additional institutions needed to define goals, develop policies and programs, improve communication, and motivate action toward these goals?
3. What national institutions are needed in the United States and other developed countries to further international cooperation?
4. What is the required information base, in terms of long range supply and demand for materials, to enable policy planning and decision-making?
5. What areas of international cooperation would be most feasible and fruitful in terms of mutual benefit?
6. What are the obstacles to mutual cooperation in global materials management ?
7. Can international programs in materials be effective in the conservation of materials?

Task Three: DESIGN IMPROVEMENTS TO INCREASE EFFICIENT UTILIZATION OF MATERIALS

What design improvements will improve efficiency of use of materials and energy?

Rationale

Design improvements can extend the life of systems and improve the economy without major additional cost. Limits to growth are implied by the energy shortage, the agitation for environmental protection against

pollution, and problems of waste accumulation and disposal. When high grades of ore are depleted, industry turns to leaner grades. To process these requires increased efficiency of extraction, but also higher cost of the material produced. This higher cost, in turn, requires that more use be made per unit of material, or resort to substitutes like wood and glass, to overcome inflation. In addition, there is implied the justification of a more intensive effort to recycle recovered secondary material. In other words, systematic consideration of the entire life cycle of materials is necessary.

Questions

1. What new designs are implied by the need to improve the efficiency of utilization of materials and energy?
2. What unused or under-used technologies could contribute to better utilization of materials and reduced costs?
3. Where are the most rewarding opportunities for design and process improvements? (Viz,, heat transfer.)
4. What materials are available in quantities and at prices to replace depletable hydrocarbons?
5. Can energy input of aluminum and magnesium be justified by the performance properties of these materials, or by their more efficient recycling?
6. What should be the role of Federal regulations in encouraging improvements in design?

Task Four: MOBILIZING ECONOMICS AND TECHNOLOGY FOR MATERIALS RECYCLING

What actions, public and private, could motivate the more complete recovery of waste and greater utilization of secondary materials, thus closing the materials cycle?

Rationale

A host of studies have shown that there is an abundance of technologies to extract useful values from municipal wastes. Agricultural and forest waste are a large, valuable, and unused or under-used source of energy. Human waste in sewerage is permitted to contaminate surface water instead of providing safe and useful energy and fertilizer. Traditional reliance on virgin materials has created patterns of use that require alteration if secondary materials are to replace them. Industrial locations favor primary over secondary materials. Consumer standards, freight rates, industrial processes, and commercial credit practices favor primary materials. Present collection systems are inefficient and skim off the top, leaving the bulk of municipal wastes to pile up in disposal sites. Costs of waste disposal are not capitalized within the materials cycle. Yet the use of urban land space as repository for wastes is

limited and costly. Environmental regulations deter open burning, and the burning of trash—even to generate energy—is increasingly recognized as wasteful of resources. Better management of wastes is almost universally recognized as an essential element of the life cycle of materials.

Questions

1. Beyond the general goal of achieving a closed cycle in materials management, what more explicit and detailed goals are there?
2. What kind of institutional mechanism and aids, private and governmental, could best provide the motivation toward achievement of these goals?
3. If scrap, such as aluminum and iron scrap, represents an investment in energy, should U.S. exports of these materials be permitted—or from other energy-short countries—to countries with surplus energy?
4. Would it be possible to "design" municipal wastes streams by applying regulatory principles to the design of products that comprise the bulk of these streams?
5. What materials should be kept entirely out of municipal wastes streams and how?
6. What techniques could be used to maintain the value of materials throughout the entire materials cycle, to increase the motivation for their recovery and re-use?

Task Five: THE ROLE OF THE TECHNICAL COMMUNITY IN NATIONAL AND INTERNATIONAL MANAGEMENT OF MATERIALS

Can members of materials groups, such as materials societies formed for various public, corporate, and informational purposes of persons in technical disciplines, organize cooperatively for larger national and international objectives and programs related to the combination of disciplines they encompass?

Rationale

There has been a long history of successful international cooperation among societies in basic science. The scope of international scientific activities has gone beyond information exchange to the actual planning of joint projects like the International Geophysical Year and the International Biological Program. Some efforts have been made to extend this cooperation into fields of applied science through bilateral programs, the United Nations, NATO, and OECD. The UN Conference on the Environment showed that there was a lively interest in the interaction of technology with environmental quality. Within the United States it has been found that the Federation of Materials Societies can play a significant role in furthering national materials objectives. Presumably

similar technical federations in other national settings could be similarly beneficial. To the extent that technical objectives are shared among nations it is possible that an international materials institution might further these objectives.

Questions

1. What materials goals tend to be most evidently shared among nations?
2. What kinds of programs could be sponsored within nations by their technical societies for public purposes?
3. What kinds of interactions might be fruitful regarding similar programs in various nations?
4. What type of international organization is likely to be most effective?
5. What contacts and exchanges of personnel and information by technical federations across national boundaries might be mutually beneficial to the federations and to the respective national publics?
6. Is there a role for the United Nations or UNESCO in support of international technical federations of materials societies?
7. What limitations would be necessary in the design of international cooperative relationships within an international federation of materials societies ?

SUMMARIES OF TASK FORCE REPORTS

Task One: The Management of Materials Information

Group A	*Group B*
Points of Agreement	
Most elements of a materials information system already exist within the government.	Existing agencies can be utilized in support of a materials information system.
Public interest and participation in the collection and dissemination of materials information should be encouraged.	Public, as well as Government, participation should be encouraged.
Points *of* disagreement	
No major new bureaucracy needed, but should have a central coordinating agency to oversee the collection of data within existing agencies.	New Cabinet level Department should be established to take charge of materials information.
Comments	
Survey is needed to determine what kinds of data are already available. The survey could be done through existing agencies.	Information on mineral resources should be collected by individual agencies and coordinated by the Cabinet level Department.
	This new Department should also be responsible for information on the production, consumption and reuse of materials.

Task Two: The Increasingly International Character of Materials Issues

Group A	*Group B*
Points of Agreement	
Maintain materials stockpiles.	Maintain stockpiles.
Self-sufficiency is not a reasonable goals.	Self-sufficiency is not a reasonable goal.
U.S. should export its materials science and technology, in exchange for raw materials from less developed countries, and for other technologies from more advanced nations.	Materials science and technology are important to furthering international cooperation.
There is a need for better interaction and communication between/among nations. This can be furthered through existing organizations. No new bureaucracies needed.	Increased trade with PRC and USSR could lead to more open lines of communication and trust between ideological adversaries.
No new federal agencies are needed to better this international communication, However, we need closer ties between government and multinational corporations.	MNC'S could be important in encouraging international cooperation and communication.
Wider materials information base needed.	Wider information base needed.
Points of disagreement	
No new bureaucracies needed.	Department of Natural Resources should be created, along with an independent agency for data collection along the lines of the National Commission on Supplies and Shortages pursuant to S. 3523.
Comments	
Best way to foster international cooperation is through exchange of technical information.	Standards for materials information could be a useful form of international cooperation.
Some institutional factors inhibit mutual cooperation. These, in some cases, can be eliminated by governmental action. However, there are other factors inherent to the international political system which will never allow complete trust and cooperation.	

Task Three: Design Improvements to Increase the Efficient Utilization of Materials

Group A	Group *B*
Points of *Agreement*	
There are new barriers to the introduction of new technologies which could result in the most efficient use of materials.	There are many barriers to optimum materials utilization.

Economic constraints are most important, but institutional factors are critical and can be dealt with by the Federal Government.	Institutional factors are important in the encouragement of innovation and current practices inhibit that activity.
A vigorous Federal program is needed to educate the public on materials options.	A Government program is needed to encourage materials conservation.
Need to disseminate information on the life, repairability, and recyclability of products.	Need to find new ways of improving the quality of products, in terms of lifetime and recyclability.
Need to study materials substitution and ways of improving durability of important materials.	Need to improve durability and find areas where substitutions for materials can be made.
Investigate government design/performance specifications incorporating ideas of materials conservation practices.	Government should provide standards for performance in promoting conservation, but should not dictate design criteria.
Investigate areas of direct government intervention which could effect materials conservation practices.	Should identify areas where government standards could result in better materials conservation.
Serious problems are 10-15 years off, but need to begin examining government policy alternatives now.	Indications show serious supply and shortage problems in the future, if action is not taken now.
Comments	
The constraints to innovation include scientific knowledge, education and manpower, capital and equipment, energy requirements, characterization of materials properties, insufficient technology transfer.	Need government incentives for innovation. Revamp government purchasing systems to encourage efficient materials use. Declare an International Materials Conservation Year.
Government should better define the materials/energy content of products.	Need more effective government-industry relationship.

Task Four: Mobilizing Economics and Technology for Materials Recycling

Group A	*Group B*
Points of *Agreement*	
There are weak economic incentives and institutional barriers which limit recycling efforts at present.	There are institutional constraints to the operation of recycling facilities.
Current disincentives should be eliminated, with incentives added to the institutional structure.	Government should enhance marketability of recycled materials.
Promote voluntary industrial programs for purchase and disposal of materials.	Encourage joint government-industry R&D and recycling efforts.
Comments	
There have been no incentives to promote the recycling of materials from the municipal waste streams.	Federal and State governments should share costs of developing recycling technologies.

Reduce waste by promoting product durability, repairability, and maintainability.

There are many recycling technologies, but no single optimum process can be found for use in all locations.

The cost of water used in materials processing—including the cost of restoring it to recyclable quality-is often overlooked.

Landfill requirements/regulations should be re-examined.

Products should have their social as well as economic costs listed, including disposal costs and materials and energy requirements.

Task Five: The Role of the Technical Community in National and International Management of Materials

Group A | *Group B*

Points of *Agreement:*

There are **certain goals compatible with the objectives of all countries, which could be** discussed cooperatively by technical communities in most nations.

A basic materials goal is improving the international atmosphere to the point where the exchange of materials, goods, and services takes place, and dislocation is minimized.

Technical societies can assist in the exchange of technology and the identification of problems within the materials area.

The technical community should also continual y advise legislators of materials problems and opportunities which warrant legislative action.

There is no need at present for an international federation of materials societies, as this type of exchange already occurs.

Contact should be maintained with technical societies in other nations.

Comments:

Technical communities should focus their discussions on information needed for materials optimization, substitution, assessments of materials needs and the strengthening of educational weaknesses in the materials science field.

Professional societies **could assist** in an effort to educate the public, aimed at changing attitudes to produce more efficient use of materials.

A National Materials Policy Commission **could coordinate special studies and symposia by single or multiple technical societies, with backing from private and governmental** groups.

To increase awareness, an International Mineral Resources Year should be launched.

A compilation of international mineral and materials societies is needed.

There is a need for greater cooperation between industry and government in achieving materials policy objectives through international exchanges.

Technology exchange **can be used in furtherance of so-called competitive national goals.**

Task One (A): THE MANAGEMENT OF MATERIALS INFORMATION

Most of the elements of an effective information and data evaluation and dissemination system now exist in the USA. We should build on our present pluralistic system, recognizing that no single approach or massive central organization is likely to meet all our diverse needs. A central organization, almost certainly within the Federal Government, is needed to monitor the adequacy of these services, to point out significant gaps, and to act as a referral center in guiding users to sources of data and information they need.

Some additions and expansion of elements dealing with data on material properties are needed, and there is an unsolved question as to how discipline-oriented evaluation and information centers should be financed.

We can pretty well identify the additional needs for supply/demand statistics on U.S. resources and reserves. On a world-wide basis, the initial need is for a survey to find out what data are now available.

RECOMMENDATIONS :

I. Establish a continuing coordinating office, charged with analyzing U.S. information sources dealing with materials to:

1) Determine the adequacy and timeliness of existing info to meet present and anticipated national needs;

2) Identify and publicize areas where needs are not being met, and whether expansion of existing operations or new operations are required;

3) Make available, by publication and/or referrals, guidance to specific sources of data and info on materials.

> ***(NOTE:*** ***This would*** *be the type of service now provided by the Library of Congress, but based on a more detailed base evaluated by specialists. No* single *organization can* do this *evaluation job alone. It might be possible to utilize voluntary panels from* various technical societies. M might *be* better to assign portions to organization like *the* ***Bureau of Mines, Department of Agriculture,*** ***NBS,*** *etc., who are already doing pieces of total job. However, some one central group should be responsible to see that the whole job is* done—and maintained *up to date. It should be an* office whose warnings of gaps in coverage would be listened to attentively by *Administration, Congress, and business.)*

II. Most of the existing data evaluation and information analysis centers were started with governmental funds, DoD, AEC, NASA, and others. Support for such centers from at least these three agencies has decreased in recent years, and there is as yet no obvious alternate source(s) of support. Such centers must operate along essentially disciplinary lines, whereas most major sources of funds are from organizations committed to programmatic goals. No one funding group will accept responsibility for supporting a center whose outputs are used in many programs. We suggest that the member societies of FMS and other materials-oriented societies and trade organizations accept some responsibility for seeing that adequate information sources (centers

as well as publications) exist in their area of interest, and endeavor to encourage their adequate funding from both private and governmental sources.

111. It is recommended that a survey of organizations throughout the world that presently gather supply and demand information on materials be undertaken. This survey should have two purposes: (1) to provide information which will show what sources of data on materials are now in existence, their frequency of collection, timeliness, and adequacy, and (2) to provide information to indicate where there is missing information. This survey would be the first step in providing to the "central referral agency" information sources for supply and demand data. It would also provide this agency with the basis for recommending establishment of other information centers or collection agencies for obtaining missing data.

Organizations that might be possibly approached to perform such a survey are OECD, UNESCO, the World Federation of Engineers, UN Transportation Resources Agency.

IV. The exchange of technical information, resource information, design data, and specifications, among industrial firms is inhibited by the current adversary interpretation of the Federal Trade Commission Act and the Anti-trust laws. This limits the ability of private firms to cooperate in effective utilization of national resources in the national interest. A re-evaluation of the impact of the current interpretation of these laws is needed in view of our changing materials situation, and its present and potential impact on our balance of trade.

V. FMS/OTA Survey. The initial results document in a convincing fashion the diversity of sources of information and the need for more effective evaluation of publications, etc., covering existing information and data. Also the need for an effective, centralized referral source or sources (publications and/or centers) to assist users in finding needed data and information.

We do not believe that any major extension of this survey is needed at this time, nor would it be practical without a major investment. We recommend a modest additional effort to fill some of the major gaps in the Materials Information Matrix and to complete the analysis of replies at about the level of specificity of the initial analysis,

More detailed additional surveys, where and if indicated, should cover smaller segments of the whole field.

Task One (B): THE MANAGEMENT OF MATERIALS INFORMATION

The role of information in our society is always undervalued. Information is not a need which has been perceived with the urgency of no gasoline for your car or no food for your stomach. Therefore, in the process of establishing priorities in the Federal Government, the State Governments, and companies and societies, information needs tend to always get less support in money and resources than the value

deserves. One means of redressing this imbalance is to establish, within these organizations, groups with specific missions for developing information and making the results available to decision-makers and making the public and researchers in general aware of the information source.

Information and materials has suddenly become unimportant ingredient in decision-making at all levels. A corporation president wants to know whether he can design a product around chromium and expect to be able to get supplies at reasonable prices five years from now. The Federal Government wants to know whether it has weapons and alternatives available to counter extortion from international cartels. These answers cannot be provided unless there is in place a Materials Information System which can be used to develop the answers.

Against this backdrop, the Task Force makes one general recommendation, followed by specific recommendations on various areas of materials information. We have divided the Materials Information System into three major categories. Category I covers information, usually in the form of numbers, on the scientific and engineering measurements of materials. Category 11 covers information, which may be numeric, but also may be in the forms of texts, maps, and other forms, on the resource base for materials. Category 111 is on the production, consumption, and reuse of materials by society and contains physical information, economic and financial information and qualitative information on such things as government policy and market structures.

General Recommendations. The Task Force urges that a single cabinet level department be established with responsibilities spanning all materials. We define materials as defined in the Boyd Report—that is, those things that are used by Man with the exception of food. This cabinet level department, along with its major programs of operations, should have within it three distinct information agencies corresponding with the Categories enumerated above.

The rationale for this recommendation is that the interconnection of materials is such that a wide diversity of disciplines and talents are needed to manage and develop information systems. It is not the sole province of the librarian and statistician to manage such systems. Inputs must come from all classes of the professions, the physical sciences, the social sciences, the behavioral sciences, and others. The information must be evaluated and judged, which is a professional matter, not a matter for an information specialist, Secondly, the materials problem is now handled by an extreme diversity of federal agencies, which leads to conflicting information systems and conflicting policy determinations. Our task group will not attempt to give the full justification for this recommendation, since it has been adequately developed in a series of hearings before the Congress, but we do emphasize that from the point of view from the Materials Information System itself, there is strong justification for the proposal.

1. SCIENTIFIC AND ENGINEERING MEASUREMENTS.

There are an extremely large number of sources for this type of

information. The professional societies, the Federal Government, individual companies who are marketing materials, are but a few of the numbers. In the survey conducted by the Materials Information Committee for the Office of Technological Assessment, well over 500 specific sources were cited by the relatively few respondents to this date.

Knowledgeable researchers in this area have developed for themselves a set of sources upon which they rely, The problem here is to make this body of information accessible to the non-specialist who has need for it and to give him an evaluation of the state of that information. One could characterize that information as being of three general forms: (a) preliminary, in the sense that it is the result of an initial research effort, (b) of intermediate validation where some considerable work has been done on the measurement and it might be included in, for example, a handbook, and (c) final, verified, reproducible information, subject to many trials, such information being fully reliable and usable in, for example, products which are essential for the public safety. Any information system which will meet the requirements for this category must specify the category of information provided and must evaluate the information received.

The Task Group makes the following findings and recommendations with respect to Category 1.

a. The system of specialized information centers that currently exists is the proper one, and should form the basis for the Information System. These specialized information centers provide authoritative compilations of data which they have evaluated with respect to its reliability.

b. The Information System requires general shared financial support because in this case, as in all others, information to a substantial degree is a public good. Thus, a significant proportion should be borne by the general public through tax support although the professional societies and the users should also make contributions to the cost.

c. An independent agency, hopefully within a Materials Department, should be given the mission of establishing standards for and overseeing the operations of the above Information Centers; of developing awareness of the sources of information in this area; and to identify the need for new Centers and help establish the same where required.

11. The Resource Base for Materials.

The information covered by this category goes to the basic resources in the earth's crust for materials and the productivity of the earth's surface in its soils and water for the growing of organic materials. The major agencies involved are many, we mention the United States Geological Survey (USGS), the Department of Agriculture, the Corps of Engineers, Bureau of Reclamation, National Oceanic and Atmospheric Administration (NOAA), the universities, professional associations, companies, both industrial and financial, industry trade groups, national cartographic groups and non-profit organizations. On a world basis, the UN and their specialized agencies affiliated, as well as each individual country's geological survey and equivalent agricultural organizations.

The information in this area exists in the form of maps, stream flow data, soil characteristics and computerized system of numerical information such as the CRIB system of USGS and the analytical computer models of River Basins of the Corps of Engineers and the Bureau of Reclamation.

The Task Group makes the following findings and recommendations with respect to this category:

a. There is an urgent need to coordinate this information by specific geographic areas such as has been done for limited areas by the USGS. Such coordinated information will describe a vertical section of the earth and atmosphere starting with its geological characteristics including its hydrologic characteristics, the characteristics of the soil, the land uses made on the surface and the characteristics of the climate and atmosphere above it. This coordinated information is an absolute necessity for rational land use planning. A specific group within the Federal Government, hopefully the Department of Materials, should be responsible for bringing together this coordinated information by specific land areas.

b. The USGS should be charged with responsibility of being the evaluator of all geological information and should serve the function of an Information Center in regard to this information; the Department of Agriculture should play the same role for the soil and biological information; and the NOAA should play the same role for climate and atmospheric information. All three of these groups should be combined at a proper time in the proposed Cabinet department.

c. The above lead agencies should establish continuing relationships with each other and with sister agencies on a world-wide basis and should determine and make available to the public information on the size, nature, and characteristics of the world resource base of materials.

d. The professional societies, such as the constituent members of the AGI, should continue to publish and catalog basic geologic and geophysical research. These societies should consider establishing a formal advisory committee to the above agencies to further their mission.

III. The Production, Consumption, and Reuse of Materials by Society.

There are many agencies involved in providing information under this category. They include the Department of Interior, Department of Commerce, the regulatory agencies of the Federal Government, the Department of Agriculture, trade associations, research organizations such as Battelle, SRI, and RFF, and hundreds of universities and foreign organizations, most especially of course the United Nations.

One can characterize the information under this category into four major groups:

a. Physical measures of reserves, production, stock, capacity, trade flows, consumption by end use, recycled materials, employment, etc.

b. Economic and financial information such as investment, prices, balance sheets, costs, demand, foreign trade balances, taxes, royalties, etc.

c. Material balances by major industrial process whereby the physical flow of materials as for example, the petrochemical company, would be presented.

d. Market structure information on the organization of materials markets and the structure of Federal and other national policies on a world-wide basis with respect to the production, consumption and recycling of materials.

The Task Group makes the following findings and recommendations with respect to this category:

a. The various information systems which exist are not integrated by standard definitions, standard units or in any other way. It is virtually impossible for the researcher to tie together any information, for example, on the IRS, which is on the basis of the taxpayer, with that of the Bureau of Mines, which is on the basis of the commodity. This results in a greatly reduced value to the current information systems, which are many and large.

b. The information available in Category a above is greater than that in the remaining three categories. However, even Category a needs improvement in terms of standardization and in terms of additional detail and consumption by end-use and in better categorization of reserves, to mention but a few major deficiencies.

c. Given the above two findings, it is proposed that a major federal agency be given responsibility for this portion of the Materials Information System. This agency would contain a wide diversity of professional talent, a substantial capability in survey and information management and a substantial capacity in the analysis of information. It would be made up of parts of existing government agencies such as Bureau of Mines, the Bureau of Census, the Bureau of Labor Statistics, and elements from the Department of Agriculture. It is believed that such an agency properly belongs in the proposed Department of Materials, since one of its major functions will be to provide information for government decision-making.

This agency must have the tools to do its job properly. This includes control of very large computer systems for the handling of data, mandatory authority for collection of data, with appropriate safeguards for the industrial and consuming sectors of the economy, and independence from political control so that the data will have credibility to all sectors of the society. This implies a Commissioner system with fixed terms to run this agency, something like the Bureau of Labor Statistics as a model.

Our Task Group was asked specifically to comment and advise on the survey conducted by the Materials Information Committee of the Federated Materials Society for the OTA. We have reviewed the survey and make the following findings and recommendations:

a. The survey is a very important first step in understanding the characteristics of the Materials Information System.

b. In the continuing conduct of the survey, efforts should be made to broaden its scope to cover materials not now covered, such as

textiles, and to broaden its scope so that disciplines not now adequately covered, such as designers, are included.

c. As a follow-on to this survey, new surveys should be designed to sharpen and help implement the recommendations made by this committee concerning the Materials Information System.

d. The OTA should devote a larger proportion of its funds to an evaluation of the Materials Information System, because of the traditional inclination to undervalue these efforts. OTA is in a unique position to urge and help implement the recommendations of this Task Group.

Task Two (A): THE INCREASINGLY INTERNATIONAL CHARACTER OF MATERIALS ISSUES

Question 1. What are the goals of international cooperation in materials and technology?

I. Goals of all societies, world wide, are economic growth, higher standard of living, improved quality of life.

II. Goal for international cooperation is development of a synergistic system in which buyer and seller both perceive benefits. For a stable relationship, each needs to feel it gets as much as it gives (e.g. willing seller to willing buyer).

III. Goal of the United States is to assure an uninterrupted flow of materials when and where needed and at a reasonable price. To attain this U.S. goal, a sufficient world supply of materials is necessary, for interdependence is increasing. Self-sufficiency is not a reasonable goal and, in the long run, would be counterproductive. Stockpiling can overcome temporary aberrations in supply.

IV. Goal of the United States, therefore, must be to export its materials science and technology in "a consulting firm relationship", for payment.

A. With technologically advanced countries, the United States would both export and import materials technology; for some countries are ahead of the United States, as the increasing number of foreign patents demonstrates. This export/import exchange would include technologies for development of new materials and application of materials as substitutes for materials in short supply. Substitution may be expensive, but it is a protective measure to keep trade negotiations gradual and prevent extreme price escalations.

B. With countries less technically advanced, the United States would export its technology and import raw materials. Resource-rich LDCs will continue to supply primary materials until these countries meet their own industrial goals. The basis of materials technology export has changed.

1. In the past the U.S. exported technology to develop foreign resources owned by U.S. corporations, thus obtaining primary materials for fabrication in the United States for sale—with value added—in the world market.

2. From now on the U.S. will be paid for expertise furnished to help LDCs move into the manufacture of goods from their raw resources. Know-how and management techniques are the exportable items that cannot be put on paper.

v. Goal of the United States should be to maintain U.S. strength in materials science and technology, recognizing these as exchangeable commodities that are renewable and non-appropriable resources.

Question 2: Can existing institutions be better used and are additional institutions-needed to define goals, develop policies and programs, improve communications and motivate action toward these goals?

1. Existing institutions can be better used. Special emphasis should be given to the use of existing international institutions. Among these are the U.N. and its agencies; OECD; World Bank; Export-Import Bank, International Monetary Bank; international corporations and international societies; trade associations; the World Court and patent law.

II. No new bureaucracies should be created, but the missions of existing international and U.S. institutions should be clarified and should be broadened where such change is ascertained to be desirable.

Question 3: What national institutions are needed in the U.S. and other developed countries to further international cooperation?

I. No agreement was reached on the need for a new national U.S. institution to further international cooperation nor on location or nature of such an institution were one to be created.

11. In view of the close government-industry linkages in other countries, closer association between the U.S. Government and U.S. corporations engaged in international trade seems necessary and inevitable. Therefore, the roles of existing federal agencies should be examined to determine whether one or several could be used more effectively to:

A. Supply reliable information on which corporations can act.

B. Guarantee capital and insure against loss through political events, with companies paying a fair price for this reduction risk in international investment and trade.

Question 4: What is the required information base, in terms of long range supply and demand for materials, to enable policy planning and decision-making?

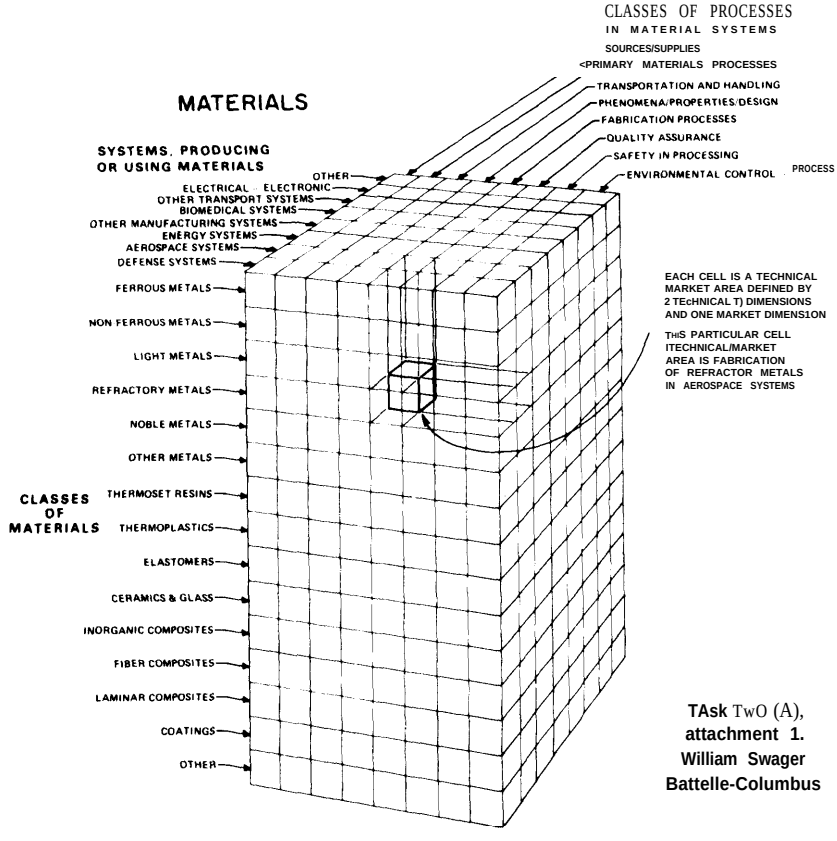
A wider information base is needed than is now collected by the Bureau of Mines on reserves and the U. S.G.S. on resources. Information is required on:

Physical characteristics of primary and secondary supply,
Economic characteristics of reserves,
Demand in relation to specific uses,
Stocks at all levels,
Foreign trade in materials,
Transportation systems for materials.

Question 5: What means of international cooperation would be most fruitful and feasible in terms of mutual benefit?

I. Sharing of technical information is the best way to develop cooperation and respect among nations. The U.N. should be used as the vehicle for international information system development and international standard setting.

II. Establishment and adherence to a well specified, agreed-upon set of conditions under which one nation can transact business with



Attachment 1. Task Two (a)—No caption

another (e.g. a basic framework of acceptable behavior based on enforceable contracts so that buyer and seller will know where they stand).

Question 6: What are the obstacles to mutual cooperation in global materials management?

The chief obstacles are:
Differences in patent law,
Self-interest of companies and nations,
Mistrust between nations,
Absence of desire to cooperate (e.g. insufficient motivation),
Worldwide, a lack of trained manpower in mineral-supply technology science and engineering disciplines.

Question 7: Can international programs in materials be effective in the conservation of materials?

Such international programs can be effective among countries that perceive some reason to use materials prudently. If conservation is defined as "efficient use", conservationist policies in any country will vary with stage of economic/industrial development and availability of materials at a reasonable price.

Goals or some problems in reaching materials goals.

	Trade partners/topics	*Producing* nations	Consuming nations	Status
Short term (day-to-day), markets	Consumption	Want demands evenly spaced.	Want materials available when needed, avoid large inventories.	Conflicting
	Prices	Like upward trend.	Like downward trend for raw materials.	Conflicting
	Technology transfer.	Expand capacity. Duplicate technology. Invent new technology.	High productivity. Turn-key technology to other countries.	Conflicting
Long term markets		Growth	Growth	Cooperative

Task Two (A), attachment 2, Developed by F. H. Buttner, Battelle-Columbus.

Task Two (A), attachment 3
A brief statement of position on the question:
International character of materials issues.
By B. D. Lichter, Vanderbilt University

The following is a brief personal statement which attempts to address our topic of integrating (1) information presented at the morning session of Task II(A), (2) information presented at the Monday session, and (3) information included in the publication "Resolving Some Selected Issues of a National Materials Policy" (Henniker H, July 30-August 4, 1972) as well as my own views derived from the reading of the abundant literature and discussions with conference participants and others.

Distinguishing Ends from Means. The entire discussion this morning was hindered by the failure of an adequate statement of "ends" as distinct from "means". This is in no way a fuzzy-minded philosophical exercise; nor, is the practical difficulty of reaching consensus (as experienced in our ''goals" discussion) reason for avoiding clear ends/means distinctions. Although George Watson's statement of the desire to provide improved technology, economic growth and "quality of life" to all the people of the world is one possible statement, it is not an adequate statement of ends, nor was its impact sufficient to influence various statements of "goals of international cooperation" which were offered by members of our group (e.g. "to maintain the U.S. position of world leadership in materials resource activity. . . ."). As examples of alternative statements of ends associated with the international character of materials issues, I offer the following:

1) Recognition that the United States is included within the world materials systems; that the satisfaction of materials and resource needs of any and all of the individual member states is of great concern to all nations; that such needs be satisfied is of particular concern to the United States, from the perspective of a broader notion of self-interest (if not derived from ethical-moral considerations).

OR

2) Recognition that critical resource and materials problems confront the United States in both the immediate and into the mid-range and long-term futures; that these problems arise from previous historical growth patterns in materials use vis-a-vis the world community; that the current 7-fold disparity in per capita resource usage between the U.S. and the rest of the world community must be maintained from further erosion as has occurred since 1950 at which time the disparity was 12-fold; that to resist such erosion will result in serious lowering of U.S. standards, since it can easily be shown that projections of resource "accessibility" together with realistic assessment of future technological innovation both indicate a failure to meet rising world community expectations of uniformly distributed per capita resource availability at present U.S. standards.

OR

3) Recognition that growing interdependence of the Nation states with respect to materials issues among all other issues has led the

NCMP to offer in their final report 19 recommendations that impinge on the question of international character of materials issues; that these recommendations define as suitable an explicit policy of interdependence as opposed to the pursuit of self-sufficiency with respect to materials resources; that our end therefore is a well-conceived "project interdependence' as distinct from an ultimate counter-productive 'project independence.

References:

1. "*Resolving* Some Selected issues *of a National Materials Policy," Engineering Foundation Conference,* July *30-Aug.* 4, *1972 (Henniker* 11). *pp* 2-7, *12,* 14, 38-45.
2. *Final* Report, National Commission on Materials *Policy,* June **1973. Section** *1*, pp **3-8**; *Section* 9, *pp 3-27.*

Task Two (B): THE INCREASINGLY INTERNATIONAL CHARACTER OF MATERIALS ISSUES

Goals

The Task Group adopts Mr. Daddario's overall goal of encouraging sound, stable, and growing societies for nations of the world and of avoiding disruption to growth. Subject to these broad goals, the Task Group adopts the five goals of the National Commission on Materials Policy (NCMP), having to do with the energy and materials marketplace, environment, recycling and the material-energy -environment complex as follows:

Energy *and Materials.* To provide energy and materials supplies to satisfy not only the basic needs of nutrition, shelter, and health, but a dynamic economy without indulgence in waste, while recognizing all societies must face up to changes and adjustments.

Marketplace. To rely on market forces as a prime determinant of the mix of imports and domestic production in the field of materials but at the same time decrease and prevent wherever necessary a dangerous or costly dependence on imports.

It is recognized that such primary determinance depends on pluralistic participation in the marketing process, so that distortions and imbalances are clearly absent. For example, where restraints of trade and cartelling are present, or where dependency/interdependency arrangements between trading partners exist, or where mutually beneficial trade deals between partners *exist,* the free marketing process may be distorted or brought into imbalance. In that case market determination or price alone, for example, is not fully realistic.

Environment, Accomplish the, foregoing objectives while protecting or enhancing the environment in which we live.

Recycling—conserve our natural resources and environment by treating waste materials as resources and returning them either to use or in a harmless condition to this ecosystem.

Materials-energy-environment complex—institute coordinated resource policy which recognizes the interrelationships among materials, energy and the environment.

Phasing

The Task Group sees this contemporary time period, up to 1985, as one in which forces of scarcity and high price can overtake our technical and institutional abilities to deal with them. During this contemporary period three response strategies appear to be viable. First, assume a reactive posture, i.e., adjust to the pressures of scarcity and high price as best we can, when and as individual commodity pressures occur. Second, employ the contemporary period for planning to regain control of our destiny by 1985. And third, undertake vigorous research on massive recycling technology and the widest possible substitution technology to bring these potential scarcity-response moves up to speed by 1985.

Accordingly by 1985, the U.S. should be in a position to dynamically exercise all four scarcity-response modes (stockpile, stand by capacity, substitution and recycling) in some cost-effective, optimum mix to deal with any complex of commodity scarcities of the moment. At that time we should move off the reactive stance to a balanced, positive stance wherein we are in fuller control of our destinies.

Institutions

Existing institutions and new institutions were considered and this group endorsed and supported the Mansfield-Scott Bill (S-3523) leading toward the establishment of an independent agency (NCSS) to provide data collection and storage and to aid in the examination of supplies and shortages both in the U.S. economy and in relation to the rest of the world. In addition, this panel also supports the creation of a cabinet-level agency, the Department of Natural Resources, to bring materials management and related factors to the attention of the highest governmental levels. It is also recognized that government cannot function alone in this area but that more effective cooperation between U.S. industry and government is necessary, particularly in external activities.

From the above national institutions, it is felt that determinations will flow regarding U.S. participation in and/or creation of international means of meeting world societal goals and the amelioration of problem areas—including those relating to the seabed. However, at the present time, it would be premature to specify or suggest a form that such international institutions should take.

Data Base

Data are essential to all efforts of the world economies to achieve materials goals. The data base is constantly changing so that gathering

systems must be dynamic, timely, consistently accurate to be credible, and responsive to world needs. Raw statistical data must be authenticated to be capable of sound interpretation and broadly available. Sources must be widely developed so that assessments of availability may be applied to decisions in the private and public domain. There are real dangers in the distribution of static inventories of resources.

Areas of International Cooperation

1. The capabilities of the U.S. in materials science and technology form an important national asset that play a part in our export sales and goods and services. Much of it, however, partly by consensus policy and partly by the nature of science technology, is provided free to the rest of the world and is a vital element in our share in international cooperation. Within the limits allowed by public policy this free transfer should be continued.

2. The increased trade with centrally planned economies (PRC, USSR and others) represent an important area of cooperation with ideological adversaries, opening lines of communication and engendering mutual trust.

3. The multi-national corporations, with their global outlook and partial freedom from control by nations may serve to increase cooperation among nations through the former's need to cooperate with the latter in order to prosper.

4. Cartels are an effective force in materials trade and may play an increased role. These cartels currently represent limited international cooperation among producer nations. Similar limited international cooperation by consumer nations may be attempted. While cartels may be beneficial to member countries, their effect is to reduce world-wide cooperation.

5. International material standards (in supply and demand data and in tech data) form a useful area of international cooperation.

Mutually beneficial trade arrangements and tie-in deals involving coupled and uncoupled commodities and volumetric or regional arrangements, are recognized, some of which are new and others have appeared in earlier times of world economic strain. It is also felt that international methods must be explored to discourage the expropriation of large investments of technical know-how and facilities.

6. Oil over next two decades is the world's major source of energy and is transport system lifeblood. The oil producing countries of mid-east possess the capability when acting in concert to disturb the whole system. Longer term, each area in world system will try to develop more energy resources under local or regional control. Also, new impetus for push into oceans resources of all types . . . offshore oil production rising from 17% in 1970 to 34% in 1980's.

7. There is a widening gap between the expanding materials needs for world system community and the financial/political structure of the world system . . . if gap goes too far without some new forms developing can mean near collapses and/or rampant military activities. Patience and faith . . . time and belief to resolve problems is required.

Trade alone will not solve all problems, but it may alleviate problems to some degree.

8. Question: What are the obstacles to mutual cooperation in global materials management?

A. In assessing this question, it was considered that some rough and general perspective of the U.S. position in the world system would be helpful in addressing implementation of a National Materials Policy and obstacles to be overcome in global cooperation:

Emergence of the recent U.S. energy problem . . . is indicative of:

1. basic changes in the balance of the world system
2. other coming problems associated with these changes

Background of U.S. dominance in the world system 1945-1970. . . helpful in viewing changes to date and expectation for further changes over next few decades:

USA—Immediate post-WW II period
50% of world productive capacity (GNP) and only undamaged major power home base
75% of world gold holdings

From this position, the U.S. set out to revive the rest of the industrial world . . . our allies and enemies:

1) Industrially, 2) Economically

This revival considered as being in the best long term self-interest of the U.S. and of the world system.

U.S. aid of all types to 70 nations from 1945-70 . . . about $200 billion:

1) $ for economic revival
2) opened doors to trade and investment for all.

In one sense, the U.S. took on responsibility of an indirect development in cooperation with about 40 nations—15 million square miles—600 million people.

Some direct benefits to U.S. . . . certainly.
Exports increased 10 times
Overseas investments increased 7 times
U.S. business abroad—$200 billion volume in 1970

The revival polity has been successful; now U.S. dominance is not so overwhelming in proportion:

USA FACTOR	PEAK	TODAY	1985 PROJECTION
World GNP	50%	28%	25%
World Gold Holdings	75%	10%	8%

Many people in the U.S. do not realize that the U.S. has already slipped a long way from the top. Now the U.S. must adjust to these changes and that in the international system . . . policies /'finances/ economics/politics are no longer geared (in total) to maintenance of

U.S. predominance in the world system. The post-war status-quo has been and is being disrupted.

U.S. is still the most important element in the world system (just not totally dominant alone). Quality of coming U.S. leadership is crucial . . . Must have constructive vision of world to expedite continued growth and development—neo-isolationism can be problem. Others will lead, if we do not, or fragment; each on its own—Europe/Germany, Japan /etc.

B. The alternate for further expansion of world economy is collapse and international anarchy in a growing interdependent world. Many problems to expansion for world system exist:

1. Financial panics may be endemic for decade.
2. The age of cheap energy is passing and will become even more expensive.
3. Industrial materials and metals are facing demand rise and persistent and steep increases in prices.
4. Longer term resource developments require massive investment of capital and new process systems for recovery of lower grade or remote deposits.
5. Finance system for new capital input will require 10- 15% a year . . . from recent past of 3-4% a year.
6. National raw materials independence in total is almost impossible over coming decades and cost is prohibitive. However, impossibly large cumulative imbalances of payments or trade could be equally prohibitive.
7. Multi-national corporations can perhaps be an engine for revving up and evening out of world economic system (of top 600 world enterprises, 450 were U.S. entities originally); or they maybe an obstacle. The quality of multi-national leadership is also crucial to further potentially positive benefits.

C. Cooperation between trading partners is simple when there is mutual interest in goals of each partners. In some respects, there is mutual interest, in others mutual exclusivity. The basic conflicts that trading partners bring with them require resolution before full cooperation can be achieved.

An example is North/South relationships . . . an affluent North and largely poor South developing or under-developed lands. South has used cold-war levers of U.S. /U.S.S.R. to extract concessions from North. . . South now planning to use raw materials to correct imbalance as much as possible (teaming arrangements among suppliers are proliferating). Tensions and drastic actions are to be anticipated and are likely to increase .

9. INTERNATIONAL TRADE INVENTORY

Rather than having national economic stockpiles built by consumer nations to protect themselves from prices penetrating from price ceilings, we conceive an international trade inventory (ITI), to be managed by an independent, professionally trading management. It would serve traditional inventory functions between suppliers and consumers, and

generally serve to stabilize the economies of both producer and consumer nations,

For producer countries, the ITI would (1) be a welcomed customer in times of low demand when traditional customers disappear, (2) avoid economic damage of sudden large increments of demand at times of full production, i.e. by-pass the acceleration effect, (3) stabilize prices and prevent penetration of floor prices, (4) provide de facto, if not former, currency support to producer-country currency and (5) provide a credit base on foreign exchange markets.

For the consumer countries, the ITI would (1) provide an inventory that meets variable demand requirements, (2) avoid economic damage of scarcity, (3) stabilize prices, preventing them from penetrating price ceilings, (4) de facto currency support, and (5) defacto currency expansion without inflation.

The ITI is similar in concept to Graham's commodity currency scheme of the 1920's, which is, in the Task Group's view, worthy of serious, professional re-evaluation in the light of an opposite economic climate to that of the depression years gone by.

Task Three (A): DESIGN IMPROVEMENTS TO INCREASE EFFICIENT UTILIZATION OF MATERIALS

The objective of this task force is to recommend several federal policy actions which would promote the efficient utilization of materials and energy in design. In other words, efficient utilization of materials and energy is assumed to be our goal, and we seek to accomplish this through improving any or all aspects of product design (i.e., durability, repairability, functional satisfaction, recyclability, compatibility, etc.), Therefore, we have asked what should be the role of both the public and private sector in promoting use of new product designs consistent with materials conservation.

Important to this consideration is the realization that the design of all product classes, industrial, constructional, and commercial, could be improved in terms of efficient materials use. Technologies now exist which could significantly change materials use patterns, and it is important to ask first of all, why these technologies are not being used, especially if it is true that they are more efficient and therefore less costly (in terms of materials costs).

There exist many barriers to utilization of these more efficient technologies or design systems, and they can be categorized as economic, technical, or institutional. To be more specific, a list of constraints to innovation might include the following:

(1) Scientific knowledge
(2) Education and manpower
(3) Capital and equipment
(4) Energy requirements
(5) Characterization of materials properties themselves
(6) Insufficient technology transfer
(7) Institutional /managerial restraints

It was felt that one of the more important barriers to new design innovations was the cost of changing capital equipment (i. e., concerns for return on investment). Institutional restraints in the form of management policies, zoning laws, anti-trust policies, design specifications, etc., were also thought to be important considerations when attempting to isolate barriers to innovation. In any case, again and again it seemed to be felt that economic considerations were always primary in ultimately deciding whether or not to adopt new design practices and procedures.

When discussing the role of the Federal Government in minimizing these barriers or constraints to innovation, there was one area of complete agreement: the Task Force Committee recommends that Government design and implement a vigorous program of information collection and dissemination aimed at educating the designer, management, and the ultimate consumer. It was felt that the designer, manager, and consumer, all needed to be made more aware of materials options open to them and the relative life-cycle costs and benefits (i. e.. in terms of longer life, cleaner environment, more repairable products) of alternatives. To be more specific, government should:

(1) Work to better define energy and/or materials content of products, aimed at eventually expressing this in terms of total life-cycle costs. This research must factor in regional data variations, technological forecasts, political scenarios, etc. The Bureau of Mines is already sponsoring a study which is asking materials industries for information on total energy content of their various products. It was suggested that other agencies of the Federal Government might follow this lead by sponsoring similar studies for materials other than energy.

(2) Study and disseminate information on the life, repairability, and recyclability of products. This is to effect primarily the consumer or the designer's market. Again, such information must be translated into dollar equivalents before it would be meaningful to the consumer. There was disagreement as to the efficacy of massive consumer education programs along these lines, but it was felt that a limited effort should be mounted to inform consumers of some purchasing criteria. How this consumer information should be disseminated was discussed and it was felt that voluntary labelling of products might be one action to take.

(3) Attempt to educate designers to broader concerns for materials availability, recyclability, life-cycle costing, etc.

The next area of recommended government involvement was that of funding R&D* in materials properties, corrosion and wear, recycling technologies, and new uses for recycled materials. More specifically. government might want to investigate such research areas as:

(1) Abundant natural resources, not presently utilized (Mg).

(2) Materials used in energy producing systems.

* This falls into the traditional purview of the Federal Government (i. e., funding high risk R&D for potential public benefit) and could be carried out in government labs and/or with contracts and grants to industrial labs.

(3) Materials for water-proofing membranes in buildings.
(4) Life-cycle costs of building materials.
(5) High-strength materials.
(6) Materials which would substitute for scarce materials.

These are merely suggestions, and before deciding on research priorities, government might consider conducting a thorough state-of-the-art study evaluating the state of materials R&D in specific functional areas. Only in this way will government funds be most efficaciously spent in areas most critically in need of advanced study.

Additional studies which could be conducted by government include:

(1) Identification of constraints to innovation and investigation of means for overcoming these constraints.
(2) Analyzing the effects of alternative designs on recycling costs.

Along these same lines a recommendation was suggested to continue find expand programs similar to NBS's Experimental Technology Incentives Program (ETIP) and Interior's Office of Coal Research (OCR), which are attempting to identify and overcome institutional barriers to innovation. It was also recommended that anti-trust laws be investigated as to their prevention of necessary materials R&D; such R&D can often benefit from close industrial cooperation and exchange of data, facilities, and personnel. The unique example of the Electric Power Research Institute (EPRI) was sited as a possible model for initiating other cooperative industrial research organizations.

Finally. it was felt that government should be involved in establishing design and/or performance specifications which incorporate ideas of materials conservation. For instance, it was agreed that recyclability should probably be considered as part of any general performance requirement. Standardization of design and designer's components is another way one could encourage designers to conserve materials. Professional and industrial societies could join with government in setting standardization guidelines. Presently, there are a number of standard setting bodies which impact designer's decisions (ANSI, ASTM, SAE, & SME), and it was recommended by the task force that these organizations get together to reduce the multiplicity of standards in all areas. the thousands of standards documents which now exist could then hopefully be reduced into a single set of national materials standards.

It was also felt that standards in areas of repairability, durability, recyclability y, etc. should remain voluntary. Also, conditions under which products are designed and purchased do change, and standards must remain flexible and not foreclose new technological alternatives.

Investigation should also be made of existing specifications which may be over-restrictive, thus promoting inefficient utilization of materials. For instance, over-demanding and/or unduly restrictive building codes and building materials specifications should be reinvestigated.

Also, it was felt that there should be serious investigation of areas of direct government intervention; i.e., regulation, enforced standards, economic incentives (e.g., tax benefits) which could effect significant

increase of material conservation practices. Suggested areas of further study include:

(1) Instituting "life-cycle costing" prices on products.
(2) Tax benefits for a) industries that practice materials conservation and b) consumers who purchase products which have been made with conservation design processes.

Mention was made of a whole host of other government policy options which could be considered in attaining more efficient materials use in design; however, discussion was superficial and no concrete recommendations were drawn up by the committee.

In conclusion, it was agreed that government does have an active role to play in encouraging materials conservation but that this role and any ensuing action must be careful not to foreclose future innovations. In other words. it was suggested that all the recommendations listed above, as well as those suggested elsewhere, be studied to insure that such an action does not inhibit development of alternative technological solutions to materials problems.

Task Three (B): DESIGN IMPROVEMENTS TO INCREASE EFFICIENT UTILIZATION OF MATERIALS

The Task Force adopted as its theme the necessity for the Federal Government and other governmental institutions to assume a lead role in promulgating a new ethic of conservation for the efficient and effective utilization of materials and materials resources. The government should use its regulatory and taxing power and the power of the purse, and through appropriate policies, actions, incentives, programs and mechanisms promote a national awareness and consciousness of the status of our materials resources and the benefits to be derived from efficient utilization patterns. We recognize that the available information on materials reserves and resources do not lend themselves to the characterization of a materials crisis in the near term. But they do indicate serious future supply and shortage problems unless actions are instituted. in concert with other nations, to assure effective development of materials resources, accessibility of materials supply and effective utilization practices. This is indeed one opportunity in which sufficient lead time is available to prevent a serious problem from developing into a crisis. In effect, we see the need for a cultural transformation in the consumption habits of American Society. We recognize that these issues provoke the dichotomy of the dialectical extremes of the Neo-Malthusian Limits of Growth philosophy. on one hand, and the ''cornucopia'-increasing growth school of thought on the other. We believe, however, that rational and sensible actions and implementation of a conservation ethic; i.e., efficient utilization of materials represents meaningful first steps towards charting a rational course of controlled and acceptable growth, between these two unlike] y extremes. We believe that the fundamental issues are not technical nor technological, but really involve preferences and ethics as manifested realistically in our

national business and economic decision making process. We suggest that what is needed is a national affirmative action program for materials conservation and efficient utilization of resources.

We see therefore that the design/materials system, particularly as related to mass-produced, high-volume consumer products offers opportunities for instituting this new conservation ethic and action program.

However, we recognize that there are barriers in the design system which inhibit more optimum materials utilization in current design practice. Some of these are:

(1) Inadequate product performance criteria—Unlike aerospace or defense systems many consumer products are not designed to fixed performance envelopes. Thus design practice must factor in consumer service use variability.

(2) Inadequate feedback and long time lag between design system and field performance history.

(3) Design often may be subordinate to existing manufacturing capabilities and facilities which may inhibit design and materials innovations,

(4) Consumer Acceptance is a non-quantifiable but important design parameter. "Quality of Life" can assume equal ranking to functionality.

There was general agreement that the most effective force to impact the design system and materials utilization practice is through the pricing and free market system. Comparative materials and energy costs affect design directly and the utilization of less expensive and/or more available materials.

Government in no way should dictate design criteria, but provide standards for performance and functionality where necessary to meet societal goals. The regulatory, taxing power and related options available to the government should be used, as appropriate, for the internalization of external (social) costs to ensure proper interaction of materials utilization and design practice with the goals of environmental, safety, health requirements, etc.

New parameters will be impacting current design systems in the future, such as designing for recyclability, designing for easy repairability, designing for guaranteed reliability. These will have significant effects upon materials utilization patterns.

On the other hand, the task force recognized that the gains to be achieved in materials utilization through change in design systems may be secondary to the gains possible from new or improved manufacturing technologies. In this respect the integration of design, manufacturing and materials in the design/release systems needs to be vigorously encouraged.

One area of particular importance for Federal encouragement or support is the greater utilization of technological and manufacturing innovations and processes which have materials savings capabilities. Numerous such innovations have been developed or are being developed and remain under-used because of such items as capital and facilities investments, reluctance to obsolete existing facilities, amortization factors, etc. It seems like sound common sense for the government to promote incentives for industrial innovation, particularly where

significant materials conservation can be achieved.

Three technical areas may be cited which are significant to our overall utilization of materials and reduced costs.

a) corrosion
b) wear
c) non-destructive evaluation

All three areas impact the important features of reliability, durability, and longer life of consumer products. More effective non-destructive evaluation methods capable of being used as continuous on-line production systems are needed for manufacturing quality control and to reduce waste, scrap and inefficient materials consumption.

Some opportunities which appear ripe for effecting design and process improvements and which should receive attention are:

(1) Modeling opportunities—Improved modeling techniques and systems could result in better trade-off analyses particularly where energy, materials and environment are interactive factors.

(2) Regionalization of use of indigenous materials—To reduce transportation and energy costs and again to increase efficiency in materials utilization.

(3) Re-evaluation of industrial technological experiment stations—an analog to agricultural experiment stations.

(4) Major materials and energy savings through more functional systems in housing, communication, transportation, etc. Housing, particularly can be a major source for energy conservation.

(5) Designing for recycling with particular emphasis on design/materials systems approach.

(6) Opportunities in Academia—Changes in educational systems, curricula, research policies and practices and traditions, etc. geared to education and training a new generation and breed of design, product and materials engineers inculcated with the conservation ethic as a design parameter.

(7) Analysis of government research and education funding distribution to define areas of emphasis and disclose areas of inadequate attention.

(8) Opportunities through government incentives to promote more industry (government cooperation and less of the traditional adversary position.) The new dimension of materials conservation and more efficient utilization suggests re-evaluation of anti-trust regulations, trade barriers, etc. to promote greater industrial consciousness in this area. In particular, the patent regulations of non-defense agencies involving government/industry contracts needs to be examined to determine whether it inhibits development of industrial technology.

(9) A particular opportunity resides in the purchasing systems of governmental agencies. They can provide a real demonstration of the applicability of life cycle and total costs as a more meaningful approach to ‘competitive bidding concepts than the traditional initial purchase costs.

The Task Force suggests some other specific areas in which Federal

interaction can be important in affecting materials utilization practice:

(1) Promulgation of an International Materials Conservation Year
(2) a. Develop government/industry cost-sharing and other support programs to introduce and/or develop materials saving technology and practices. Canada and other countries can be examined as possible models for cost-sharing techniques.
b. Extend the IR&D government support programs (now in practice for Defense Contractors) to civilian industry to encourage industrial consciousness of materials conservation programs.

(3) Implement the recommendations of the National Commission on Materials Policy for closer and more effective industry/government relationships. This may be particularly important in this new era of deficit balance of payments, involving to a significant extent the costs of materials inputs.

(4) Bring materials conservation consciousness to a high level of national attention through affirmative action programs.

Task Four (A): MOBILIZING ECONOMICS AND TECHNOLOGY FOR MATERIALS RECYCLING

1. General Features of Recycling.

Recycling as a policy aims at the optimum amount of recovery of secondary materials. This optimum in general is not the physically possible maximum because of energy constraints and in some cases because of environmental constraints, Nevertheless, the closed materials cycle is a useful concept, because it replaces the linear or once-through approach of materials utilization by a circular or continuing approach.

Secondary materials are of three generic types. Home scrap (process scrap) is generated in the primary production process, prompt industrial scrap (new scrap) originates in manufacturing operations and post-user scrap (old scrap) arises as goods are discarded.

Home scrap is an internal concern of the primary producer and poses no major policy problems. The recycling of prompt industrial scrap is usually motivated adequately by economic considerations except in small or inefficient establishments. Post-user scrap ranges from the obsolete equipment of manufacturers, utilities and transportation companies to discarded consumer durables such as automobiles and major home appliances to consumer nondurable; the level of recycling of these objects (i.e. the ratio of recycled to recyclable scrap) decreases in the order listed and at present practically vanishes for those nondurable which enter the municipal waste stream.

Home, prompt industrial and post-user scrap may consist of nonferrous and ferrous metals, paper, wood products, rubber, textiles, glass and plastics. The order in which these materials are listed indicates approximately their level of recycling.

Recycling always serves two functions: conservation of resources

and reduction of waste. It usually also results in an energy saving and decreased pollution.

The bulk of secondary materials is recycled by the private sector. Since the driving force is economic gain, the industry concentrates on those materials which have substantial intrinsic value. The activities of the secondary materials industries result in the conservation of resources and only incidentally in a reduction of waste. By contrast, the disposal of household waste is essential] y a local government function serving the public interest.

Current interest centers on the recycling of at least part of the municipal waste stream. However, implementation is difficult for several reasons, particular y weak economic incentives and institutional barriers at the local government/industry interface. .

2. Technology and Engineering.

The established secondary materials industries have in hand adequate technology for the recovery of metals, paper, glass and various other materials. This technology makes the recovery of a large fraction of these materials economically viable. In our opinion there is also adequate technology for recycling of at least part of the municipal waste stream. While related institutional and economic problems are yet to be solved, demonstrations of such technology should not be delayed further. Indeed such demonstrations are essential for further progress.

It should not be concluded from the foregoing, however, that technology is available for the recovery of all types of materials or that existing recycling technology is satisfactory in all respects. Research and development in selected areas, therefore, are still necessary.

The technology of handling the municipal waste stream needs further development. In particular, collection, which accounts for a large fraction of total waste management costs, has to date not been effective] y modernized in technical respects. Recycling requires the separation of the waste stream into its constituent parts. This function is receiving much attention and various techniques are available. However, the separation of mixtures of some materials, for example, paper and plastics, cannot yet be achieved dependable under all conditions.

The metallurgical processing of secondary metals still presents some unsolved technical problems. There are no procedures for removing copper from ferrous materials, the properties of which it affects adversely. Detinning of ferrous scrap is possible but is restricted geographically and in other ways. Except for the usually undesirable removal of magnesium, aluminum alloy scrap cannot be refined. These examples illustrate the need for new process technology.

Research into the benefication of mixed cellulose fibers is desirable for expanded recycling of paper products. The effects of secondary fibers on the properties of paper and paper board are largely unknown. The most extreme lack of technology involves the recycling of plastics. This has often been ignored in discussions of municipal wastes recycling.

An interesting technical and organizational challenge is the design of the municipal waste stream for facilitating recycling. Qualitatively

this approach requires the elimination of some mixed materials (pernicious contraries) which cannot be readily separated; examples are bimetallic cans, metal foil/paper and paper/plastic combinations and incompatible adhesives and inks on paper. In quantitative respect a reduction of the volume of the waste stream would result from the reduction of over-packaging or the elimination of non-returnable containers. An entirely different approach to a more tractable waste stream is sorting at the source.

3. POLICY AND LEGISLATIVE RECOMMENDATIONS.

The Federal Government should continue to pursue vigorously policies designed to promote recycling of secondary materials with due regard to economic, energy and environmental constraints. Parallel or implementation actions should also be taken on the State and local levels.

We make the following recommendations for specific action in three major areas:

A. IMPROVING THE ECONOMICS OF RECYCLING.

(1) Eliminate current disincentives, specifically discrimination in freight rates, and unequal tax treatment (depletion allowance, capital gains treatment and preferential treatment of foreign income of primary producers).

(2) Establish positive incentives through preferential Government procurement policies favoring secondary materials and the adoption of a disposal charge on materials likely to enter the municipal waste stream with a rebate for secondary materials used.

B. IMPROVING THE TECHNOLOGY OF RECYCLING.

(1) Fund selectively demonstration grants designed to test the feasibility of available new technological systems and to reduce institutional and economic uncertainties now relating to them.

(2) Support laboratory research (i) to solve specific technical problems such as the removal of harmful impurities from recovered steel scrap, (ii) to find new recycling processes, for example of aluminum alloys, and (iii) to develop recycling technology for materials such as plastics that are currently not recyclable.

C. CONDITIONING POST-USER SCRAP AND PARTICULARLY THE MUNICIPAL WASTE STREAM FOR IMPROVED RESOURCE RECOVERY.

(1) Suppress combinations of materials that are incompatible in current recycling systems by procurement specifications and standards and the promotion of voluntary compliance by industry.

(2) Reduce the volume of waste by promoting product durability, repairability and maintainability.

(3) Encourage the upgrading of the municipal waste stream through source separation by appropriate public interest campaigns.

We recognize that the recommendations made in (A), (B), and (C)

above are not necessarily novel. We are making these recommendations now because we believe that they deserve consideration especially as new information or understanding in support of some of them has developed.

D. S. Lieberman:

It is straightforward to see how resources, waste, and pollution are affected by recycling, but its effect on the energy required for producing a material warrants amplification. In a sense, recycling can be considered as a way of "reusing" energy already spent on resource extraction rather than the commitment of an equal amount of energy for the production of a new batch of the same material. Aluminum may serve as an example that will demonstrate that far less energy is required to use a recycled raw material than to start with an energy absorbing primary source: thermodynamic calculations show that 1/20 or less of the original energy is required to produce aluminum from scrap metal rather than from mined ore. This example illustrates why energy savings are a powerful argument for recycling.

F. L. Smith:

Both consumer durables and non-durables are eventually discarded and become part of the municipal waste stream. They thus impose on society downstream waste management costs which at present are not paid by the producer and hence are ignored in production decisions. As a consequence, relatively inexpensive waste reduction measures may be overlooked. Similarly, the producer cannot readily capture savings in waste management costs resulting from a decision to reuse waste materials; such materials, therefore, remain underutilized. The current lack of sufficient economic incentives because of the absence of effective cost internalization tends to inhibit recycling.

Demonstrations would be especially valuable for such dry separation systems as are now being developed by the Forest Products Laboratory (Madison, Wisconsin) and the Bureau of Mines (College Park, Maryland). Demonstrations of techniques for recovering the raw materials in major household appliances should also be funded. Demonstrations and research on resource recovery could be supported by funds generated by the imposition of disposal charges.

Recent developments concerning recycling have been unfortunate. Initially there was great enthusiasm for action but the analytic support was weak. Now after several years of extensive research on various aspects of materials policy, the base for action has been greatly improved but the enthusiasm necessary to translate this new understanding into policy has waned. A rekindling of enthusiasm is greatly needed.

Task Four (B): MOBILIZING ECONOMICS AND TECHNOLOGY FOR MATERIALS RECYCLING

Introduction

The rationale mentions the abundance of technologies to extract values from wastes and abundance of wastes, agricultural, forest, human sewage, industrial and consumer. This is followed by the question: "What actions, public and private could motivate the more complete recovery of wastes and the greater utilization of secondary materials, thus closing the materials cycle?"

Additional questions suggested to lead discussion appeared to be

addressed to municipal or consumer wastes and the closed cycle wastes from materials processing. It was decided by the committee that they should address themselves solely to the last two subjects since water, agricultural, sewage and wood wastes were too broad to include. It was emphasized, however, that water is a key ingredient in material processing and could be considered one of our scarcest materials when related to closed cycle materials management. Its true cost including the cost of restoring it to recyclable quality is often overlooked.

It was also emphasized that the divided, multistage processing in the United States makes closed cycle management of materials difficult. Despite this difficulty the costs of disposal should be borne equitably, and better data are needed to determine and distribute these costs.

Question (l): Beyond the general goal of achieving a closed cycle in materials management, what more explicit and detailed goals are there?

Discussion: It is true that there are an abundance of technologies to extract useful values from municipal wastes, but there is an abundance of ignorance about costs, optimum size, interconnecting or tailoring the process to the waste of a particular sector and practical operating data. There is no universally best method which can be used anywhere. Recycling has finite limits based on both economic and ecologic factors.

To approach the closed cycle or optimum disposal, information must be obtained regarding:

Quantity and quality of recycle feed material,
Preferred disposition for that location, for example:
Should combustibles be burned or recycled?
Availability of local markets for reclaimed products,
Collection and transportation methods,
and many other factors which are cost interrelated.

One major goal would be to provide information to guide process selection once the above information has been obtained by the municipality.

Other proposed goals are as follows:

A. Reduce landfill requirements from its present 7 acre feet/year/ 10,000 persons and reclaim filled land for highest quality applications.

B. Attempt to direct landfill materials to longer term use, for example, to construction materials which would not immediately enter the recycle stream (cinder block, road building aggregate, home insulation and sheathing paper).

C. Reduce material consumption by increasing the initial life of the product and by designing for maintenance rather than discard.

Question (2): What kind of institutional mechanism and aids, private and governmental, could best provide the motivation toward achievement of these goals?

Discussion: It is acknowledged that there are built-in constraints between public and private ownership and operation of recycle facilities; there are problems of political boundaries; of capital funding; and there are some barriers set up by regulatory agencies. These must be met and resolved by an equitable and rapid process of reconciliation.

A. Federal and State guidelines and funding should exert leverage to obtain regions and waste recovery units of appropriate size.

B. Total technology is not proven and Federal and/or state should share the funding to accelerate the demonstration plants. The operational information is needed to reduce the risk to the municipalities involved. For example: Clean separation of copper from steel or aluminum from other nonferrous metals has not been achieved. Corrosive effects of burning municipal combustibles are not well known. Inorganic other than metals have no economic use, and even well-segregated glass may not be a viable product. Only selected portions of waste paper are effectively recyclable.

C. Encourage joint government-industry and multi-industry cooperative R&D to accelerate projects in these high risk and potentially low profitability projects.

Question (3): What is the nature of the legislative package which can increase the extent of post-consumer product recycling? What details of legislation can facilitate recycling programs of municipalities?

Discussion:

A. The government should enhance the marketability of recycled materials. There should be legislation to remove penalties or disincentives for the use of secondary materials. Some of these are:

(1) Inequitable freight rates (ICC rates for iron ore vs. scrap).
(2) Depletion allowances for virgin materials.
(3) Pejorative labelling laws. Where feasible, performance should be specified, not recycle material content.

B. The government should expand a purchasing program, rewriting specifications which currently limit or penalize the use of recycle material.

C. The government should be encouraged to continue to sponsor research for the separation, refining, and use of recycle materials. There is now a shortage of mining and metallurgical engineers. Government aid could fund university programs to solve separation problems and simultaneously train students for this expanding field.

Question (4): Would it be possible to “design” municipal waste streams by applying regulatory principles to the design of products that comprise the bulk of these streams?

Discussion: It may be too discriminatory to legislate separation of products in the design stage (although the economics of recycle did

cancel the aluminum topped steel can) but incentives based on designs which facilitate separation should be considered.

Question (5): What techniques could be used to maintain the value of materials throughout the entire materials cycle, to increase the motivation for their recovery and reuse?

Discussion:

A. The total social costs of the product should be estimated including the cost of disposal. Much more economic data are needed to do this realistically and should be obtained.

B. Products are now being designed to show efficiency and related energy consumption. Why not add data on recycle value or cost to this effort?

Task Five (A): THE ROLE OF THE TECHNICAL COMMUNITY IN NATIONAL AND INTERNATIONAL MANAGEMENT OF MATERIALS

Assumption

While every scientist and engineer active in the materials field can and should take individual actions to provide technical input to their professional societies and other materials study groups, their capacity, prestige, and influence in helping to solve national and international materials problems can be multiplied manyfold through the unified backing of an entire learned society (i.e. ACS, ASME, IEEE, ASM, etc.). Consequently, we have interpreted the words "technical community" in our task title as meaning the learned and professional societies organized at the national level in the USA. This task is therefore directed as exploring the possible roles that technical societies are currently playing, and could play, in participation in cooperative efforts on the national and international level, to deal with related materials problems and opportunities. In so doing, we have also identified possible roles that we do *not* feel are appropriate for the technical community.

1. USA and International Objectives in MateriAL Policy.

The final report of the National Commission on Materials Policy (NCMP) listed five general goals for USA materials policy. Three of these five national objectives we feel are shared in common with all nations, namely:

Provide adequate energy and materials supplies to satisfy not only the basic needs of nutrition, shelter, and health, but a dynamic economy, without indulgence in waste.

Accomplish the foregoing objectives while protecting or enhancing the environment in which we live.

Conserve our natural resources and environment by treating waste

materials as resources and returning them either to use or, in a harmless condition, to the ecosystems.

2. COMPATIBLE AND COMPETITIVE GOALS IN INTERNATIONAL INFORMATION EXCHANGE.

In implementing the three common goals identified in paragraph 1, we felt the need to separate "compatible" goals from "competitive" goals. Compatible goals are those which we feel the technical communities in most nations could discuss cooperatively with no constraints on the subject matter. Competitive goals are those where barriers and constraints exist which would impose limitations on open, free discussions and which have a definite "bargaining" connotation.

a) Compatible Goals:
   1) Information on fundamental properties of materials (materials science) sufficiently detailed to provide designers the necessary information for materials optimization and/or substitution.
   2) Information on fundamental factors controlling processing, performance, safe and durable usage, recycling and environmentally compatible disposal.
   3) Realistic assessments of national and international materials needs and reserves of materials, and
   4) Exchanges to strengthen educational weaknesses in the materials science field as related to material scientists, design engineering, governmental materials specialists, information specialists and general public.

b) Competitive Goals:
   1) Maximum prices and stable markets for raw materials exported.
   2) Minimum prices and stable supply for raw materials imported.
   3) Maximum prices and stable markets for manufactured goods and technology exported.
   4) Minimum prices and stable supply for manufactured goods and technology imported.
   5) Concealment of national material problems involving security weaknesses, size of stockpiles, costs, quotas, etc.

3. CURRENT TECHNICAL EXCHANGE AND TRANSFER ACTIVITIES.

a) Many scientific and technical societies and "umbrella" federations of learned societies are currently active in materials information exchange with their counterpart societies at the international as well as national level. These exchanges involve information where proprietary topics are not discussed (intentionally). These exchanges in the materials field can be expected to continue and increase without any external encouragement.

b) Special studies and symposia by single or multiple technical societies are being sponsored and funded by national and international governmental and private groups such as NCMP, OTA, IAEA, OECD, CCMS, NASA, COMSAT, NSF, NMAB, NAS, NAE, etc. These will undoubtedly continue but perhaps may

be better coordinated and promoted by a temporary or permanent National Materials Policy Commission (when such a group *is* legislated into existence).

c) Many material scientists and engineers in private industry are participating in the transfer of materials technology and management techniques with counterpart personnel in foreign industry. We can expect this mutually advantageous type of materials information exchange to continue and increase in the private sector of the materials field.

4. COOPERATIVE VERSUS BARGAINING ROLES IN MATERIALS INFORMATION EXCHANGE

a) Choice of cooperative role (for compatible topics) or bargaining role (for competitive topics) depends on the importance of the commodity and its associated technology being considered for information exchange.

b) Choice also depends on whether the exchange is with developed, developing, or emerging nations.

c) Choice may be influenced by assessments of the equality of exchange or the probabilities of accelerating mutually beneficial materials goals by joint effort.

5. INTERNATIONAL MATERIALS AND INFORMATION EXCHANGE THROUGH BARGAINING.

Government and private industry have both separate and cooperative roles to play in the exchange of materials and materials technology. There is a definite need for increased and improved cooperation between government and industry in achieving national policy objectives through international exchanges. To achieve this end, there first must be a more definitive agreement on national objectives in international bargaining in each specific materials supply and technology area. Our task force feels the specific mechanism required to arrive at the above objective is not yet in place. Therefore, we agreed that this area needs serious national attention.

6. GENERAL CONCLUSIONS OF TASK FORCE.

a) Competitive goals requiring bargaining materials and technology exchanges are more important in the short term than cooperative (compatible) exchanges to help resolve immediate materials problems. Hence, they have the major motivation for action.

b) Cooperative exchanges by technical/scientific societies and "umbrella" federations (such as FMS, American Institution of Physics, American Geological Institute, Federation of American Societies for Experimental Biology), though less important in the short term to our national materials policy, have two vital roles:
   - Fundamental materials science information gathering
   - Technical assistance to the "bargaining" organizations

c) Technical societies are ***not*** appropriate "bargaining" organiza-

tions, but they can and should assist in:

- Assessments and forecasts of technological trends
- Recommending areas and topics for bargaining
- Providing the mechanism and knowledgeable materials specialists for technology transfer after bargaining agreements are reached

d) Private industries or governmental agencies (NASA, AEC, NBS, etc.) may be selected or solicited by bargaining organizations to provide the needed technical exchange. If proprietary information is deemed in the national interest for exchange, licensing or royalty payments should it accrue to the private industry releasing such information at the bargaining organizations' request.

7. ANSWERS TO SPECIFIC QUESTIONS IN THE TERMS OF REFERENCE FOR TASK GROUP 5.

a) We feel the answers to all but Questions 4 and 5 listed in the charge to the Task Force are given in the above summary of our discussions. With respect to these two, we see no need or priority at the present time to promote an International Federation of Materials Societies, but we do feel technical liaison between such national federations where they exist should be fostered (i.e., between the U.S. Federation of Material Societies and the British National Committee for Materials).

b) Question 6 asks how existing private and public institutions can be better utilized. We want to emphasize the need for a strong one-on-one relationship as the best means for effective information exchange. Nothing can substitute for a face-to-face technology transfer by the most knowledgeable scientist or engineer in the specific materials field being discussed. A classic example for us to emulate is the County Agent/Farmer relationship in the agricultural field backed up by viable agricultural experimental stations. We should aim to achieve similar effectiveness in materials technology discussions.

Task Five (B): THE ROLE OF THE TECHNICAL COMMUNITY IN NATIONAL AND INTERNATIONAL MANAGEMENT OF MATERIALS

It should be recognized that the existence of a true technical community capable of speaking with a single voice on materials issues is tenuous. There are many allegiances of any individual to his professional society, his employer and his nation, to mention only a few. In order that a meaningful technical community exist on these issues requires vigorous and ongoing education of the constituency. Only in this way may the group expertise and prestige be effective y mobilized. The creation of FMS is encouraging in this regard since it signifies a growing awareness on the part of governing councils of the member societies, at least, of the need for coalition for the common cause.

The Harwell Conference on Conservation of Materials is another indicator of recognition of the need for unity of the technical community in order to provide well-thought-out advice to policymaking and implementing branches of government.

Question 1: What materials goals tend to be most evidently shared among nations?

The dominant goal of each nation is to sustain and better the lives of its citizens and to ensure territorial security. In highly industrialized countries this goal requires an assured supply of energy and raw materials as well as processing and manufacturing facilities to satisfy the civil and military technological needs. In addition, there are, of course, the truly basic needs such as food, clothing, shelter, medical care, etc., which are shared, at varying levels, by the less developed nations. All of these requirements in a market, rather than an internally controlled economy, lead to worldwide flow of materials, skills and data, as well as capital.

Therefore, the world must regard the basic materials concerns within the context of providing for the needs of all people as they arise.

The present concern is with assuring supplies at a time when there is increasing dislocation, both in respect to materials flow and finance. Consequently, a basic materials goal is to improve the atmosphere in which the exchange of materials, goods and services takes place. The danger is the formation of groups which in the long run will divide the world into self-sufficient blocs preventing continued interaction through world trade.

Question 2: What kinds of related programs could be sponsored within nations for public purposes?

Among materials related programs that could be sponsored on a national scale for public purposes are the following:

1. Improved utilization of
   a. Energy and fuels
   b. Minerals through enhanced effectiveness, extension of life of products, recycling and reduction of social costs.
2. Development of alternatives in a and b to minimize dependence on critical foreign sources of supply—this is, of course, destabilizing to the world-trade situation (e.g. Project Independence).
3. Increased awareness among consumers that stringencies require a change in attitude among the public in the highly growth-oriented nations.

Attainment of most of these goals can be greatly assisted on a national scale by involving the active participation of members of the engineering and scientific community through their organizations in each country. In addition, research programs in support of these goals should be sponsored not only within university and industry but also within

research institutes and competent government agencies in furtherance of the goals enumerated above.

Dissemination of information concerning these national objectives should be sponsored through the professional societies by government and industry, even possibly including TV programs.

As a final point, materials societies have a vital role to play in advising legislators of materials problems and opportunities which require legislative action.

Question 3: What kinds of international interactions might be fruitful with respect to similar programs?

Among the developed nations there is an obvious need to keep their standard of living high and unimpaired to the greatest extent possible.

The spirit of private enterprise and the profit motive in the countries of the market economies will ensure international dissemination of the fruits of at least the significant innovations resulting from the activities outlined under Question 2 above.

Engineering and scientific societies can play a great role in this endeavor through their many activities, meetings, publications, even through their standards and specifications, and can alert their membership to goals that are substantially analogous within the range of the industrial countries. It is, therefore, desirable to establish closer links with corresponding engineering and scientific societies to coordinate efforts and improve collaboration.

It must be emphasized that much may be learned from countries which have, of necessity, practiced a high degree of economy in the use of materials through past generations.

There are two categories of countries in the so-called Third World, those like Brazil, Mexico, and India which have a highly developed professional class, and those like Mauritania, Upper Volta and Mali which have no organized professional class in science and engineering to correspond with their colleagues in the industrial world.

There is no problem in establishing contact with professional societies in the former group of countries.

However, in the latter class there is no clear communication link other than between governmental bodies or, perhaps, via commercial enterprises whose desire to exploit resources of these nations has established stable relationships. In this regard it should be reiterated that recent formation of raw-material cartels have shaken confidence in these relationships with the less developed countries. Whereas such cooperation has formed the basis for economic growth in these nations in the past quarter century, one is now faced with the growth of self-sufficient economic blocs. Can professional societies do something to reverse the trend that has emerged so strongly during the past year? If so, the efforts toward increased reliance on domestic sources will have to be held in abeyance, and the present trend toward fragmentation of the nations into suppliers and consumers into blocs can be halted.

It is not up to the engineering societies to decide this question,

but they should probably draw the attention of their membership, of the public and especially of their lawmakers to the seriousness of the options which the world community faces at this time.

it is therefore appropriate to launch an "International Mineral Resources Year" to publicize the options which the world faces before positions become irrevocably frozen. *

Question 4: What options for international organization exist, what are the advantages and disadvantages of each, and which are likely to be most effective? What course and approaches should be adopted?

International organization will, of course, require some body to take the leadership (i.e. provide the initiative). This could be an existing national or international organization (e.g. UN, IUPAC, FMS) or, less likely, a completely new organization. The possibilities would become clearer if an intense but limited activity such as an 'International Mineral Resources Year" (IMRY) were organized, probably under UN auspices, but with support from individual governments. This would establish a need for international cooperation and the communication links formed would survive beyond the formal end of the "Year" and could become the network for a dialogue on a more permanent international cooperation. The advantages of the IMRY mechanism are that it would provide an important compilation of information on mineral resources at the same time as providing a framework which could evolve into an ongoing mechanism for extended cooperation without the need for pre-judging what the details should be, and without requiring an early decision as to the source of leadership.

Question 5: What role exists for an international technical federation of materials societies?

It is likely that the proposed IMRY would identify or create a body which could function as a coordinating agency for national materials societies. For the present, until more is known about the world materials community, it would be unrealistic to attempt to define the role of such an organization.

Question 6: How can existing private and public institutions be better used in support of the above goals and in support of conclusions derived from the above? What, if any, additional institution(s) is needed?

A considerable difficulty in making meaningful recommendations concerning improved use of public and private institutions is their number

* The suggestion for such an international program originated with Professor Rustum Roy of Pennsylvania State University.

and diversity. It appears that compilation of an inventory of Minerals and Materials Societies covering international and, perhaps, even national societies would appreciably help the situation. It is proposed that the inventory not be a mere listing of organizations by title and address but rather include a short description of the societies, their participating nations, their interests, activities, publications and constituencies by principal professional discipline or trade activity. To make the document most effective, it should be made widely available at low cost and be updated periodically. In the short run such a compilation should aid communication and, perhaps, in the long run could suggest possible reduction of redundancy or formation of federations of compatible organizations (possible alternate to 5).