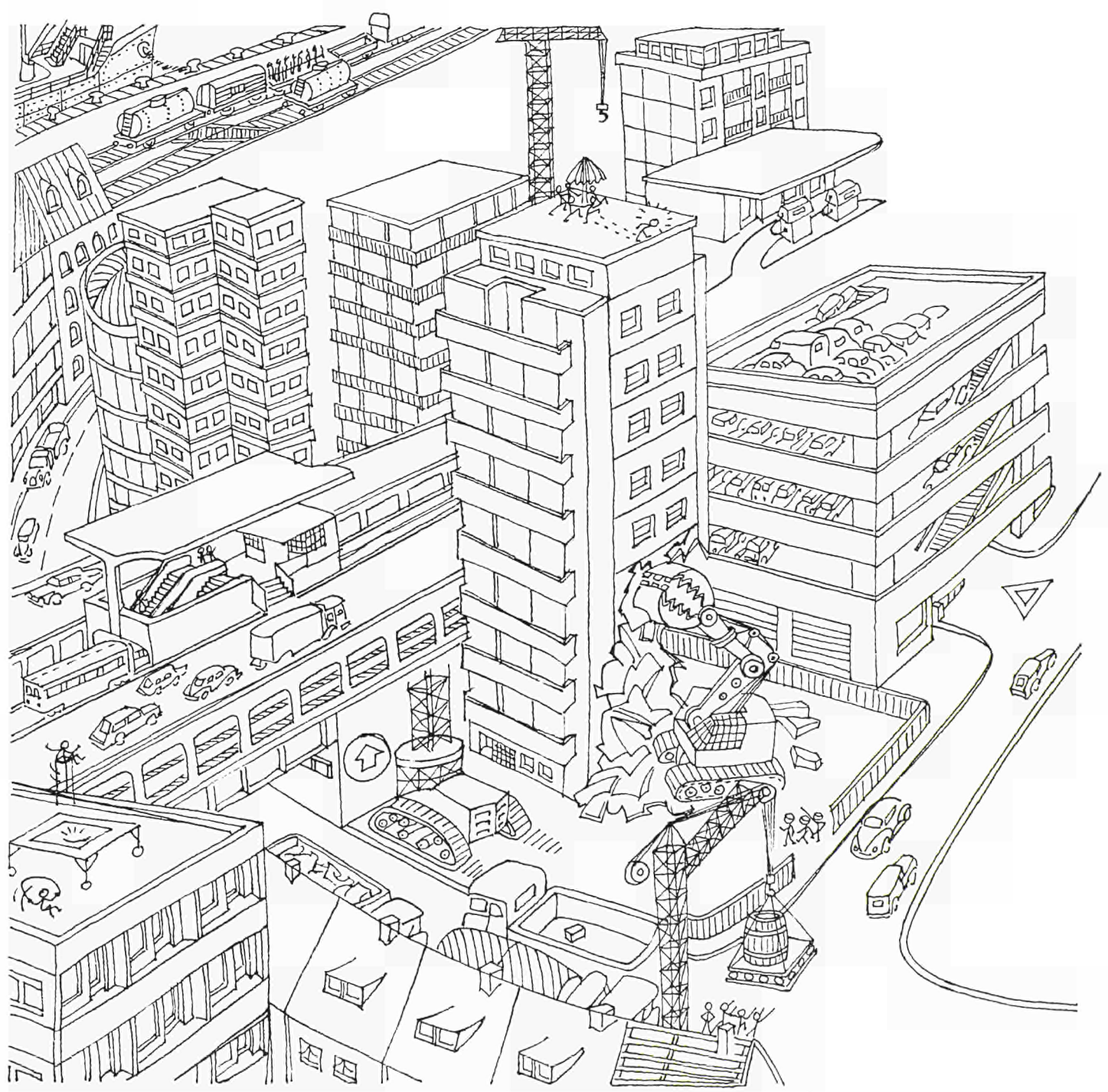


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It is by now only too evident that the important work done by the Club of Rome tends to be discussed by people who for the most part only have a limited knowledge of the subject and are basing their views on other men’s interpretations and assessments. The two articles in this issue which deal with the nature and progress of that work, the one being a basic explanatory report and the other a critical evaluation, should provide a more complete picture for those who, through lack of science or original references or for countless other good reasons, have to some degree contented themselves with reading only the negative reactions to the first report on “The Limits to Growth”.

Whilst the problems studied by the Club of Rome are of a world scale, the CEC studies are actively helping to define the problems discerned at European level and to produce the necessary solutions thereto. We are therefore publishing an article which briefly summarizes the initial steps taken by the Commission in regard to the building industry and its market.

Finally, the documentation addicts will find food for thought in the last article by an author whom we may define as an independent since he belongs to no particular school. We hope that readers interested in this subject will peruse the article and provide us with their comments and/or criticisms as they always have done in the past.

The following two articles are concerned with the work of the Club of Rome, which was founded in 1968 and suddenly won widespread renown when its report "Limits to Growth" was released to the press in 1972, as the political economic and social realities it described were not limited to any one country or continent, but concerned the whole of mankind. The report made a sensational impact and pricked the public conscience in a painful and disconcerting way; as a matter of fact, the work of the Club of Rome is still surrounded by strong opposition and lively discord.

The two articles presented here relate to the more recent activities of the Club of Rome. The first, written by Manfred Siebker (a member of the Club), is mainly concerned with some of the new fields of research which, after the first phase of activity, were selected for the new generation of total studies, their underlying philosophies, the models used and the conclusions drawn from the first partial results presented at the latest congress in Tokyo. The other article, written by Johan W. Brinck (one of the outside experts invited to take part in the research carried out by the Gabor Group), makes a critical analysis of the dynamic world model of Forrester and Meadows.

One fact that seems significant is that both authors were officials of the CEC and are now contributing their experience to the study of the much more far-reaching problems tackled by the Club of Rome.

The two articles, we feel sure, will not fail to arouse keen interest and stimulate discussions between all those who feel deep concern in a future which is in many ways depressing and uncertain.

The Editor

The Club of Rome : Report from Tokyo*

Towards a global vision of human problems

MANFRED SIEBKER

The general context

IT IS INCREASINGLY acknowledged that the great problems of today's societies are not just modern editions of old troubles but that they are cases where a change in order of quantity and speed has engendered a qualitative transformation. At the same time it becomes apparent that mankind, although divided and subdivided in so many and often radically different nations, classes and groups, forms a global system in which no part can escape the influence of the others, nor remain innocent in its responsibility to the others by acting or refusing to act. Finally, it is being felt that the multiplicity of widespread, elusive and apparently independent problems could be the heterogeneous symptoms of one general syndrome. Increasing tension between rich and poor within and among nations, inflation and monetary disruption, energy crises, deterioration of the environment, anarchic urban spread, alienation of the youth and isolation of the old, erosion of the values of society, educational and institutional irrelevance, violence: all these individual problem areas are amplified by cross-feedback mechanisms, acting with the boundlessness and speed of modern communication whereas individual and institutional reactions remain as slow as ever.

* Abridged, from Siebker and Kaya, in "Technological Forecasting and Social Change", Harold Lindstone ed., 1974.

MANFRED SIEBKER, Member of the Club of Rome, Brussels.

Our forecasting and planning capacities are in early stages of development. But this is not a valid justification for being imprudent or reckless, nor for becoming paralyzed in the expectation of doom. If we think that there is a fairly high possibility—if not certainty—of worldwide and basic disorder if humanity pursues its present course, then it is our duty to act without further delay. And the first step of such action is to create a basis for understanding what is actually happening in this most complicated system. We first have to understand how the "machine" works. Our situation is indeed that of an intelligent child finding himself alone in the cockpit of a jetplane in full flight, gazing at the hundreds of dials and levers and trying to figure out how it all functions, hopefully before the craft hits a mountain or fuel runs out. Furthermore: the child is not alone; there are many of them around, kicking, nudging and distracting one another!

The point is then that our problems are no longer straightforward, of a specific nature—economic or technical or political or social—, problems which can be dealt with in their own terms, each independently of the others. All major issues of modern society defy such a linear approach. They form a complex dynamic system with an inextricable multitude of interdependencies, the lines of cause, effect and feedback often being hidden or changing with time.

It is in this twisting tangle that we have to extend our vision as far ahead into the future as the consequences of our present actions reach, in order to devise policies which not only satisfy

the needs of today but the exigencies of the entire time frame.

The initial phase of the Club of Rome

The Club of Rome was formed in 1968, as a constructive expression of concern with the way human affairs had developed. After having spent its first two years in deepening its understanding of the problematique, it began to discuss with policy decision makers, but with no immediate practical response.

Even those who shared its apprehension of a looming global crisis were too submerged by immediate problems—in time or space—to worry about the far graver difficulties ahead or present elsewhere. But more often the judgement of people was perverted by superstitious belief in the omnipotence of technology or lulled to sleep by a micawberish faith that humanity will "somehow" overcome any future crisis. It became evident that reasoning could neither move this complacency about our industrial civilization nor change the attitude of *laissez-aller* which tolerates its excesses as palliatives of immediate difficulties or tributes to dominant groups.

At this state of affairs, the Club of Rome felt that nothing short of a shock treatment could help. "Its immediate purpose was thus temporarily shifted from the search for answers to basic questions to the search for a device capable of opening a breach in the hearts and minds of people, of arousing their awareness to the complexity and seriousness of the world problematique. After long consideration, a commando operation was decided upon, in the hope that its rapid tactical success might have strategic consequences" (Peccei). As the approach to this operation, the rationale and the simulation techniques devised by Jay Forrester of MIT were chosen. The project was carried out by a team headed by Dennis Meadows.

It was recognized (and should continue to be recognized) that models trying to represent reality—be they mental models in our brain, or formal ones built with the assistance of charts, graphs or computer programs—are a more or less gross simplification of reality. The factors selected for the world dynamics project to characterize

the present situation and its critical developments were: demography, industrial production, food, environmental pollution and the depletion of non-renewable resources. In short: this first global research sponsored by the Club of Rome was a systematic exploration of the dynamics of uncontrolled human expansion in the finite dimensions of the spaceship Earth. Its results were comprehensively presented in *The Limits to Growth*, which was published first in English (March 1972) and by now has been printed in twenty other languages.

Its message was:

- If the growth trends characterizing present human societies continue, the limits of the Earth supporting capacity will soon be reached—probably during the next 100 years—with the consequence of an uncontrollable civilization breakdown of one kind or another;
- There is still time to avoid a major disaster, if present growth trends are rapidly brought under control;
- The more time passes before such a change is effected, the more painful it will be, and the smaller its chances of success.

A new generation of global studies

Important as the MIT study was a pioneering entry into the new field of investigating the world problematique, it could by no means represent the totality of the Club's approach. New research into global, regional and national systems was immediately felt to be required, as well as extension towards the consideration of broader social and value issues and a penetration into some of the deeper problems of human nature.

Reassessment, refinement, disaggregation and extension of the first model were steps logically to be taken both by those responsible for the first project and by the more serious of its critics.

The new areas of study which The Club of Rome emphasized immediately after the first phase concern (see also Table I):

- (a) disaggregated models in which social, cultural and other factors can be taken into account and which permit an assessment of the interdependence between highly

industrialized and less industrialized countries;

- (b) integration of regional models into a global model;
- (c) models for policy assistance and testing, based on a multi-level, hierarchical systems approach which in addition to physical, ecological and short-term economic causality represent society's response and permit an evaluation of values and needs as to their relative influence on the goal-making process;
- (d) the specific problem complex of the less developed countries and their plea for planetary socio-economic justice;
- (e) the world population problem, both in terms of the possible policy measures to contain it and the socio-economic means to cope with the inevitable increase;
- (f) sustainable systems, the study of qualitative elements of growth, development of better growth indices and of a new socio-economic theory in general;
- (g) reassessment of technological potentialities and research priorities vis-à-vis the problematique;

(h) research structures; scientific planning methodologies; assessment of technology and its social, cultural and ecological consequences;

(i) value systems, motivational structure and behavioural limitation of the human species; policy studies in this context.

Most of the problem areas indicated are now being attacked in the framework of projects or institutional initiatives, many but not all of them promoted, co-sponsored or triggered by The Club of Rome. No project presented at the last annual meeting of the Club of Rome (Tokyo Symposium, 24-25 Oct. 1973) had been fully accomplished at that time and some of them will still have years to go. In the following, a few highlights and first conclusions from some of these "second generation studies" are given.

An opening for brains and minds

A recurring criticism in the "limits" debate—be it on *Limits to Growth* or

"Our situation is indeed that of an intelligent child..."

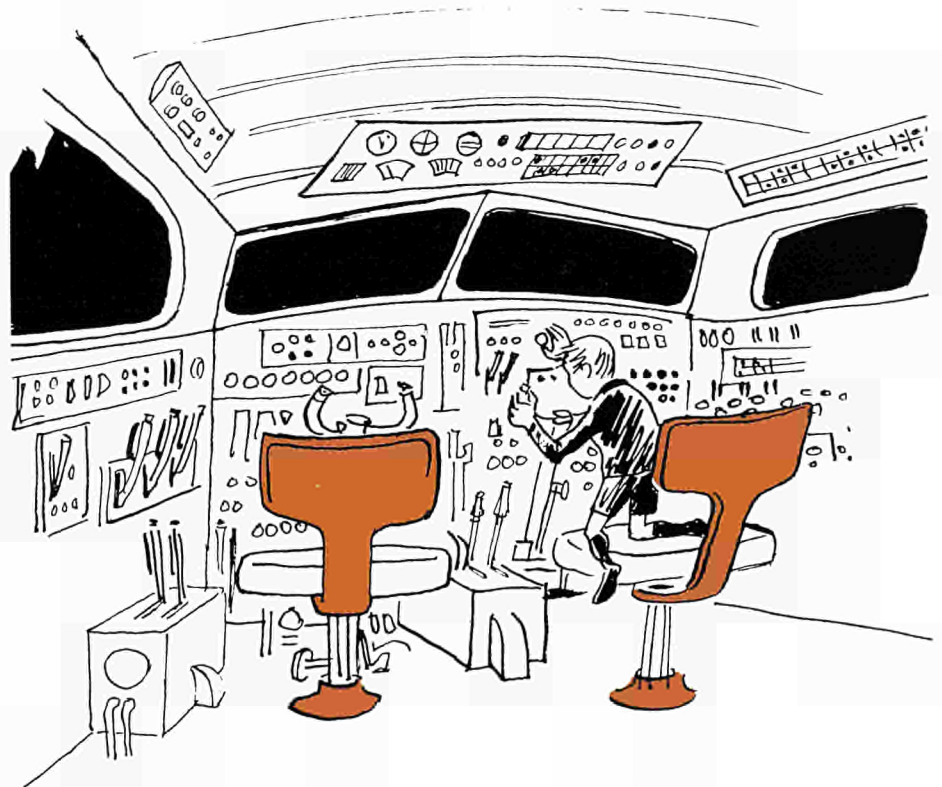


Table I: *Studies presented at the Tokyo Symposium in 1973*

STUDY OR PROJECT NAME	PROJECT LEADER AT THE SYMPOSIUM	STUDY AREAS *
Outer Limits	A. Buzzati-Traverso (Italy), paper presented by C. Wilson	(f)
Preparations for UN Population Conference	V. Urquidi (El Colegio de Mexico, Mexico)	(d), (e)
New Directions for Science and Technology (CoR Group)	D. Gabor (UK) U. Colombo (Italy)	(g), (h)
The Ford Foundation Energy Policy Project	D. Freeman (USA)	(g), (h), (i)
Sustainable Systems	C. Wilson (MIT, USA)	(f)
Policy Studies on World Problematique	K. Kishida (JATES, Japan)	(d), (i)
Work for the Future	F. Böttcher (Netherlands)	(f), (g), (h), (i)
Cultural and Socio-Political Relations for the Future (SEA Study Group)	Soedjatmoko (Indonesia)	(d), (i)
Latin American World Model	A. Herrera (Bariloche Foundation, Argentina)	(b), (c), (d), (i)
Global Constraints and New Vision for Development	Y. Kaya (Tokyo University, Japan) Y. Suzuki (Osaka University, Japan)	(a), (b), (c), (d)
Population Doubling Problems	H. Linnemann (Amsterdam Free University, Netherlands)	(b), (c), (d)
Strategy for Survival	E. Pestel (Hannover University, FRG) M. Mesarovic (Case Western Reserve Univ., USA)	(b), (c), (d)
Decision Making Trial and Evaluation Laboratory (DEMATEL)	H. Thiemann (Battelle, Geneva) A. Gabus (Battelle, Geneva)	(c), (i)
Japan in the Changing World	H. Ishitani (Tokyo University, Japan)	(a)
Economic Change and Environmental Pollution in the Fed. Rep. of Germany	G. von Kortzfleisch (Univ. Mannheim, Fed. Rep. Germany)	(a)
Employment Model for West Africa	G. von Kortzfleisch (Univ. Mannheim, Fed. Rep. Germany)	(a)
Economic Growth and Social Change in the Fed. Rep. Germany	G. von Kortzfleisch (Univ. Mannheim, Fed. Rep. Germany)	(a)
Ecological Studies for MITI	K. Oshima (Tokyo University, Japan)	(a)
Value System and Social Dynamics	S. Saito (Rikkyo University, Japan)	(a), (c)

* With respect to the categories listed in the text.

on *Outer Limits* including the demographic question—is that science and technology are not sufficiently taken into account.

Yet, not only have many critical problems our modern society is confronted with become grave in spite of science and technology, but some even because of them. One of the reasons for this is the functioning of the socio-economic system which does not aim at a social optimization of research applications, nor automatically penalize the misuser, nor trigger and foster the necessary long range developments. These facts stimulated The Club of Rome to set up, early in 1973, the Working Party on *NEW DIRECTIONS FOR SCIENCE AND TECHNOLOGY* under the leadership of Dennis Gabor¹. It is composed of Club of Rome members and outside experts² particularly competent in the three areas under study: *energy, mineral resources and food*.

The report will indicate some essential policy lines and suggest specific research actions; in cases where the degree of understanding of a problem

¹ Nobel Prize in Physics 1972.

² The authors of this article and of the following participated in this work.

is not believed to be satisfactory, further in-depth analysis is recommended.

Here its preliminary conclusions in a nutshell. All three problem areas do not appear seriously critical when taken separately and assuming favourable “boundary conditions” (e.g. in food: plenty of energy for fertilizers, water desalting and long distance pumping; no environmental limitations; no problems of social and behavioural structure; no training bottlenecks or constraints by political interdependence). However, when considered in their global interrelationship they impose limitations on society and necessitate drastic innovations in technology, but even more so in the socio-political and institutional fields.

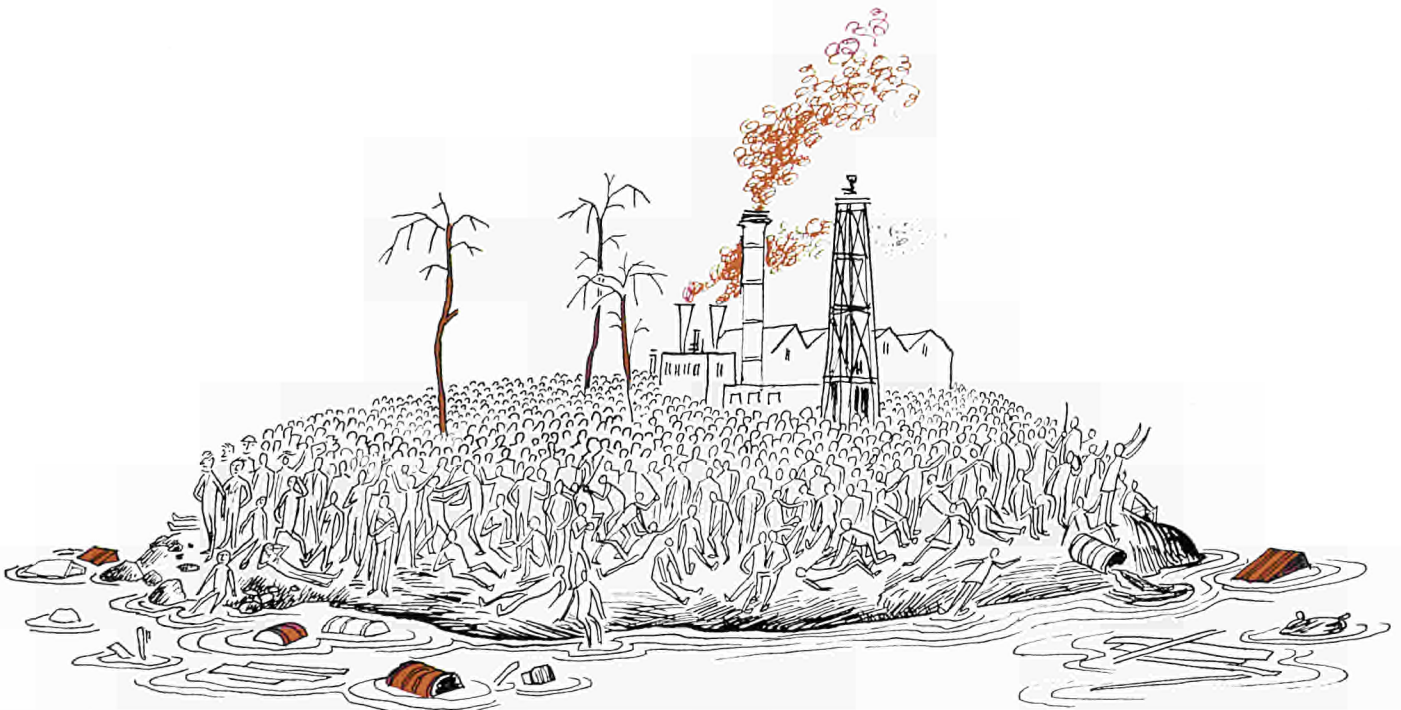
Weighted in this way, *food* is a most critical area susceptible to develop from short-term regional crises to medium-term planetary unrest. The difficulties in supplying raw materials are comparatively less important. *Energy*, clearly, comes out as the key to the solution of both problems.

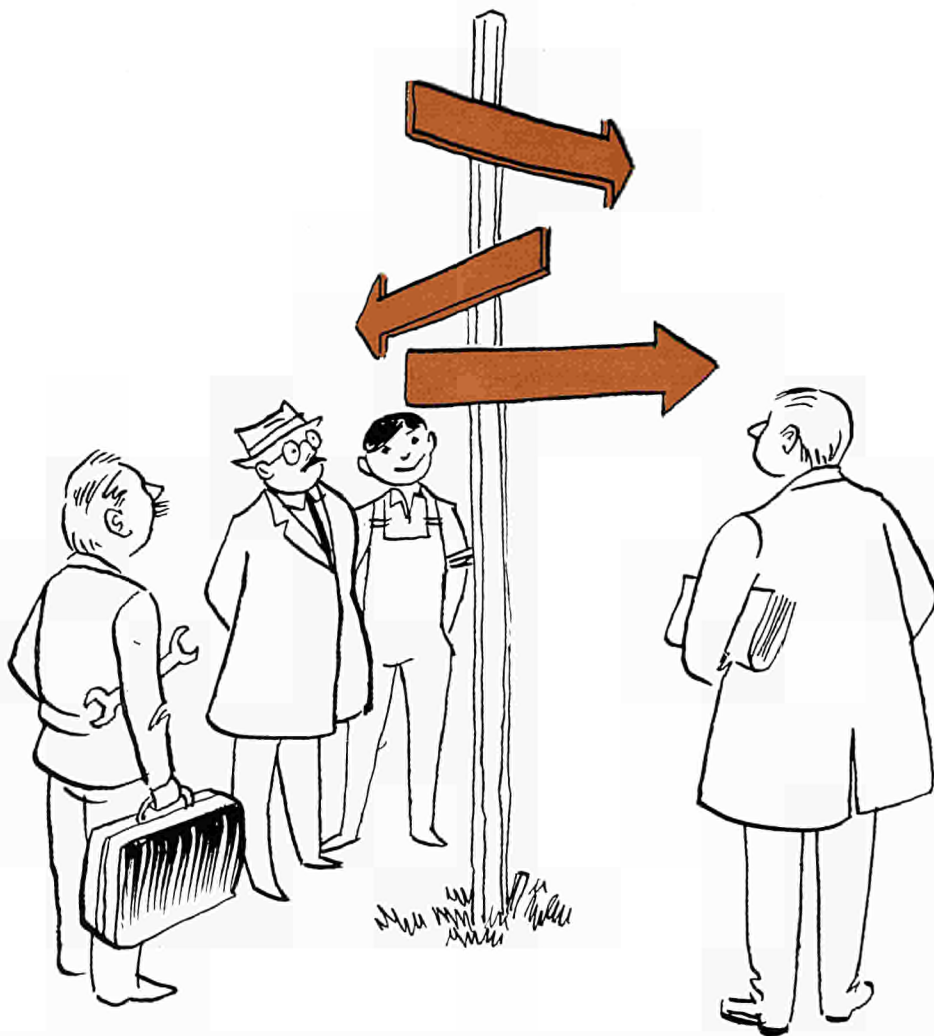
The long-range energy potential is seen, as limited by environmental effects, in particular by climatic constraints to be reached somewhere in the next century. As to the technological options, there is serious doubt concern-

ing the wisdom of binding the long-range energy supply of mankind to a technology involving large quantities of plutonium, as does nuclear fission and in particular the fast breeder reactor. Plutonium, of which the isotope 239 with a half-life of some 25 000 years is typical, is one of the most hazardous substances known because of its cancerogenous action in quantities of less than one millionth of a gram. Absolute control of plutonium and of long-life fission products against dispersion in aerosol form by accidents, sabotage, warfare etc. would have to be assured for a time scale far exceeding the observed life-span of human cultures. This problem seems to be virtually unsolvable. In any case a decision to generate such hazards cannot legitimately be made by technical analysis. It has a deep ethical character and as it concerns mankind as a whole—the present as well as thousands of future generations—it should be made on the broadest base, not in small circles.

The other three practically inexhaustible power sources are nuclear fusion, solar energy and geothermal energy. The technical feasibility of

“... the limits of the Earth supporting capacity will soon be reached...”





"New directions for science and technology"

fusion has not yet been demonstrated. Its environmental impact would also present considerable problems, although much less fundamental than those of nuclear fission.

Solar energy is still in an early stage of development and so is geothermal energy which is exploited only in a few favourable regions of the world. It is therefore imperative to proceed with a vigorous research and development effort on these energy sources which are without undesirable side effects on human life and with relatively little on the environment.

In the short term we shall depend on a continued increase in the production of energy from solid fuel. The most important short-term development in this context is the conversion of coal to gaseous and liquid fuels. Related technologies are not yet established on a sufficient scale, because of a deplorable lack of foresight.

Parallel to the effort in the supply field, methods for energy conservation must be developed, both at the technological and the socio-economic and political level.

Mineral resources show a somewhat brighter outlook. While proven reserves of some ores may be exhausted within decades, the potential resources of the related chemical elements are in most cases immense. They are converted into reserves not by moving rocks, but by expanding the artificial boundary of geological knowledge and economic availability which distinguish both. For most of the useful chemical elements this potential can be realized through intensive research only. Moreover, the processes involved are generally highly energy consuming by nature.

Some elements are intrinsically scarce and hence their shortage might become a bottleneck for some critical technolo-

gies. Much effort should therefore be paid to the identification of those cases where alternative materials or technologies are not conceivable. Parallel actions to decrease the demand are suggested, mainly through improving the quality of materials on the one hand and of related products and application methods on the other.

In the *food* sector, notwithstanding important research projects to be promoted, most of the scientific and technical knowledge needed in the short and medium range to exploit new land and for increasing productivity is available. Here the obstacles preventing or limiting the application of existing knowledge in developing countries are of a socio-economic nature, both internal ones and those of relations to industrial powers. One fundamental point is that generally food production may increase only if it is stimulated by a higher per-capita income. This in turn calls for full employment, which the present international structure of society seems to prevent in most cases.

Long-term food prospects depend decisively on the ecological and energy situation on the one hand and on the societal development on the other.

In conclusion: a discussion of the limits to growth merely in material and physical terms is simplistic. Technological problems prove much less intractable than their accompanying political, social and psychological concomitants. The vital need, therefore, is for an integrated approach to economic, social and technological policies in a long-term, prospective and global sense.

We have seen in the examples of the food and mineral resources questions that energy is not a separate issue. Its problems and its impact are part of an interconnected whole, often a decisive part, so that the energy question is like a gigantic mirror of the world problematique.

This is underlined by the findings of the "Ford Foundation's Energy Policy Project", which started in mid-1972. The work, which was presented in Tokyo by David Freeman, director of the Project, is a precious complement to the Club of Rome effort.

The era when countries like the United States had energy “to burn” has come to an end. They are now faced with hard choices, in which one desirable goal may have to give way to another. And the first essential in making intelligent choices is to raise the fundamental issues and analyze them.

Life-style studies are important to reveal how much can be saved and how much more energy may be needed to permit the poor to catch up to a decent standard. Also the environmental aspects contain many unknowns including the question of how much energy must be used to attack pollution problems and how to evaluate and control oil spills at sea from tankers and off-shore drilling. A particular issue is the conservation of energy. Here not only the technical possibilities are investigated, but the policy questions of how to make them happen. An international study addresses questions of security and balance of trade, paying serious attention to the energy interests of other countries, and to the energy affected relations between countries, producers as well as major consumers. It also considers the effect which competition among industrial nations for the world’s finite store of energy resources has on the underdeveloped world.

The final report of the Energy Policy Project will pull the strands of energy issues together into contrasting models of the energy future in the United States based on three separate policy packages, reflecting different priorities in national goals:

1. “business as usual, i.e. an all-out drive for more supplies, with no policy affecting ingrained habits of energy use;
2. “change things, not people”, i.e. use of engineering know-how to attack the waste in the way energy is applied, without aiming at fundamental changes in values or way of life;
3. “from the disposable society to a durable society”, i.e. the consequent transformation of society versus a post-industrial stage, the service sector dominating economy, long-life goods and recycling being self-evident.

This last option is perhaps the most important new prospect. It would mean a consequent redistribution of industry



“Business as usual”

throughout the world, e.g. energy intensive industries clustered around primary energy producing sites. The USA might thus achieve a steady-state in energy use after 1985, which does not imply that the national output would cease to grow, but rather that a fairly stable adult population would level off in per capita energy consumption and grow in activities that require more education and serve genuine needs of the individual.

This brings us to the subject of *SUSTAINABLE SYSTEMS*³. Research and even study of this matter is still in a very early stage. It has been bound almost exclusively, up to now, to the premise of maintaining the pattern and substance of existing nation states, treating them as “Systems”. There is, however, a growing feeling that meaningful solutions are possible only by major changes in this pattern.

A *sustainable system* is one in dynamic balance with both the Biosphere and the Ethosphere. The Biosphere is the total physical/biological environment in which the System functions. The Ethosphere is the total web of values, traditions, attitudes (cultural, social, political) which determines the behaviour of the System. While the Biosphere sets quantitative constraints on the System, the Ethosphere comprises the means by which the System develops within the changing constraints of the Biosphere.

Sustainable systems need by no means be stagnant. In fact, a great

³ Permanent seminar at MIT since 1972.

variety of activities meets the constraints of the Biosphere such as low resource use and little environmental impact. Existing cultures show great differences in their value structures which may make a transition to a sustainable system state easy or difficult. The obsession with growth is fairly recent in many parts of the world. Sets of values compatible with a sustainable system are within the experience of many living people.

The Ethosphere of each society determines the potential of motivations and means of social action to achieve and maintain a sustainable system. Features working toward stability are e.g.:

- broad income distribution;
- wide access to impartial justice and education opportunity;
- sufficiently decentralized decision-making to engage a large fraction of society, yet strong enough central management to maintain it in a sustainable mode.

One of the sources of frustration in achieving or maintaining an acceptable quality of life stems from growing urban concentrations and rising interdependencies within states. Meeting the conditions for sustainable systems would reduce such interdependencies.

Also in the global scene interdependence has been increasing. Until recently this has been considered an unqualified good. Yet it is probably true that there are explicit limits to the dependency of a system on external relations if it is to achieve and maintain a sustainable mode.

One of the basic aspects of the problematique is the inherent difficulty of implementation — against institutional and general inertia as well as vested interests — of the remedial measures once they are identified and assessed as to their compatibility. A special study group has therefore been created at the Japan Techno-Economics Society, the Far East branch of the Club of Rome, in order to perform basic *POLICY STUDIES ON THE WORLD PROBLEMATIQUE*.

It is a fact that practicable countermeasures to well known and well circumscribed problems like the demographic explosion, meet considerable resistance, rooted in value concepts which man has unconsciously accepted as a result of the experience of his long

history of existence. This irrational resistance is e.g. reflected in the schizophrenic behaviour of governments complaining about problems resulting from population increase and at the same time passing laws favouring larger families.

A second premise is the anxiety felt by most people when the “state of global equilibrium” is advocated. Only if some sort of equality were achieved, would it be acceptable for the developing countries which represent a majority in the world. Thus, the state of global equilibrium is to be interpreted as including equality. But unless work is done to clarify the content of the price for equality and the price for stability, the global equilibrium concept may very well only stir up resistance.

Another basic policy obstacle concerns the heterogeneity of the world which renders globally identical countermeasures impossible and necessitates a “game theory” type approach.

Finally, the mental conditioning and psychological feedbacks of the consumerist society are considered hurdles difficult to overcome which add themselves to the inertia and short-term fixation of most decision makers.

As a first general conclusion it is considered necessary, when proposing new *thoughts* and concepts, to undertake parallel efforts to devise practical *methods* of application as well as the

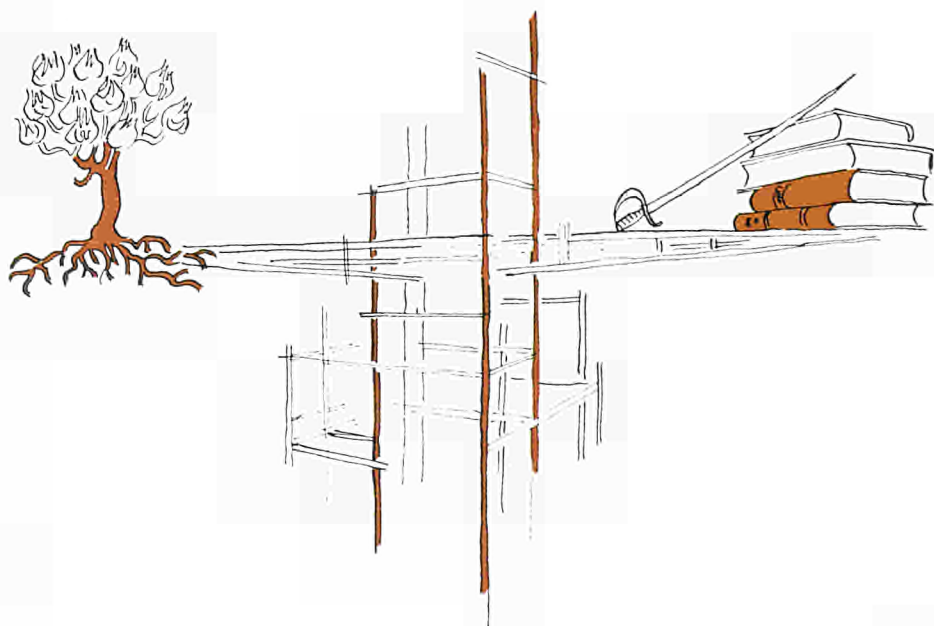
institutions needed for implementation and continuity of action. Only a mix of many measures, well “orchestrated”, can be of real effect.

Members of a study group in south-eastern Asia have expressed opinions on the future significance of cultural and socio-political criss-crossing which do basically correspond to those formulated by the Japanese team.

It has become apparent that an exaggerated preoccupation with growth as such leads to the rapid increase of social disparities which easily destroy social cohesion.

In particular, the countries of extreme ethnic and cultural plurality become more, instead of less, dependent on the powerful industrial nations, especially if consumption patterns and levels are imitative of those of the industrially advanced nations when the development of the indigenous industrial base is insufficient. The growth path for such countries should therefore not be a repetition of the process through which industrially advanced countries have gone, but one using science and technology more directly to meet specific social needs in a way less wasteful or ecologically destructive

“A sustainable system is one in dynamic balance with both the Biosphere and the Ethosphere”



and above all more capable of providing cultural enjoyment and a meaningful life.

But there are international factors that limit the options in the choice of a proper growth path. Unless significant changes take place in the international political and economic system, there is very little hope for realization of such goals. The new awareness about limits to growth holds therefore special significance for developing nations. The more clearly it is realized in the industrial countries that a fundamental shift to patterns of sustainable growth is needed (in ways, however, which will not reduce the opportunity for the poor countries to grow), and the earlier it is acknowledged that partial solutions will not do, the greater the chances will be of structural changes in the international system, capable of overcoming the growing dualism between the rich and the poor on our globe. As man can no longer hope to overcome the problem of poverty by simply increasing growth in the hope that through trickle-down effects the level of the poor can be sufficiently raised, he is now forced to confront the problem of injustice and inequality directly. And his capacity to do anything in this regard on the international level may well depend on how he deals with these problems domestically. In short, what is needed is a reasonable prospect that power, political and economic, will not remain the dominant criterion in determining the international system. The source scarcities that are beginning to show themselves—in food, energy sources and some other raw materials—pose moral questions about rights of access and the right to deny access, questions for an international order based on justice, equality and freedom.

A new balance between individual rights and collective obligations, between freedom and social discipline, between economic efficiency and justice, has to be found. Individual initiative and competitiveness on the one hand need a balance in sharing, and cooperation on the other. This search is taking place against the background of fundamental shifts in behaviour patterns and aspirations. Trends towards larger political and economic structures transcend the nation state whereas there is at the same time a need for smaller

internal social and political units, in which man's yearning for identity and authenticity can be fulfilled. Lifestyles are looked for which respond closely to man's intuitive, expressive, artistic and transcendental needs. There is even an antirational backlash from what is perceived to be the socially and morally irresponsible paramouncy of science and technology, and its underlying rationalism.

Real concern for man's present predicament and for his options for a civilized future in a crowded and limited world inevitably forces man to confront himself and the ultimate questions of life and death, the meaning he chooses to give his own life and that of the human race. There will be no single answer to these questions. Part of our problem is therefore to devise ways which will enable us to live together with different answers, in a combination of moral purpose and humility of mind.

The help of powerful tools

Neither a detailed analysis of complex problems nor an assessment of optional policies referring to them are possible without the help of powerful tools in the form of computerized mathematical models. A decisive part of the effort to enhance global thinking and action has therefore been dedicated to their development.

World models — In spite of the imperfection of the "World 3" model which is at the basis of the "limits" report, few deny that it was a milestone on the road leading to an understanding of the world system. Although it should be acknowledged that already earlier some efforts such as the World Order Model had aimed at obtaining an integrated and simulated image of the world, it was the publication of the *MIT* report which stimulated not only a worldwide debate but also an important number of new projects on modelling the world. These "second generation" studies generally aim either at a linkage of various regions or at hierarchical representation of Man/society/physical world interaction, or at both.

One of the defects of the *Limits to Growth* model is that it can say little about the differences in the behaviour

"World models"



of various regions of the world, because the model is essentially global. Gaps between developed and developing countries and even within the same country, however, are so wide that the existence of such gaps may be considered in itself one of the most serious worldwide problems. The contrast between the material affluence in the "developed" countries and the poverty and malnutrition of the "developing" ones, inevitably leads us to stress the need for research on how to ameliorate this situation of inequitable distribution of wealth within and among nations, in the context of global constraints. This is the background of the *LATIN AMERICAN WORLD MODEL* project which was launched in 1972, seeking for a desirable image for the development of an equitable world society, on the premise that the developing countries can and should not imitate the path followed in the past by the developed countries. The aim is not to forecast the future but to find an optimum transition pattern to an alternative equitable world. In this sense, the model might be called a "utopian" or rather a "eutopian" model. It should not, however, be thought of as a perfect plan with a detailed set of implemental steps to reach the contemplated goals, but rather as a norm referring to a system of needs, to the conditions for welfare, to the entire pattern of social, organizational, cultural and political conditions. The model concept is explanatory, not projective. A new vision for the future world, far different from a mere projection of the present pattern is, however, expected to emerge from its application.

The model is an integration of four submodels representing: the developed countries, Latin America, Asia, and Africa; each of which with five productive sectors: food, housing services, educational services, "other" consumption goods and services, and capital goods. The development of each sector is analyzed as a function of the basic human needs. The model being of the planning type, it operates through the optimization of a specified criterion, such as life expectancy which is influenced by many social and economic variables.

The *Latin American World Model* project of the Bariloche Foundation has been particularly stimulating because of its concept of *minimum requirements* for food, shelter, health care, education, communication, and working opportunity, i.e. the minimum material and cultural basis for a decent life for a human being, to be taken into account as an absolute lower limit for all projections. The theme appears also, if less explicit, in the Dutch project *Problems of Population Doubling*.

In dialectic response to this concept of "minimum needs", there appeared in the discussion the complementary concept of "maximum needs", this being the maximum of material consumption per person, not to be surpassed, a consumption "purged of vulgarity, crudeness and wasting". It is evident that such a maximum concerns in the first place the "advanced" (or rather: the more affluent) countries. This thesis was brought forward by Romesh Thapar (India) and supported by many other participants.

The Japanese project on *GLOBAL CONSTRAINTS AND NEW VISION FOR DEVELOPMENT* touches on the problem of a more equitable world from a somewhat different angle from the Latin American one, aiming at an optimum production pattern.

In the first part, mineral resources including fossil fuels are surveyed, concluding that the problem is not mineral resources, but the demand-supply gap for *energy* over the next two or three decades. The global climatic effect of released energy has been estimated using a computer model. The results show that there will be no significant effect until the world energy consumption increases by more than an order of magnitude above the present level.

The philosophical background of the world model developed in the second part of the project is based on the fact that the distribution of resources and capital in the world is extremely uneven. It is therefore understandable that the developing countries, especially in Asia, demand that the industrialized countries reform their industrial structures so that developing countries may extend the share of their industries (now mostly agro-based light industry) in the world market. The project aims on the premise that such a plan is politically feasible, at determining what production pattern, for each continent, would be the most desirable and in balance with the physical and socio-economical constraints of the region in question. At the same time it can show how effective such an approach would be to help the developing countries.

The model divides the world into nine regions, each with six industrial sectors. Intermediate results suggest that the world industrial pattern should be greatly reformed in order to accelerate the development of the less industrialized countries, and that such a reform could be very effective.

Barring calamities of unprecedented magnitude, it is certain that world population will double its present size within the next 30 to 35 years. The motivation of the already mentioned project *PROBLEMS OF POPULATION DOUBLING* was the question whether it will be possible to provide every world citizen with the material requirements for a decent human life.

The project has a twofold aim. The first is to establish what developments may occur in various regions of the world before the world population actually doubles and to examine the four basic sectors of the basic material condition of human existence: food, housing, education and health care. The model will be an integration of models representing the different continents and the results of the projection will be compared with pre-established norms. The second aim and also the second phase of the project will then be to determine what policy measures are necessary in order to attain these norms. Also, the implications of additional targets—such as a high level of employment or specific reduction of income inequalities—may be studied. The model like those of the previously outlined projects, is therefore hoped to be a useful planning tool, badly needed in view of the unprecedented magnitude of the task to create a physical infrastructure at least equal in performance of what mankind has built in 2000 years, a task that will require relocation and reorganizing of the entire productive system of the world.

Perhaps the most ambitious of the World Model studies is the *STRATE-*

GY FOR SURVIVAL project. It aims at a regionalized and adaptive model which enables the implementation of scenarios representing visions of the world future according to different cultures and value systems. The model will be developed to become a planning and opinions-assessment tool for long-range issues, thereby providing a basis for conflict resolution. This aspect will increase in importance with the narrowing of freedom of choice imposed by conditions of the global system and by the interplay of the main nations or regional groups. In particular in response to stress or danger, the current practice of narrow if not intuitive evaluation of options has become inadequate and thus dangerous.

The world system is represented by a linkage of submodels corresponding to ten regions: i.e., North America, Western Europe, Eastern Europe, Japan, Rest of Developed World, Latin America, Middle East, Rest of Africa, South and South-east Asia, and China.

Each submodel has a hierarchical structure in which geophysical, ecological, technical, economic, institutional,

"Little by little the 'development models' of the advanced countries..."





"The real limits to growth then..."

socio-political, cultural value and human-biological levels are involved. Simulations of the world economic system, of demography, of energy production and consumption, and of food production and land use have already been developed. The central part of the project is the economic system model with a two-level structure, and a matrix has also been developed to represent international trade flows.

A particular feature of the *Strategy for Survival* project is the recognition of the purposive aspects of the human community and adaptiveness of human beings. The model will, therefore, contain a so-called causal part, representing dynamic processes which follow historical patterns of development, and a so-called goal-seeking part which represents purposive changes under new conditions. The goal-seeking part in turn includes a decision-making or actions level and a level which represents the values and norms which constrain and condition the purposive response.

This approach should enable a policy analyst or decision maker to evaluate alternative options on various levels of the decision process. A "game" between man and the computer will thus, hopefully, provide fruitful

experience producing results applicable to reality.

The next phases of this project include:

- an assessment of how the span of options of some major crisis problems changes over time;
- implementation of the regional models in different parts of the world and their connection via a satellite communication network for the purpose of a joint assessment of the long-term global problems by teams or individuals situated in the various regions;
- model implementation of the vision of the future which leaders from underdeveloped regions have, in order to assess existing obstacles as well as the means whereby the vision might become reality.

Also aiming at pre-action assessment of the consequences of alternatives in world action programmes, but with a methodology quite different from that of the preceding world model projects, is the *DEMATEL* project (Decision Making Trial and Evaluation Laboratory).

Stimulated by the thinking and activities of the Club of Rome, the Battelle Institute in 1972 started a study on the world problematique. The attempt to apply computerized systems analysis to the solution of global problems such as pollution, exhaustion of natural resources and overpopulation, has often been criticized on the grounds that the choice of parameters is subjective and arbitrary. Clearly this must always be so to some extent, since human society is highly fragmented and has no common set of goals, so that problems and their connections are differently perceived by different people. It was therefore with the aim of introducing some empirico-objective order into this subjective element, that the *DEMATEL* project was initiated.

It began with an enquiry addressed to approximately 80 leading figures in politics, finance, industry, science, the arts, religion and other fields in all parts of the world. The survey questionnaire contained definitions of 48 problems thought to be of world significance. Respondents were asked to identify and define the relations between these problems, to grade them with regard to seriousness and urgency, and to suggest

any others that they felt to be of similar importance. Following computer processing of the results on the basis of a methodology developed and adapted by *DEMATEL*, the respondents are now being interviewed.

In this way it is hoped to obtain a census of the opinions held by a representative cross-section of the world's most influential minds. It seems very probable that there will be wide areas of disagreement, but these may well fall into patterns and recognizable schools of thought. Since in the last resort there exists no better instrument than the human mind for the appreciation of diverse qualitative data—and although some of the problems may be seen in quantitative terms, the choice of solution is necessarily a matter of value judgment—the *DEMATEL* approach aims at making the fullest use of it in a logical manner.

Conclusion

In general, therefore, we can conclude that as far as the material limits of our planet are concerned, it should be possible, through good planning and resource management on a world scale and with the help of science and technology, to get by for many decades to come. It is increasingly apparent, however, that real as these material constraints are, the final barriers are unlikely to be reached without fundamental changes in the attitudes of governments and individuals everywhere to the distribution of wealth and the need for development with global scope. This means much more than the integration of the individual development policies of the 140 odd sovereign states of today. The real limits to growth, then, are not material but political and social, or, if more fundamentally viewed, imposed by the behavioural and motivational pattern of man, the biological basis of which is ill-known, even less its potential of development through education or religious purpose.

A particular feature of the Tokyo meeting was the general concern with the problems of the great majority of world citizens who live in the so-called developing countries. It is increasingly evident that the problems of development cannot continue to be dealt with unilaterally in terms of aid—"charity" of the affluent bestowed upon the poor,

and rather seldom with unselfish motives anyway. The basic issue is that of the maldistribution of wealth in all forms between countries. Hitherto the aid process has consisted in the transfer of capital and of technology from the advanced to the developing countries. This is, of course, a continuing necessity: what is in question is the nature of the modes of development which the industrialized countries seek to transfer and their motivations in so doing. Little by little the "development models" of the advanced countries are being rejected by the recipients of aid, firstly because they do not sufficiently allow for the historical, cultural and ideological conditions of the developing countries and, secondly, because they are increasingly being realized by the developed nations as wrong even for themselves. The interdependence of nations with regard to trade, availability of sources of energy and materials, the population explosion in certain parts of the world—these and many other trends begin to signal warnings to the developed nations that the reciprocal effects between North and South cannot be ignored or wished away by an aid psychology.

Some of the newer work of The Club of Rome will bring these matters forward brutally. The Bariloche Project, which is basically egalitarian in its concept, will provide a stark realization of the demands which will arise and the adjustments to be made if every citizen of the world is to be given a decent minimum of material existence and this, of course, will have a political corollary. These matters were discussed with great concern at the plenary meeting of the members of the Club which followed the Symposium and their next main meeting (Berlin, October 1974) will be devoted essentially to them.

The preceding and many other considerations which surfaced at Tokyo point to the need for an "equilibrium state society" as advocated by the *MIT* report and mentioned by many political economists and philosophers in the past. Discussion of the desirability of planning towards such an equilibrium has been somewhat clouded during the past two years by black and white considerations of economic growth versus no-growth. The Club of Rome is not dedicated to a policy of zero growth,

it suggests rather that we must basically modify the nature of growth. And the energy crisis is at least proving useful in dramatizing some of the obvious difficulties of our present policies and approaches and in raising widespread doubts as to the possibility, to say nothing of the desirability, of continuing indefinitely along the present road. Transition to a state of equilibrium would be politically and economically extremely difficult, but it will not be possible for our political leaders to ignore the issue much longer.

Finally, a word must be said concerning the deeper human and motivational aspects of the present situation and of the system of values on which it has arisen. Chauvinism and the selfishness of nations is but a projection of the egoism, aggressiveness and power ambitions of the individual human being. Transition from a nation state geopsychology to that of a global vision may well be necessary for survival and this reflects the imperative for the individual man to subordinate some of his selfishness to the needs of society as a whole. The problematique, while material, social and political in manifestation, is undoubtedly anthropological in essence.

Even though recognition of the need for global vision is deepening and spreading rapidly throughout society, consequential action is lamentably absent. If The Club of Rome has a message to transmit from Tokyo, it is essentially this:

All serious research made so far has signalled that a global collapse of human affairs is inevitable if the present course of mankind is not radically changed. It is felt that much before the physical limits of growth are reached, socio-economic and political crises stemming from the same fundamental root, could occur. The energy crisis is the first of a series of predictable events. In spite of the circumstantial and therefore transitory elements in it, there is no doubt about the basic nature of this crisis. Nothing will be as before. And there is no longer any excuse to pretend ignorance of the menace ahead of us, of the profound wrongness of the present direction in which humanity persists in moving, by inertia or by narrow motivation.

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An illustrative example of normal growth from a modified dynamic world model

JOHAN W. BRINCK

THIS MODIFIED VERSION of Jay Forrester's dynamic world model (1) is the result of many discussions on the long-term sufficiency of mineral resources and in particular those held by the Working Party on "NEW DIRECTIONS FOR SCIENCE AND TECHNOLOGY", under the leadership of Dennis Gabor.

The changes were made to test the effects of the results obtained with the *MIMIC* (2) model on the predicted trends taken from the dynamic world models of Forrester and Meadows (3) of the Massachusetts Institute of Technology. When these assays were made the technical description of the more advanced Meadows model was not yet available. However, by dint of the similarity of the published results, it was felt that the older Forrester model was quite adequate for this illustrative purpose. This modified model follows the Forrester model and methodology as faithfully as is practicable and does not attempt to add to, or subtract from, the assumed validity and ultimate advantage of using computer models instead of purely mental images for the study of social systems.

The dynamic world models of Forrester and Meadows

It will be recalled that the most important concept in establishing the system structure of such dynamic world models is the notion that all actions take place within "feedback loops". The feedback loop is the closed path which connects an action to its effect on the surrounding conditions, and these resulting conditions in turn come back as information to influence further action.

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Thus, within the feedback loops of a system two kinds of variables will be found — levels and rates. The levels are the accumulations within the system (size of population, capital investment, etc.), whereas the rates are the flows that cause the levels to change. A rate or flow is controlled only by one or more system levels and not by other rates.

Five levels were chosen as the cornerstones on which to build the system structure:

- population;
- natural resources;
- food production (fraction of capital investment devoted to agriculture);
- industrialization (capital investment);
- pollution.

Each of these levels represents the principal variable in a major subsystem of the world structure. They are inter-related and developments in any of them influence subsequent developments in all others.

To give a few examples:

- Food sufficiency is regulated by the fraction of available capital investment devoted to agriculture, whereas the remaining capital investment, after deduction of an ever-increasing fraction for the exploitation of mineral resources, determines the material standard of living, which in turn influences the generation of new capital investment, death and birth rates and the further depletion of natural resources. The depletion of natural resources causes raw material costs to rise and this in turn detracts from the capital available for agriculture and the material standard of living.
- Pollution is generated as a function of population size and capital investment, which determine the degree of industrialization and the intensity of

agricultural production. The pollution level influences at the same time food production and population growth by affecting birth and death rates. This level also determines the time taken by the ecosystem to absorb pollution.

The logic of such system structures is inevitable. This, however, is not necessarily the case with the models which are built on the basis of such systems.

In both the Forrester and the Meadows models the production of food is regulated by a built-in "intelligence" which keeps the fraction of capital investment in agriculture at a level such as to guarantee a sufficiency of food for as long as possible.

This intelligence is notably absent in the feedback mechanisms regulating the depletion of resources and the generation of pollution. Both the depletion of mineral resources and the generation of pollution are considered to be unavoidable side-effects of population growth and progressive industrialization. This is clearly no compliment to the geological profession or to the industrial community. It is precisely in these groups that the detrimental effects of these developments on society have been recognized first. Very often remedial action has been taken in such cases long before the general public even became aware of the existence of any problem. Apart from the moral issue, however, this lack of recognition inevitably determines the final outcome of both the Forrester and the Meadows models.

The most surprising thing about these models, therefore, is not their prediction of doomsday within a century but the fact that such a civilization could apparently continue for such a long time without intellectual guidance in some of its most critical areas.

Obviously, some of the input data representing the pertinent system levels do not reflect the comparable actual world system levels very faithfully.

The first critical level in both the Forrester and Meadows model is the initial amount of finite mineral resources on which the growth and survival of our technological civilization is based. In both models this amount is quite arbitrarily put at 250 years' an-

nual consumption at the 1970 level. This amount does not in any way correspond to existing classifications or estimates made by mineral economists or economic geologists on mineral resources or reserves.

Mineral resources and the supply of raw materials

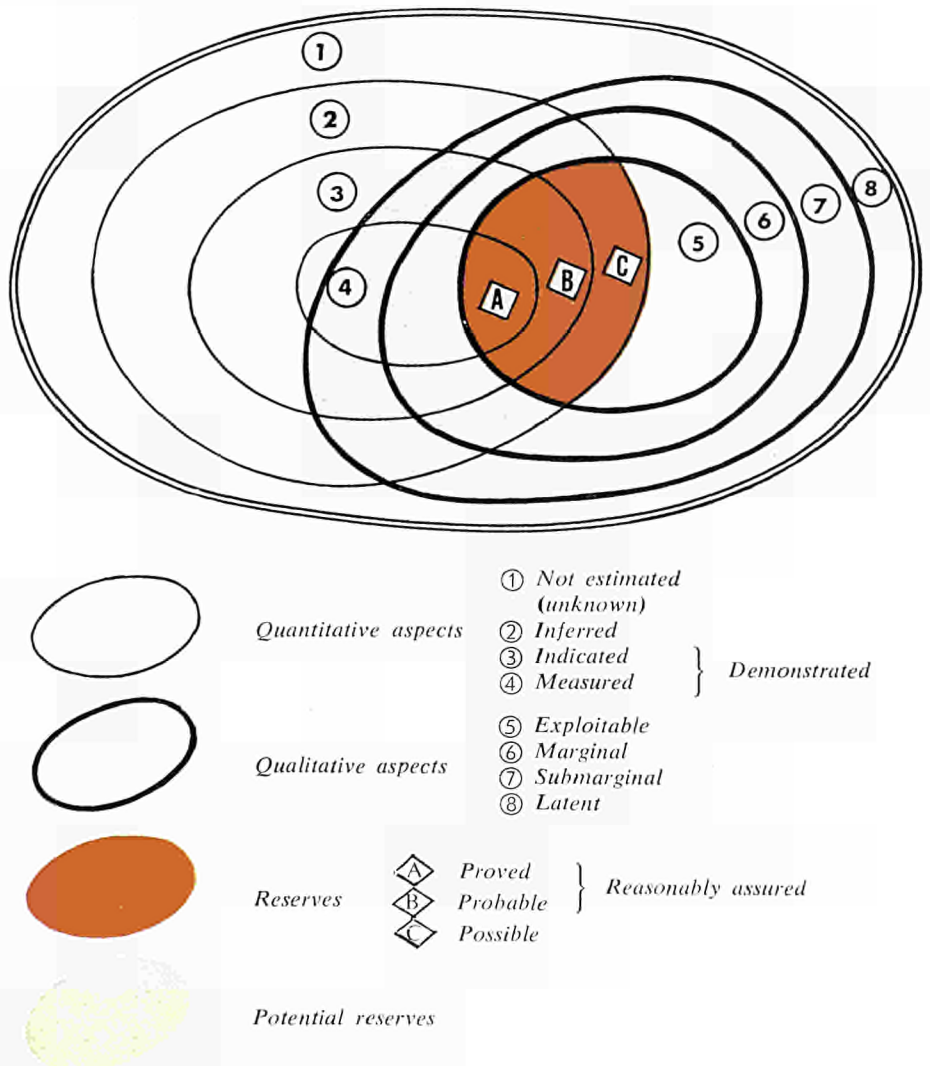
An ample and uninterrupted supply of raw materials has become one of the essentials of our technological civilization.

The natural availability of different mineral materials, their geographical and geopolitical distribution, the cost of extraction, concentration and transport, the production capacities and capabilities of mines and fields are some of the closely related aspects of the mineral supply problem.

Reserves and resources are the terms commonly used to quantify some of these different aspects of mineral potential under the common denominator "weight of available product" for a given economic situation.

Although hopes for an internationally accepted terminology and definitions have so far proved idle, most of the classifications currently used are based on the recommendations of F. Blondel and S.G. Lasky on behalf of and approved by, an international Committee of the Society of Economic Geologists (1956).

Fig. 1: Venn diagram illustrating the terminology and classification of mineral resources and mineral reserves as recommended by Blondel and Lasky on behalf of, and approved by, an international Committee of the Society of Economic Geologists (1956).



proved by an international Committee of the Society of Economic Geologists in 1956 (4). Fig. 1 illustrates such a classification, as used by the European Commission's Directorate-General for Energy. In this terminology the term "reserves" is limited to estimated quantities of mineral materials considered economically recoverable with existing technology (exploitable), whereas "resources" represent "reserves" plus all mineral materials which might become economically recoverable under more favorable conditions in the widest sense. The classification is based on our inevitably incomplete knowledge of the existence of certain mineral resources (physical availability or quantitative aspect) and on the feasibility of their extraction (economic availability or qualitative aspect). Of course, estimated resources are always much larger than demonstrated and inferred reserves together, but this fact should not be allowed to induce excessive optimism. Even by correctly estimating ultimate resources of the different elements by multiplying the weight of the accessible part of the environment by the average concentration of the elements therein, it should always be realized that the vast majority of such resources should be regarded as latent. Not even the most pessimistic estimator should ever consider such ultimate resources as potential reserves. It has been demonstrated by McKelvey (5) that a certain relation exists between the size of the reserves of the different elements and their crustal abundance. By placing the long-term mineral reserves problem in this context, the major question to be answered is whether we will be able to extract only somewhere between 10^{-5} — 10^{-7} of the total resources of an element contained in its currently known demonstrated and inferred reserves or whether we could increase this fraction by two or three orders of magnitude to, say, 10^{-3} — 10^{-4} .

As a matter of fact, potential reserves are converted into actual reserves not by moving rocks, but by expanding the artificial boundaries of geological knowledge and economic availability which distinguish "reserves" from "resources".

Large capital investments in mineral exploration have to be made many years

before any return in the form of a marketable product can be expected. Normally, the mining industry cannot afford to invest in mineral exploration beyond the establishment of a forward reserve level (static reserve index of Meadows) sufficient to meet its production commitments, which represent 10-20 years' supply at best. Such estimates give no indication of the potential yet to come from the processes of creating and extending reserves.

For many useful elements this potential can be realized only as a result of the creative process of research and development, but the long-term policy framework needed is not allowed by the mechanism of the market economy alone.

The estimation of mineral potential by MIMIC

The econometric model *MIMIC* which was used for estimating the world's uranium resources and reserves has been employed to make estimates of the resources of other mineral materials (6).

Geochemical studies, mineral exploration and studies leading to the *MIMIC* model have demonstrated that, generally speaking, the distribution of mineral materials can best be described by a log-binomial model. Using this model, the quality and size of the mineral resources in any given geological environment are determined by the average concentration of the elements in the environment and a dispersion coefficient (specific mineralizability) which indicates whether the mineral resource is distributed homogeneously, densely or somewhere between these two extremes. With these two parameters it is possible to infer all mineral resources of possible economic interest for each element, often with the price ranges within which these resources would become exploitable using current technology (non-ferrous metals). It was also found that the long-term price differences between elements with a similar mining cost structure, such as lead, zinc, copper, gold, antimony, mercury, molybdenum, uranium and several others, are determined within some 35 % by the same parameters.

The results obtained with *MIMIC* show that, for most elements, between 10^{-4} and 10^{-3} of the ultimate resources available in the upper 2.5 km of the earth's crust occur in sufficiently concentrated form to be extractable at less than 3-5 times the current market price. These resources are concentrated in less than 10^{-5} of the environment considered. Thus the fraction of resources used at any time determines the most probable cost of extracting the remaining resources in respect to current average long-term costs.

Aggregating information on the historical development of raw material supplies (excluding fossil fuels), an attempt was made to study the effects of these *MIMIC* data on the Forrester world model.

The modified world model

The maintenance of an adequate reserve level is directly related to capital investment in mineral exploration and is a function of the material standard of living and the size of the population.

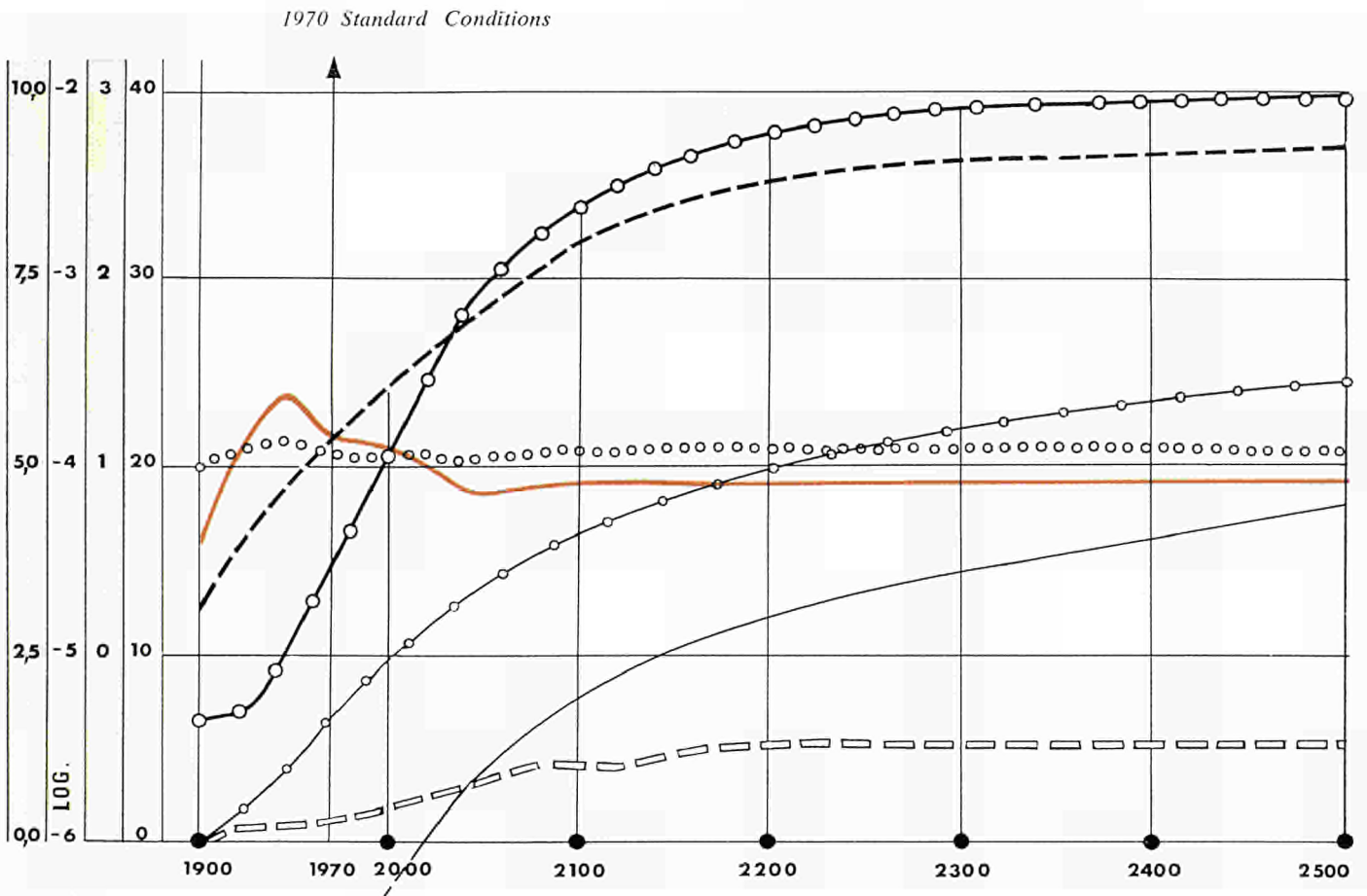
Using a fraction of the total capital available in each year for the development of mineral reserves and production capacities, and assuming a gradual replacement of fossil fuels by nuclear fuels and/or other forms of energy, it was found that with 10^{-6} of total resources used in 1900 (5×10^{-6} in 1970) and with an annual usage rate of 10^{-7} in 1970, no limits to growth are imposed by an insufficiency of natural resources for several centuries to come.

For the standard run (see Fig. 2) an average specific mineralizability of 0.2 (uranium, copper) was assumed to be representative for the cost development of aggregate mineral resources. This value seems to constitute a good average between such common elements as iron, aluminium, phosphorus, etc., with lower values, and the rarer elements such as gold, silver, lead, zinc, mercury, antimony, etc., with higher values. Economically, petroleum and coal can be considered to belong to this last group of minerals (pronounced cost increases with progressive depletion of resources). Although capital investment in the mineral industry (including fossil fuels) presently accounts for only about 3 % of *GWP* (Gross World Product), a value of 5 % has been used to represent stan-

Fig. 2: Standard run of modified world model. The model shows the development of some of the major sub-systems of the world structure based on the input data of the Forrester World Model, modified in accordance with the results of the MIMIC model. Both reserve exploitation and pollution prevention are regulated by fraction of capital investments available at any time. The Quality of Life, as defined by Forrester, is a dummy

variable which in no way influences the behaviour of the system. Being a value judgment, this variable does not figure in the later world model of Meadows. The values for the Quality of Life, Material Standard of Living and Food ratio for standard 1970 conditions are slightly higher than unity on account of the changes to the depletion of mineral resources made in the modified model.

- Population
- - - - - Material Standard of Living
- Fraction Resources used
- Food Ratio
- Quality of Life
- Fraction Phosphorous Required
- - - - - Pollution Ratio



dard 1970 conditions in order to exaggerate somewhat price changes due to the progressive depletion of resources.

To test whether or not such a high degree of aggregation is permissible, a dummy variable was introduced. With this dummy the behaviour of any particular mineral material considered to be critical for the system can be studied for normal running conditions and without influencing the system's behaviour.

The sufficiency of phosphorous for standard running conditions was studied in this way. It was assumed that the use of phosphorous will have to increase sevenfold for each doubling of food production. Existing phosphorous production statistics were used to determine the 1970 phosphorous usage rate and to check the historical validity of this assumption.

In order to simulate the irregular nature of the development of mineral reserves due to exploration luck, technological improvements and substitutions by competing materials, an optional random multiplier can be used to test the system for its sensitivity to such irregular developments.

Pollution and pollution prevention

In the Forrester model a breakdown of the world system due to excessive and unchecked pollution would occur long before any effects of resources depletion could be observed.

Therefore, effective pollution prevention by investment of an arbitrary fraction of total capital available had to be assumed in order to study the effects of resources depletion. Here also, an optional random multiplier can be used to test the sensitivity of the system to unusual pollution as a result of natural or man-made disasters. Although none of the current assumptions about the efficiency of pollution prevention or the effects of increased pollution levels on the system can be validated, it is a well-known fact that for a long time now large amounts have been spent on the prevention of many of the most dangerous forms of pollution. To assume therefore, as was done in the Forrester model, that pollution has always gone unchecked would appear naïve.

Conclusions

The most striking result of these changes is the fact that the model shows almost normal logistic population growth, indicating a life expectancy for our simulated technological civilization of the order of many centuries.

The halfway point will apparently fall somewhere between now and the year 2000. The ultimate population level of ± 10 billion people is similar to that of the Forrester model when "natural resources depletion" and "pollution" are inactivated. However, in the modified model both the depletion of natural resources and pollution prevention continue to increase costs and produce depressing effects on other parts of the system. It should be remembered that this ceiling level was programmed by Forrester and does not necessarily represent a naturally defined ceiling to population growth. It is interesting to note that a more effective pollution control at exponentially increasing cost will actually tend to depress the ultimate stable population level at a lower material standard of living and quality of life. In the current model, however, population growth appears to be controlled almost exclusively by the crowding ratio and its unknown but apparently largely psychological effects on birth and death rates.

Should these effects prove to be overestimated, resulting in a significantly higher population level, critical levels on resources might be reached earlier than indicated by the current model.

The curve indicating the "fraction of resources used" is plotted on a logarithmic scale. No additional or increased recycling of mineral material has been considered. It can be seen that the assumed lower limit of 10^{-4} of resources used will not be reached until essentially stable population and material standard of living levels are reached. By that time effective recycling would guarantee an adequate raw material supply for an almost indefinite time. Even without recycling, the assumed upper limit to potential reserves, namely 10^{-3} of total available resources, will not be reached by the standard model until long after its tested time range.

Many critical conditions which are implicitly assumed to be fulfilled in the

models do exist. Some of the assumptions that have been made in the field of energy and raw material supply are:

1. The gradual shift from fossil to nuclear fuels and other forms of energy will be successful. This appears to be one of the major short- and medium-term problems to be solved during this century and the early decades of the next century.

A significant upward change in energy costs expressed as a fraction of *GWP* seems to be indicated at present but has not been evaluated here. Its effect would tend to decrease the stable population level at a lower material standard of living. It would not change the indicated trend of normal logistic population growth.

2. Required energy levels will not exceed the thermal limits of the world system. This appears to be mostly a long-term problem on which much study is still needed.

Studies on the behaviour of the system in which the random multiplier for pollution generation is introduced indicate that the vulnerability of the system to natural or man-made disasters remains about constant over its tested life span. However, with the passing of time the chances of lethal disasters occurring increase.

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Construction

*Programme for the creation of a unified market under the CEC Sectorial Industrial Policy **

COSTANTINO FRIZ, ZVONIMIR HAINSKI

THE BUILDING OF DWELLINGS, whether public or private, civil engineering activity and major infrastructure works constitute only one part of the activities which characterize the industrial and economic sector known as "construction". More than any other, this activity influences and even conditions the economic and social development of the countries of Europe. More than elsewhere, the quality of the product is far more important than the quantity, for, in the last analysis, construction means man's environment.

This being so, it is more than a little surprising to find that, on the one hand, the construction sector is perhaps the only one where supply has difficulty in keeping pace with demand and, on the other hand, it is the one which has derived the least benefit from the stimulus to better conditions of economic development which the establishment of the European Economic Community was designed to provide.

As a result, the construction sector cannot be left out of the Commission's thinking on industrial policy, whose aim is to set up unified market and mobility of factors of production where mere application of the Treaty rules has not brought this about, especially at a time when the Commission is endeavouring to create the best conditions for a balanced industrial growth which is genuinely common to all the Member States and is directed towards

those sectors where it is difficult for such growth to occur naturally.

In the past, the main of CEC's action regarding construction has been to remove distortions of competition at both the stage of awarding contracts and that of trade in the products used. It is only recently that an indepth study has been made of the possibility to develop a common policy. The problems of integrating the sector and the attendant difficulties are due to the fact that this industry produces immovable property which is the result of a range of non-integrated products and services complying with quite different factors of production. In consequence, the provisions of the Treaty of Rome and the secondary legislation apply less to this sector than to others which concentrate on "exchangeable" products.

Generally speaking, the essential features of the European construction sector are those of a craft, with some examples of the application of industrialized techniques which vary from country to country. When applied to the construction sector, the term "industrialized techniques" has a pejorative meaning and immediately conjures up the picture of a flimsy building which is monotonous, badly-finished and normally prefabricated. The CEC view, however, is that the industrial side of construction must be characterized not only by the scope and possibilities of its achievements, their technical quality and their automation, but also by the complexity of all it embraces, whether this is at the level of the individual firm or at the high level of firms which make up the industrial system of a country or group of countries.

This definition, backed up by the – equally necessary – conviction that a strategy must be adopted which embodies an active approach and not one designed solely to eliminate obstacles, has guided the Commission's thinking on what Community-scale action should be taken in this case of the construction sector.

What in fact does this sector actually represent in Europe today?

It is estimated that about 20 % of the national resources of the Community countries are devoted to construction: this represents about 10 % of the gross national product and 10 % of

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* Introduction to the "Round Table" discussion organized by the Commission of the European Communities to mark the "Constructa" Trade Fair held in Hanover on 3 February 1974.

the working population (approximately 10 million). As far as investments are concerned, it would appear that in the member countries as a whole about half is absorbed by the construction sector. It has already been said that the construction sector is not just one economic activity among others. It is because it affects social conditions and everybody's standard of living that this sector, more than any other, must be scrutinized by the Commission and other Community bodies, since one of the aims embodied in the Treaty of Rome (which remains the basis of all their activity) is to improve social conditions and living standards. It has also been stressed that reference to the application of industrialized techniques does not connote a specific construction process but more a way of administering such activity, for it is felt that only a new management-level approach in this sector can produce economies and better utilization of both human and material resources, as well as efficient rural and urban development, i.e., improvement of the environment. There are far too many examples available of poor accommodation management: poor not only from a qualitative point of view but also because it is out of step with the real necessities of our time. The lack of foresight both in long-term projects and in overall development is too flagrant for there to be any doubting the need for effective

action in the construction sector today.

It is also clearly necessary, having regard to investments and the attendant socio-economic factors, that Community action should concentrate on stabilizing construction costs and eliminating the sometimes speculative or cyclical elements so often and easily accepted as ineluctable.

The economic-policy-instrument role in which the construction sector has been cast is one of the restraints which have prevented this sector from assuming its true social significance and its true position in the human environment to which it contributes; nor has it had the chance to show that it is really the basic activity from which other human and economic activities can develop.

Why, then, did the Commission of the European Communities feel this need to adopt an active and dynamic strategy in this sector, in addition to its programme for the removal of technical barriers?

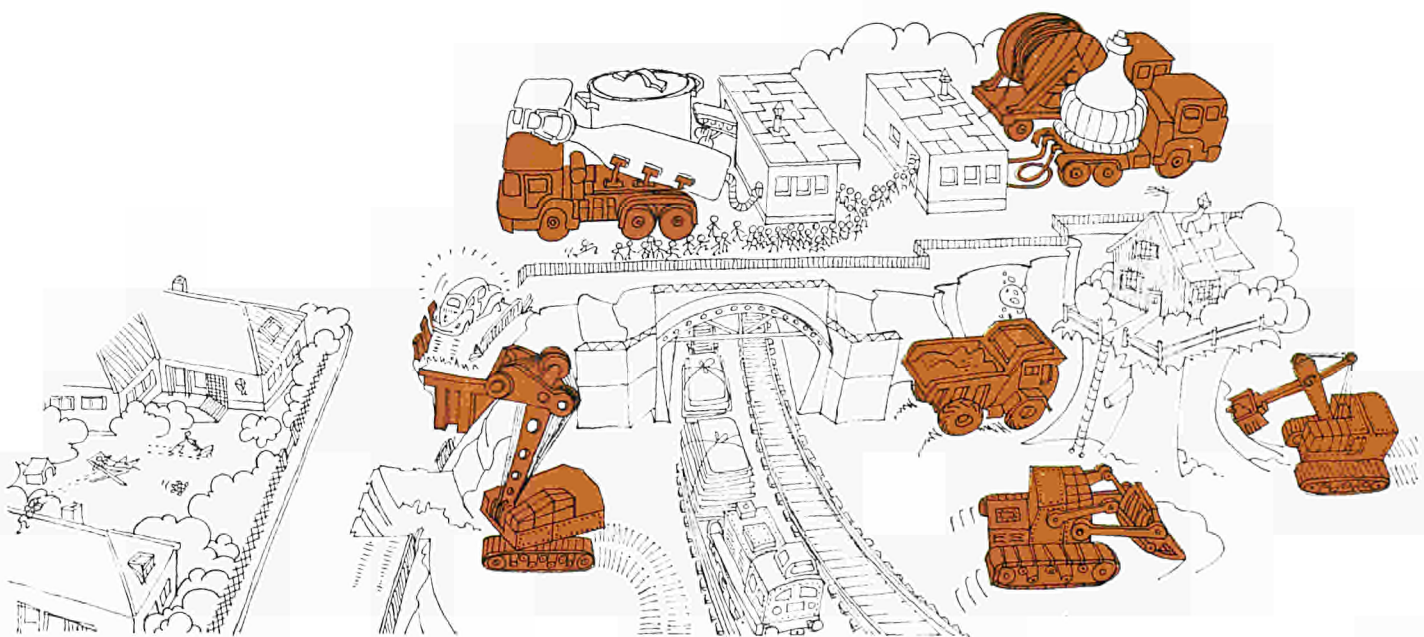
It is true that the removal of technical barriers, a process which is still in its infancy, has already yielded very substantial results with regard to the liberalization of trade in construction materials. By the same token, liberalization in the field of services has made great strides forward: there is still some way to go, however, where mutual recognition of diplomas and the free

exercise of a profession are concerned, as these affect architects, for example, as well as other sectors such as medicine, pharmacy, etc. Over and above the technical obstacles, there seem to be psychological ones to overcome both at national and at transactor levels (perhaps more at national than at company level).

Removal of barriers

A first provision for this activity was made in May 1969 in the form of a general programme. This programme, the aim of which is to remove technical barriers to trade in industrial products, was only of marginal concern to construction, since by its nature it dealt only with construction materials (cement, bricks and glass).

The removal of these barriers is subject to the provisions of Article 100 of the Treaty of Rome of 25 March 1957, which also provide the legal instrument for their abolition, namely the approximation of national laws, the disparities in which are responsible for the obstacles. Approximation carried out by means of directives should be effective as a means of removing barriers but cannot be carried out without taking account of the indirect effects that such a decision would have at various levels.



A second provision was made in December 1969 concerning freedom to supply goods to the State and other public bodies. Here the aim is to secure the opening-up of the markets of each Member State to goods coming from other Member States, so as to avoid any discrimination between goods produced by one country and those manufactured by others. As far as the construction sector is concerned, these provisions relate to materials for components or structural elements.

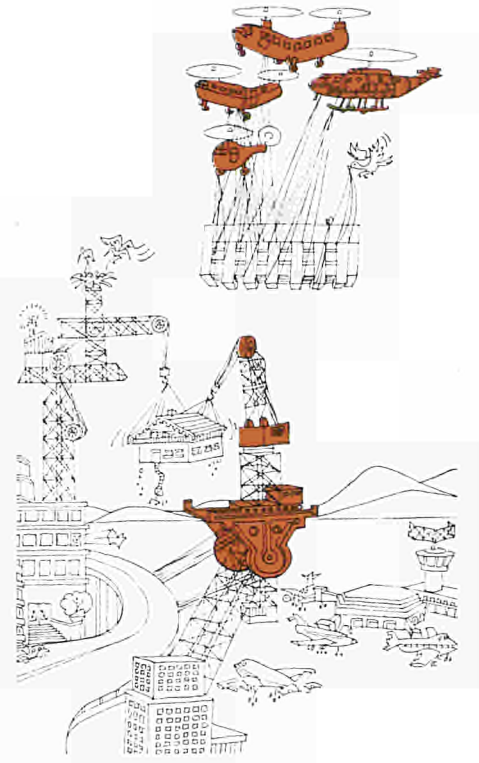
A third provision dates from July 1971 : it contains two directives concerning restriction on freedom to provide services, more particularly aimed at the construction sector and designed to coordinate procedures for the award of public works contracts. The first directive relates to the abolition of restrictions on service-rendering in the field of public works contracts and the awarding of such contracts by agencies or branches. The second directive deals with the coordination of procedures for awarding public works contracts.

The action

In November 1972 the Commission of the European Communities approved a procedure for determining, by means of exchanges of views between experts from the Member States on the one hand and Commission departments on the other, those areas which could form the basis of proposals to the Council of Ministers, the aim being to speed up the progressive establishment of a truly unified market in the construction sector.

After approving this procedure, the Commission organized consultations with government experts, which seemed to confirm the member governments' major stake in the Commission's taking action, over and above that already taken with the aim of:

1. *making a Community-wide survey of national provisions* relating to the medium-term development of the three construction markets, namely, housing, industrial and commercial buildings, public buildings and works ;
2. *harmonizing, at Community level, building codes and regulations* in the various Member States ;



3. *coordinating research and development* in the field of construction in the various member countries, particularly with regard to new ideas for further-reaching application of industrialized techniques.

Effective action by the Commission hinges on the three points set out above. There are, however, other international organizations also concerned with the construction sector, which share the same preoccupation but do not have the same institutional framework. What relationship, in this context, can there be between action by the Community and the initiatives which have already been taken by other organizations, in particular the United Nations Economic and Social Council in its Economic Commission for Europe, the International Organization for Standardization (ISO), the European Committee for Coordination of Standards (CEN), the European Community for Concrete (CEB) and the European Convention of Constructional Steelwork Associations (CECM)? In other words, how is the work already accomplished to be developed? The Commission has not the slightest intention of supplanting these organizations but hopes that all that has been achiev-

ed to date, from both a technical and a conceptual point of view, and may help to improve the construction sector in every respect, can be systematically introduced into the Community by means of the appropriate institutional instruments. It is because the Community has unique media for action that cooperation with other international organizations can be extremely fruitful, particularly in helping to avoid any duplication of effort and to ensure that maximum benefit is derived from the work undertaken by each of these bodies.

Forecasting

Needless to say, all Member States have some form of medium-term forecasting, particularly with respect to housing and public infrastructure works, but the reference criteria in some cases differ considerably from country to country, making it extremely difficult, or even impossible, to compare the various national objectives. To understand the problem as a whole, therefore, it is vital to have common methods for setting these objectives.

This in turn requires a common framework and nomenclature so that comparable estimates and statistics can be drawn up in each member country. These are vital if information is to be collated and valid forecasts made for the whole of the Community.

The competent departments of the Commission have found, from the work already in hand, that the available statistics are not comparable and that to make them so there must first be a common nomenclature, which requires :

- a) a classification of all the possible sectors in the construction industry, such as low-cost housing, publicly or privately owned flats, and villas; civil engineering as it affects roads, harbour works, etc; non-residential building such as schools, hospitals, and commercial or industrial buildings;
- b) the listing, on the basis of this classification, of all the variables which can affect the behaviour of these sectors, such as housing and housing improvement policy; short-term economic policy and the relevant needs; household sizes and incomes, budgetary policy, credits;

c) the compilation of a synoptic table from which an overall Community view of the sector can be obtained and which takes account of the nomenclature and the variables.

The preparation of these data, which is now in progress and is being coordinated by the appropriate Commission departments with the help of government experts on forecasting problems and representatives of the Statistical Office in Luxembourg, should lead to the formulation of a common methodology for forecasting.

Technical and legal obstacles

It is a well-known fact the diversity of the provisions of a technical nature acts as a drag on the extension of construction processes beyond national frontiers.

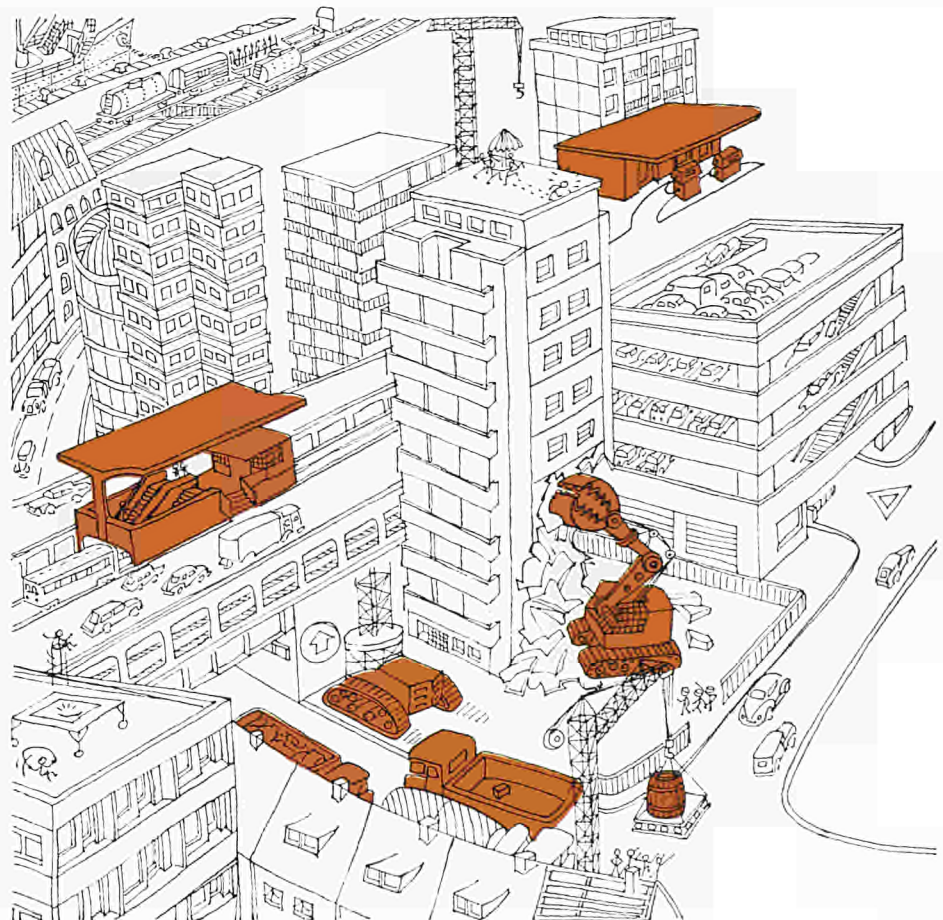
This point is particularly important, being central to the sector's very activity and the possibility of adapting its structures to Community proportions.

The Commission document outlining industrial policy states that « The establishment of European industrial base... presupposes the existence of a single market operating like a national market in which people, goods, services, capital and companies circulate freely ».

The operational solution to this problem might be to map out, on the basis of what already exists, a number of practical measures, the most important being:

A) IN THE IMMEDIATE FUTURE:

- a condensed glossary of the main technical and legal terms used in the national laws and regulations; in other words, a phraseological text designed to make it easier for the transactors involved to understand the texts and interpret them accurately;
- a selective list of mandatory national provisions, which might usefully begin with building permits, to speed up procedures for transactors wish-



ing to operate in the various Community countries;

- *the basic regulations* regarding structural safety and fire precautions;
- *a European procedure* relating to technical approval in respect of non-traditional building materials and processes.

B) IN SUCCESSIVE STAGES, A PROGRAMME OF DIRECTIVES ON:

- *general fundamental requirements* to serve as a basis for all Community regulations;
- *harmonization of standards and compulsory codes of practice*, and the submission of solutions stemming from the basic regulations concerning structural safety and fire precautions;
- *harmonization of standards and codes of practice which are not*

compulsory but which likewise represent a serious obstacle to trade.

This is a substantial and long-haul programme and the Commission will be counting on cooperation with international bodies which specialize in the various fields mentioned, since common denominators must be found in the huge mass of regulations, provisions, standards and codes of practice which directly or indirectly affect the construction sector.

Research

This activity is of prime importance both to the sector's economic development and as regards the "quality of life"; it is a field in which action at Community level might, as it progresses, make it possible to arrive at a better definition of the actual reasons for and the basic orientation of this research and, on a more general plane,

stimulate development of those areas which take human needs into consideration. For the present, the continuous emergence of new materials, better use of traditional ones and rationalization of construction methods call for a sustained research effort based on cooperation and having as its final aim public utility in the broadest sense of the term. A topical example is the possibility which the widespread adoption of thermal insulants offers of minimizing the effects of the energy crisis.

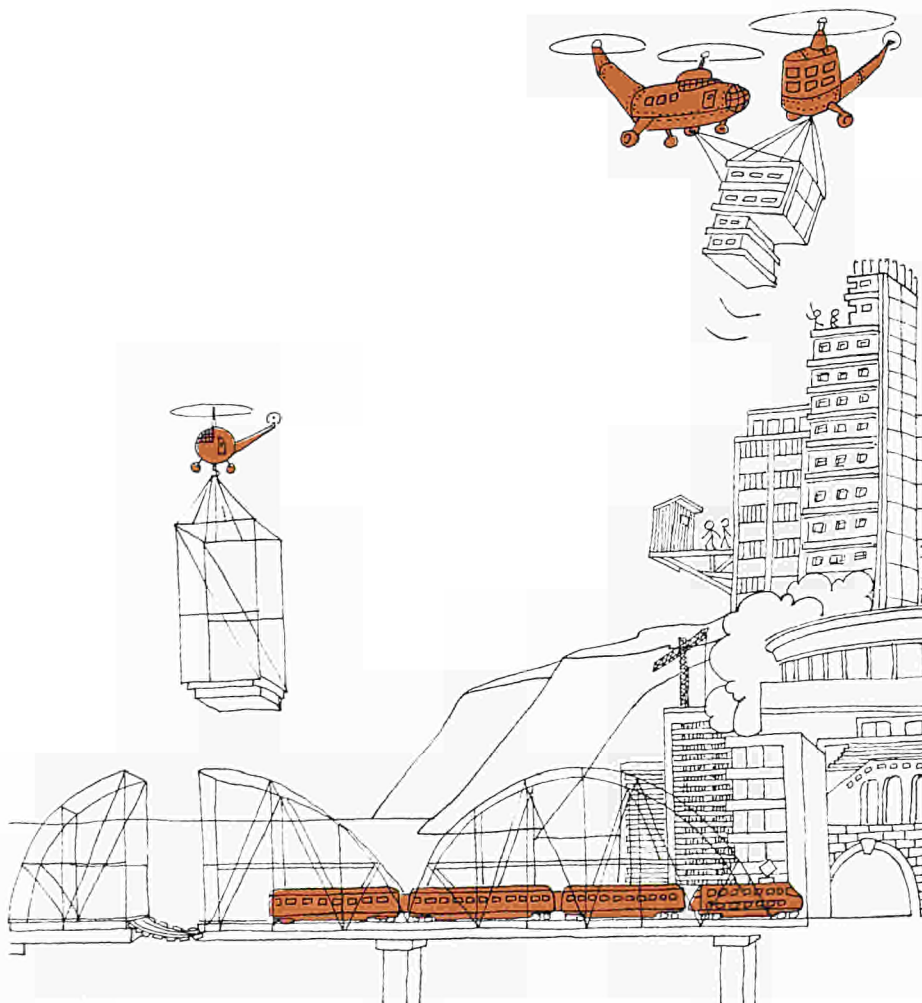
Equally, recent construction processes in many cases involving new materials, should form the subject of a thorough-going research and development effort, undertaken and carried out at Community level, in such a way as to guarantee the safety and well-being of the population as far as is humanly possible.

To attain this objective, the CEC is proposing measures of a general nature and measures of a more specific nature, such as an inventory of the research potential in terms of manpower and equipment, classification of the projects in progress and determination of areas of common interest regarding structural safety, fire precautions and new materials.

Conclusion

The measures just outlined constitute but one of the many solutions which will be required as Community action develops in the construction sector.

This is merely a start, but the extent of the problem calls for a political commitment from the outset and also for the cooperation which our countries' governments are certainly willing to give to the Community bodies concerned to be matched by an equal commitment on the part of all the trade and professional organizations involved, matched also by their determination to adopt a Community rather than a national attitude to the problems, confronting them, an attitude which is commensurate with the size and scope of the measures necessary to overcome the natural resistance which until now has militated against any solution.



Documentary communication

Objectives and structures of systems and networks

JACQUES HALKIN

Documentation is more than ever an issue of the day. euro-spectra has always recognized its importance, publishing numerous contributions from students of the problems involved, who have propounded various approaches.

Following the 1972 special issue and several other articles on the subject in recent years, this review now publishes an article by an independent writer who presents his personal analysis of some basic aspects.

“Our duty is to visualize new structures which are sufficiently flexible to keep in line technological development. This task calls for a genuinely forward-looking outlook.”

Louis Armand

THERE ARE both public and private documentation organizations: the former are often more powerful (substantial financial resources) and tend towards exhaustiveness in their coverage; the latter are more utilitarian, in that they exercise selectivity in relation to requirements. These two types of organization pursue their own courses, apparently without succeeding in complementing each other; the fact that relations between them are polite does not provide a sufficient basis for the development of new structures and, to judge from certain bitter remarks, a clash is in prospect.

The objectives of the public organizations are primarily educative, but their aid is ill-suited to the needs of industrial and scientific circles, whose activities are organized according to

economic criteria and whose documentalists are fully conversant with economic situations, at least where information has been so structured as to enable them to fulfil the “mediator’s” role in which their primary value lies.

The public and private organizations are developing along parallel lines, competing with rather than complementing each other. The private sector activities in our countries, characterized as they are by free-enterprise status, do, however, deserve to benefit more effectively from the substantial capital expenditure undertaken by governments. Aid in the field of documentation from the public to the private sector could be different and better. Would it not be possible to improve “information traffic” in the same way as road traffic has been regulated? Governments uphold the highway code in order to facilitate private road transport. What they do is to apportion responsibilities between the public and private sectors, and a similar *modus vivendi* could be worked out in the field of documentation in order to replace competition by complementarity.

Documentation networks, which are destined to supersede systems, are leading to the establishment of new struc-

tures from which the private organizations will be the first to benefit. By joining forces with others, an undertaking will be able to reduce its documentation costs and it will be possible to organize documentation processing in sufficiently small units to enable the documentalist to perform his role as mediator effectively.

In this study, an examination is made of the impact of future networks on documentary communication in the light of a critical appraisal of the current situation, supported by published works. This critical appraisal seemed necessary, since the individualism of those in positions or responsibility in the field of documentation gives considerable cause for concern. It is of little practical use to recommend agreement on the setting up of a network, or, more appropriately, of several networks. Each individual manager is working towards the objective assigned to him and is committed to a personal “system” which is impervious to all attempts at integration into a “network”.

Because of the incompatibility between new requirements and traditionally hidebound existing structures, it has become necessary to carry out an overall analysis, which alone can bring about an improvement in the situation.

Multiple worlds and communication

The expression “multiple worlds” serves to describe the documentation scenario as it is today.

Much has been said of the growing mass of available documentation, which is born and dies, and which is increasing in diversity in the range between the “generic” and the highly “specific”, the whole corresponding to a genuine hierarchy of requirements; reference has been made to the obstacles encountered by the major centralized documentation organizations as a consequence of these phenomena. Today, it is becoming clear that centralization is far from being a miracle structure which makes the information held more readily accessible. It may have suited a world more static than that in which we live, but today there is a need for communication between the holders of information — the word “holder” meaning both the person in

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possession of information which he has generated and the person who is already in possession of information and requires more information to meet increasingly subtle criteria — in order to progress, innovate... and create additional information. The required documentation structure is one which facilitates this “production line” generation of information, i.e., progress. The creation of a network as a collective means of communication is better suited to present-day purposes than centralization geared to various systems. Unlike the system, the network has a vital asset in that it lends itself to enlargement; on the other hand, it is still attended by the difficulty inherent in the lack of accepted standards. A further difficulty lies in the empire-building tendencies of those who enjoy powers of centralization.

Nevertheless, the present trouble is more deep-seated and more complex.

Information is not a “fact” in itself, but the account of a fact; as such, it can be subjective to various degrees, depending on the extent to which it is consciously or unconsciously biased by human choices, eliminations, adaptations and interpretations, by the objectives envisaged, and sometimes by “manipulations” designed to prepare, influence or modify opinion.

No one, however, questions the necessity, significance and importance of information: as long as progress remains a major theme in our civilization, information will continue to rank high in our activities. But we are not all pursuing the same ends.

Information can be invested with an *educative purpose* and placed at the disposal of all as something for the community as a whole, or with a commercial, publicity-oriented purpose.

It can be a *commodity* capable of being costed and priced whose purpose is to promote progress, that is, to “inform” those equipped to grasp it, and to innovate: hence, there is a need for information to be treated with the precautions of confidentiality in order to avoid jeopardizing any current venture.

A third major objective is to fulfil the function of supporting certain options among a range of possible choices, that is, to *serve political ends*.

There can also be various combinations of the three objectives — educative, economic and political. In each situation, the most suitable structure for documentary information will depend on the objective envisaged. This study is concerned with the economic objective of information.

In the competitive world in which we live, the question of the protection

of novelty lends importance, sometimes considerable importance, to limited or deferred circulation of information and to the maintenance of confidentiality of the information discovered. Confidentiality leads to enclosed worlds and the delimitation of restricted spheres within which information is communicated.

Wholesalers and retailers

There is controversy regarding the role of the documentalist: should he remain neutral, uncommitted, while the client himself is obliged to sift through the mass of documentation supplied in order to find the information he is seeking? Or should he become the "mediator" between, on the one hand, the literature and, on the other hand, the requirements of a clientèle with which he is in constant intellectual contact, attempting to become well acquainted with this clientèle, to meet its requirements and identify these requirements through his own reading?

Should the documentalist be an expert in documentation systems or should his primary role be as a technical and scientific specialist versed in the activities of his clients? To look at the problem from another point of view, by analogy with commercial structures, should the documentalist be a wholesaler or a retailer?

The first of these options is wedded to the centralized structure: the documentalist bases his work on what he reads and remains remote from the user who, moreover, although he asks questions, is rarely willing to "open out", so that dialogue between the two sides can be maintained only with difficulty.

The second option requires the documentalist to be competent in the profession of his users and to be able to share their lives, the essential part of his service being, not to produce an exhaustive treatise, but to select the texts capable of being of concrete usefulness to them. Competence in the sphere of documentation still retains its importance here, but nevertheless descends to the status of a secondary profession. What better way for him to integrate himself into the activities

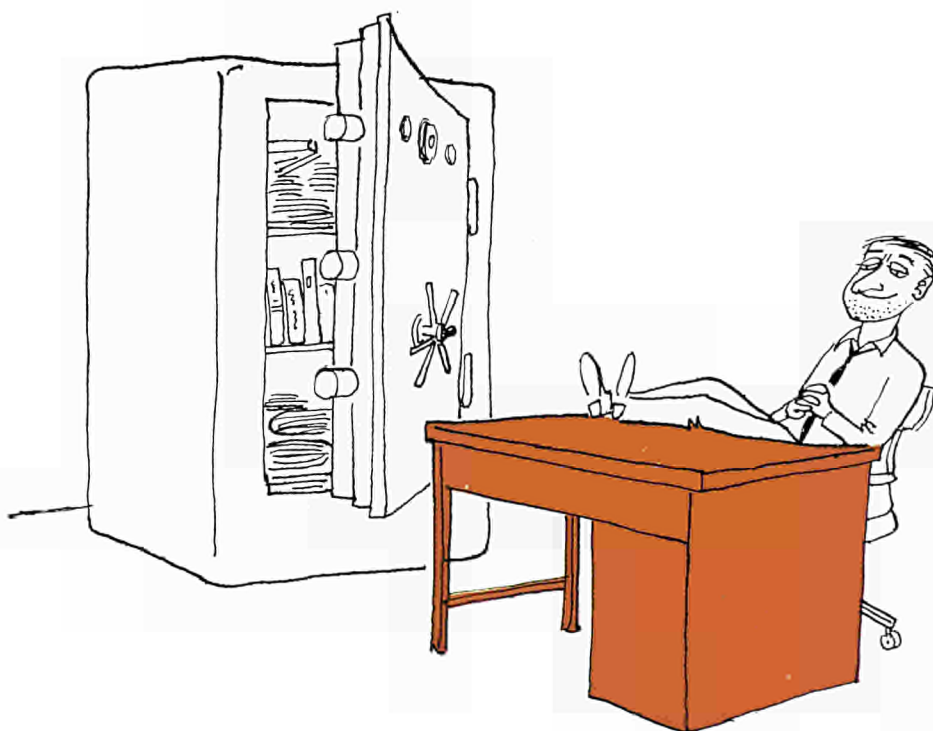
of his users than by working within the administrative unit (department, laboratory, workshop, etc.) in which they themselves work under the same leadership and receiving advice, encouragement or even reprimands from the same source?

This is the situation of the "specialized information centres"¹, as contrasted with the large-scale centralized organizations set up in isolation from the real life of business and progress.

The problem of the documentalist is developing: whereas the mass of documentation is the most important factor in the first option, knowledge of the user and analysis of his requirements are more highly regarded considerations in the second option. The documentalist is becoming specialized. "Specialization" implies "decentralization", that is, rejection of the centralized structure which governs an incredible number of documentation activities: *decentralization is the chosen course by which to specialize and to improve the documentalist's role as mediator.*

¹ The setting-up of specialized information centres is the corner stone of the Weinberg report drawn up in 1963.

Neither of these structures, however, is a cure-all solution: centralization is unable to cater adequately for the specific, individual requirements of industry and sciences; decentralization engenders compartmentalization, which can rapidly be felt to be an overriding defect. There will be a temptation to look no further than centralization and to settle for this solution where user's requirements present little or no need for individualized information and where there is no likelihood that the nature of the information sought will cause any loss of confidentiality. Where this is not the case, however, as for example in areas of advanced technology in which innovation is of great importance, the customer feels that his needs are not understood by a central organization. His frustration leads him to establish his own documentation facilities, enter into competition with, and finally denigrate, the official centre. Where the undertaking centralizes information, other documentation activities are created at more specialized levels, so that it becomes possible to give greater attention to users' requirements. More often than not, such activities are conducted in secrecy within the confines of offices and the informa-



tion collected remains unavailable to the official documentalists. This is one ground on which the centralized structure is demonstrably unsuited to individualized requirements. This is the position of all dynamic industrial concerns. The recourse to secret documentation facilities is the outcome of a lack of dialogue between user and documentalist. The *decentralized* documentation unit places the documentalist in an entirely different relationship with his users. He knows their secrets, or many of them; he is aware of plans under consideration, decisions taken, etc. He is thus in a position to supply information of a higher quality in relation to the purpose for which it is intended.

Against this, it will be said that decentralization is costly in that it is necessary to have specialists for each field. On the other hand, what would be the situation in a centralized organization which attempted to compete with the decentralized structure in terms of quality of service? Just as many specialists would be required and, in addition, it would be necessary to organize them centrally on a competitive footing with the specialists already working in each active department within the undertaking. It is accordingly fair to claim that specialized documentalists are most usefully employed in decentralized units where they are able to work in conjunction with the practising specialists in the undertaking.

A further development beyond decentralization — indeed, made possible by decentralization — is the network structure, the format of the future.

The network

The centralized and decentralized units discussed above are “systems”. Their structures derive from the terms of reference conferred when they were set up: “your task will be to meet the specific documentation requirements of user group Y”. The person receiving such instructions has, in fact, a twofold task, since he is required to develop a system to its maximum potential and, in addition, to produce information required while working within the framework of the system which he has devised. The resultant situation may be

likened to one in which each and every road haulier was entitled, not only to carry goods, but also to formulate his own highway code to suit his own convenience and to refuse to comply with a single universally applicable code. This is so much a part of the *mores* in this field that it is virtually accepted as normal. As a result, systems and information “fiefs” are unable to communicate with each other. Such individualism among systems is limiting and its effect is to cause documentary information to remain what may be termed a cottage industry. It can only be placed on a proper industrial footing if networks of organizations are established and if they collectively adhere to new rules of behaviour along the lines of a highway code.

Thus, there is at present a real conflict between two structural models; the only possible outcome is acceptance of a clear division of documentary information according to two functions, the first covering everything which is collective (as with the highway code) and which requires to be centralized under an authority responsible for maintaining order, while the second may be described as “client servicing”, that is, information processing proper (as with road haulage proper), which benefits from being decentralized into as many documentation units as are required in practice. With such a coverage, and with two different types of authority, one no longer has a system, but a network. *With a decentralized, coordinated network, it is possible to satisfy users' requirements on a personalized basis, while enabling each documentation unit to benefit from the contributions of the others.* The difficulty with the network lies in the formulation of the single system to be set up, adhered to and applied by a group of individualized documentation units, *whose success depends first and foremost on acceptance of the apportionment of powers between the two types of authority coexisting in a network.*

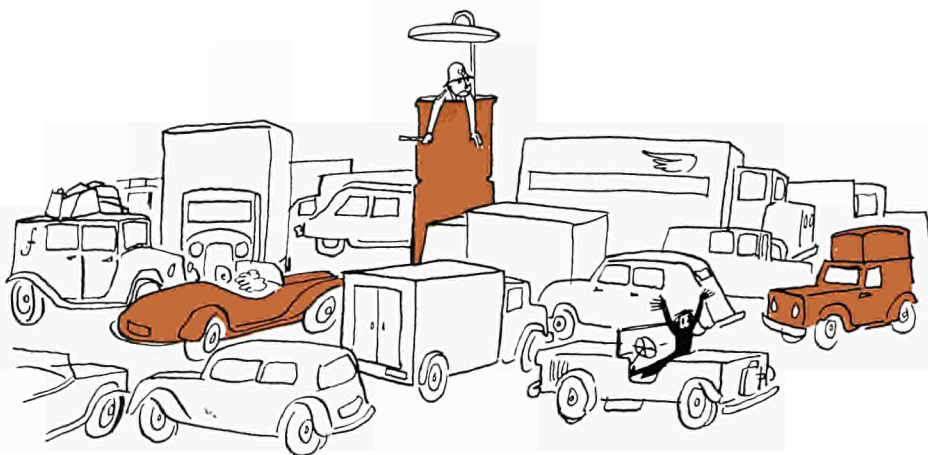
As yet, there are very few documentation networks. However, many other activities in which communication is a predominant factor have only been able to grow by applying the network principle: centralization of powers to organize communications and decentrali-

zation (specialization) of information processing. The telephone authorities, road haulage, inter-bank account numbering, agreements between electricity grids and agreements on air traffic provide a number of examples of this. The success of these ventures would not have been possible without the division into two types of authority and the delegation of the powers of communication to a central authority. In the era of the computer, it is anomalous that documentation activities should be alone in a long list to have failed to adopt the same structures.

Turning to the future, it is possible to visualize the principal trends in documentation networks: there will be networks between central organizations, networks between decentralized units and mixed networks. There could be a generalist information service supported by specialized satellite documentation units covering the fields in which demand is heaviest. Highly specialized databanks could also be grafted onto certain units in a decentralized network. One of the most useful generalist services would frequently be one supplying statistics in certain clearly defined information fields. In all these variants of the network, *the basic principle remains unchanged*: a “single cooperative” is made responsible for general function (such as acquisitions and publishing) *and for communication functions* (numbering, catalogues, glossaires, classifications). In a network, each participant knows that his own contributions through a decentralized documentation unit entitle him to have access to the contributions of the other participants and — what is more important — provide him with the means for doing so. *The network structure is based on mutual aid: it is a collective and cooperative organization.*

Delegation of powers

To opt for the network structure, therefore, implies acceptance of the division of information into two separate functions; this would appear to be so logical a prerequisite that it is difficult to see how there can be any major obstacles. Nevertheless, we are failing to make any progress beyond the phase of propaganda in support of the network.



For the members of the team, agreement to convert from the documentation "system" to the "network" represents a loss of individual power: the management of the "system" is delegated to a new authority whose role is to build a single system and to maintain it for collective use. This loss of power is a step into the unknown, something of a point of no return comparable to the decision taken by each of the Member States to enter Europe. Moreover, for certain establishments where belief in a high degree of centralization still prevails, decentralization into specialized documentation units is likely to attract criticism on the grounds of loss of central control. In fact, the shifting of centres of control is justified in terms of functional necessity. This is the price to be paid for the benefits of the network, for the benefits of individual access to collections compiled by all the participants together.

Working in a network brings its advantages, but also imposes constraints. If the "documentation fief" attitude is to give way to a spirit of cooperation and mutual aid within the context of a network, a period of adjustment and a degree of perseverance are necessary. Resistance to structural change is a damaging, and widespread, phenomenon. Today, we are passing through a phase of change in which awareness of the failure of isolated systems is growing in parallel with the certainty that, in the long term, the network is the only viable organizational solution. Very few industries have progressed

beyond this stage, and curiously enough, it has been left to technologically advanced industries, such as the pharmaceutical industry, to show the way, although it needed courage for companies often in competition with each other to cooperate in this way; however, such courage pays dividends, whereas timidity leads to inertia. We are probably all convinced of the advantages of the network, but there is reluctance to act on this conviction in the face of the price to be paid: a certain loss of central powers. Consequently, there will be attempts to compromise by setting up networks without delegating the necessary powers to ad hoc coordination cooperatives, or by retaining central control of the responsibilities conferred in theory only on the decentralized units. Such solutions would point to the desire to enjoy the benefits of the network and to the fear of losing the prerogatives of centralization, but also to the powers of survival of the centralization myth. Such a hybrid position is dangerous in itself: it is impossible to build a solid structure if one takes away with one hand what one gives with the other. *The absence of a candid acceptance of the essential need for a collective approach still remains the main obstacle to be overcome.* We shall learn to think in terms of mutual aid and free competition on the scale of the network, instead of defending monopolistic documentation positions established in isolation: the revolution is bound to come.

Public and private documentation organizations

In theory at least, if the public organizations were to achieve a satisfactory level of service to industry, the need — or justification — for company documentation centres should be reviewed. There is no doubt as to the aid provided by the public organizations; it takes many forms, including information bulletins, answers to queries, subscriptions by profile, publication of documentation reviews which chronicle developments in certain fields and, more recently (although this is still very rare), the provision of cover-to-cover indices of the periodicals to which an undertaking subscribes. However, this range of services does not meet the fundamental requirements of the individual undertaking, whose main consideration is to have at its disposal a personalized information service. It is reasonable to predict that the constant development of requirements will lead to an increasing differentiation by undertakings between their own information and contributions received from public organizations. The latter will remain one of a number of useful sources, although their contributions will be reworked, adapted, screened and sifted in the light of the particular needs and character of the undertaking in question.

The multiplicity of sources which industry is obliged to consult is becoming the real problem of communication between public and private organizations: it is caused to some extent by the sub-division of the public organizations into isolated "fiefs".

This does not mean that the official and public documentation organizations are not useful in their present form: they fulfil an educative role, they satisfy the needs of individual researchers, they are used by industry for certain types of query. But it must not be forgotten that the distance between these organizations and their customers (lack of dialogue) is such, and the prudence with which industrial and scientific undertakings treat subjects in the fields in which their vital interests lie is so important a factor, that industrial and scientific undertakings prefer to seek other more satisfactory sources or methods.

As has already been mentioned in the introduction, a clash is in prospect and is already reflected from time to time in uncompromising language².

Confidentiality and its consequences

When a valuable piece of information is discovered, it may be necessary to keep it secret, or to restrict or defer its dissemination. Any new venture could be ruined by a leak of information. In our competitive society, the problem of confidentiality can become important. The behaviour of the engineer and the industrialist in this respect is very different from that of the scientist, for whom a discovery is not a personal asset. One could write at length on the subject of this difference: it is an anomaly which, in a competitive world, appears likely to persist.

² We quote two extracts which seem particularly pertinent: in 1971, the *OECD* (Organisation for Economic Cooperation and Development) published a brochure entitled "Information in an Evolving Society" which contains (page 49) the following passage:

"Governments should analyse the structures characterizing the utilization of technical information in industry and, in the light of these structures and an assessment of their value, examine the usefulness of State-subsidized scientific and technical information systems. It is essential to develop economically viable programmes corresponding to these needs..."

The reputation of the *OECD* for moderation can only lend weight to this observation. Our second quotation is more recent, being taken from the Congress held in Luxembourg in May 1973. The final remarks by Georges Van Slype at this Congress were published in a contribution by E. Peeters on pages 18 and 19 of issue number 1, 1973, of "Cahiers de la Documentation", the journal of the *Association Belge de Documentation*. They contained the following observations:

"Research and industry, the two major users of scientific and technical documentation are dissatisfied with the facilities made available to them; the documentation serves no purpose for the researcher who has other sources and is insufficiently specific for industry.

Accordingly, the next Congress should devote a substantial portion of its time to general themes; it will not be enough to describe the existing systems — they must be subject to scrutiny. The individualism of documentation administrators continues to give cause for concern, and even the networks are experiencing difficulty in establishing cooperation".



In order to come to terms with this questions of confidentiality and, more particularly, to reduce it to its true dimensions, it is necessary to define it. Initially, a secret is no more than a piece of information like all others which are published and therefore not secret, but when it reaches a person capable of understanding it, it becomes "useful information" if that person intends to use it for a specific purpose, and particularly if he hopes to turn it to account. By being used by this person, the information becomes his property: secrecy is employed to protect its use and the benefits deriving therefrom, whereas the initial information is not subjected to any confidential treatment. The concept of "value" may be derived from the query put (in conjunction with the use envisaged): this concept often exists prior to the discovery of the information destined to be elevated to the level of "useful information". The concepts of value and use can lead to confidential treatment of the aggregate of "information+value+use", but not of the information alone: this would serve no purpose, since the information has been published. The gathering of documents for a network will lead to no loss of confidentiality, but the processing programme for such joint collections must be such that queries (from which intended uses and objectives can be identified) can be put by each user in privacy without any intermediary; in this way, confidentiality is

assured. If the public documentation organizations could be interrogated in this manner, they would provide a better service to their users. When we refer to public libraries, we look up the books *ourselves*, but, as yet, the complexity of computer programs generally makes it necessary for the client to entrust his queries, and the accompanying commentaries which are frequently necessary, to human intermediaries able to use the computer.

Public networks and private networks

The idea of a world scientific information system has been under active consideration in *UNESCO* since 1967. The draft of a system entitled *UNISIST* was approved by the general conference of *UNESCO* in 1972.

Because of the slow and unquestionably prudent launching of this project, it is unlikely that we shall see any early effects on the structures and administration of public documentation centres. In principle, the accent placed by *UNISIST* on the unification of systems should lead to mergers between certain centres and to network communication between many others operating on a single system. With this in prospect, the following question arises: once organized into networks, will these centres provide a more efficient service to the private sector, i.e., to industry and science?

This question cannot be answered without taking into consideration the structural reforms which the private organizations themselves will implement. The network structure not only enables several undertakings to enter into association (thereby reducing the cost of information), but also facilitates healthy decentralization enabling the company documentalist to give a better service in his essential role as "mediator", by placing him in a position of trust within the immediate circle of his users. Interrogation by each documentation unit and appropriate selection of the members of inter-company networks are additional safeguards against breaches of confidentiality.

It may therefore be assumed that company documentation structures will improve more rapidly than those of the public organizations.

Mr. Pierre Piganiol, a former Délégué à la Recherche Scientifique de France, pinpointed the present difficulties very clearly when recently addressing an audience of documentalists: "The problem with documentation is that we find ourselves in a very uncomfortable position. By definition, we deal with "completed science" or science which has almost been completed, but we pass it on to precisely those who are most closely involved in current developments. Accordingly, one should not be surprised to find that there are difficulties of adjustment between the two from time to time. What is im-

portant is to find the point of balance between *completed science* and *evolving science*"³.

When the documentalist is placed in closer contact with "those involved in current developments" (=decentralization), he is in possession of knowledge otherwise unavailable to him on the basis of which he is able to make a judicious selection of information from his reading and better able to make an efficient contribution to the work of his users, in other words the "value" of the information is increased. If one may be allowed to rework the observations of Mr. Piganiol, it may be said that the public documentation centres are concerned with the handling of *completed information*, whereas the queries formulated by the private sector — industry and science — relate to *evolving information*. The distinction between these two types of information would seem to hold the key to the differences of approach between the public and private sectors. In his role as mediator, the private sector documentalist holds the master trump.

³ This passage is taken from the discussion which followed the conference held in Luxembourg on 3 and 4 June 1971 by "MBP de France" on the theme of: "Information and documentation as a source of efficiency and progress". It came at the end of an exchange of views between B. C. Vickery (Great Britain) and P. Piganiol (France).



Conclusions

The network concept involves the division of documentation activities into two functions governed by authorities of different types:

- 1) *the communication function*, which must of necessity be entrusted to a central body accepted collectively and cooperatively by the participants;
- 2) *the processing function*, which is better fulfilled when decentralized, so that each resultant documentation unit is more specialized, efficient, dynamic and competent in its own sphere.

The network is a cooperative pooling of resources and, by definition, lends itself to enlargement; structurally, it is the converse of the traditional systems which hinge on a strong element of centralization, in other words, which centre responsibility for the two functions defined above on a single authority. The present state of disorder in the world of documentation is the result of the multiplicity of isolated centralized "fief" which hampers communication. Networks are destined to remedy the present situation gradually as they expand.

The behaviour of the public sector group remains primarily educative: even where its willingness to participate directly in progress is established, its general attitude draws its inspiration from that of scientists, for whom knowledge is international and unaffected by considerations of confidentiality. It is common for the private groups to shut themselves off in enclosed worlds pursuing their own economic and financial objectives and interests; the need for discretion can therefore make relations with the public group difficult. The public group often seeks to be exhaustive in its coverage, something made possible by financial resources which are generally substantial. The private group, on the other hand, since its sole objective is to provide a service of high quality to a specific clientèle well known to the documentalist, concentrates much more on the quality of choice of documentation and its adaptation to localized requirements. In his desire for efficiency, the private documentalist concentrates on his role as "mediator" between the documentation and his users.

In working towards this end, he has two advantages: decentralization of documentation structures with a view to specialization, and the opportunity to work in close collaboration with his specialized users or even to be placed directly under the instructions of one of them. By contrast, the public group is characterized by the high degree of centralization of its structures, which detracts seriously from the quality of relations between documentalist and user. Industry's frequent need for discretion can compromise relations between private documentalists and the public centres. It may be said that the private documentalist offers his users the closest possible collaboration in the area of "evolving information", since he endeavours to project himself towards them, whereas the public sector documentalist is more confined within the bounds of "completed information". Consequently, a need is emerging for the activities of the present public organizations to be supplemented by more progressive organizations, each with its own specific personality. It is towards this form of information handling that private documentation activities are progressing currently. *In the network structure, industry and the inter-company documentation associations have a tool which, if used properly, can be of exceptional value.* It is implicit in the nature of inter-company documentation networks that they lead to a reduction in information costs, but in addition they make it possible to decentralize information handling towards specialized "documentalist-user" units, thus achieving the benefits of an improvement in the mediator's function. Clearly, the choice of partners is fundamental, their mutual compatibility is very important and the acceptance of simple rules upholding the right to confidentiality where it is justified is necessary to ensure that each partner is independent while enjoying the advantages of collectivity. A documentation network of this type is both open to enlargement and decentralized, it favours mutual aid and competition and, above all, it allows important economies of effort to be made. It behoves managements to realize the various advantages offered by the network solution and to formulate the decisions which will lead to the

launching of a further phase of development.

What developments are possible in relations between the two present groups, private and public?

Industry has its own documentation sources which are convenient, although often imperfect or incomplete, which could be supplemented by contributions from the public organizations. Industry makes its choices from among the sources available to it and then adapts the information selected to its requirements: selection and adaptation are tasks best undertaken by company documentation departments. The establishment of convenient generic sources can be done outside companies; indeed, companies are interested in discovering new sources of this type. The definition of each source, if we consider this problem in general terms, involves the screening of the literature in the light of general criteria while defining industrial needs and uses, and the identification of each document concerned by a convenient designation. The mass of documentation available today is so vast that screening by computer is necessary, and this involves the use of criteria and designations written not only in clear but also in coded symbols which can be read by the computer.

For these reasons, we consider that it is today essential for a public and collective effort to be made in order to assist industry by identifying the desirable "sources" and establishing collections of them at the generic level which would be available for collective use and kept up to date by means of a macrothesaurus and screening methods.

The advantage of this type of organization is that it does not require close analysis of literature. This work is carried out exclusively by the subscribers to the sources. Thus there would be two phases in the procedure: a generic phase and, subsequently, a specific phase. The former would be organized on a collective (public) basis, whereas the latter would remain a matter of adaptation to the particular characteristics of each individual user. This brings us back to the analogy made with road transport: the first phase corresponds to the highway code in that it creates a form of order, the second phase is a specializing process.

When considering proposals for structural reform, one is reminded of the caustic but very true remark made by G.B. Shaw in the following terms:

"The reasonable man adapts himself to the world. The unreasonable man persists in trying to adapt the world to himself. Therefore all progress depends upon the unreasonable man".

EUSPA 13-7

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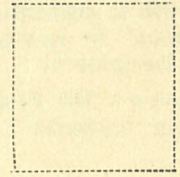
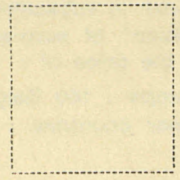
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