

Reports n° 8

AIMS AND MEANS OF A EUROPEAN POLICY

ON TECHNOLOGICAL DEVELOPMENT

Rapporteurs

L. Bölkow

H. Markmann

R. Clarke

CONFERENCE
"INDUSTRY AND SOCIETY IN THE
EUROPEAN COMMUNITY"

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ON TECHNOLOGICAL DEVELOPMENT

by

L. BOLKOW

COMMISSION OF THE EUROPEAN COMMUNITIES

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A critical review of the proposals, discussions and decisions published during the last decade in the various European countries on the subject of "Technological Development" reveals considerable confusion of definitions. Clear definitions are needed, however, in any discussion which controls or influences technological progress because the European community has arrived at an important threshold and because the survival of this community depends to a substantial degree upon technology.

Furthermore, it is most important that the inter-relationship of technological progress and the economic and sociological goals of the European community are clearly recognized, and that we make increasing attempts at utilizing the abstract planning methods which have resulted from the logic of technology and science when defining our goals.

In view of these facts I will concentrate, in this paper, on the methodology or, if you will, on the tools which form the basis upon which our work towards a policy for the future rests. Only those who recognize the logic of these inter-relationships are in a position to continuously check and recheck their work and decisions concerning the applicability and realism not only for the present but also for the future. For our emerging European economic community nothing would be more dangerous than intuitive goals strongly influenced by short term expectations of success.

1. Technology and Development

"Technological Development" defines the progress of the mental, the abstract tools (soft ware) as well as the physical tools (hardware). During the future world wide economic and social competition to which the European Community is already exposed and will be increasingly exposed, the chance of survival, of maintaining and improving the quality of life will depend upon the technological state of art.

It is in two different ways that technology shows up in engineering, in economy and in the formation of social relationships:

- Once as a means to create new technical products or to improve the quality of existing products for the satisfaction of desires and for the necessities of society both in the narrow and in the wide sense.
- Second, as a means to manufacture these products.

In spite of the urgent necessity to increase our manufacturing productivity compared to, e.g., the United States by a substantial amount I shall neglect this side due to limitations of time and because this is very much a problem of organization, of management and of the production numbers along with the technological means, that is tools and their utilization.

Let me enumerate a number of factors and theses which will clarify what I mean by "policy" in the area of technological development before I enter into the discussion of goals and means of a European policy:

1.1 There is no "natural urge" to improve existing technology

There is no inner motivation to improve the tools, i.e. the technology, which would be similar to basic research where the individual, the single human being, follows an inherent urge residing within himself and causing him to drive forward in exploring the micro and macro cosmic relationship existing in the world.

1.2 New technology results from solution of tasks by the engineering community

New advanced technology is not the result of a preconceived "Technology Research or Development" but rather the result which falls out of finding technical solutions to established goals. The most essential part of policy is therefore the establishment of such demanding development goals.

1.3 Acquisition of technology existing in other economic communities (license production)

It is perfectly obvious that an attempt must be made to acquire recognizably higher state of technology in the way of licenses from other economic communities whenever such is available. It should not be forgotten, however, that this leads automatically to a mental and consequently economic dependence. Oneself becomes unproductive and this sets a process in motion which, step by step, leads to the loss of creative capability.

To recognize this and take the necessary countermeasures is not an issue for the individual industrial enterprise but for centralized planning at the political level of our economic community.

1.4 Technology and engineering are not purposes onto themselves

Progress in technology for its own sake has no justification. Engineering and consequently its technology, i.e. its tools, serve the community. If progress, as defined above, can only be achieved through the reduction to practice of demanding requirements, then it is an absolute prerequisite in the formulation of requirements and tasks that they must serve the goals of society.

The search for and definition of such goals, the description of the optimum way towards their realization and a clear definition of tasks for technological development is only possible nowadays by use of modern, essentially abstract planning methods because the state of art is already high and society is growing increasingly more complex.

2. Limiting conditions of a European policy in the area of technological development

In view of the long term nature and the complexity of the establishment of European goals and targets it is necessary to explore the specifically European limiting conditions prior to attempting to formulate those targets.

2.1 Tradition

In the area of modern technology, Europe has, compared to all other countries, historically the longest tradition. This leads not only to the positive effect of a great diversity of thought resulting from the individual color of Europe's regions and of a great continuity and stability based on Europe's long history but it also has the negative effect of excessive ties to cultural patterns when compared to the rest of the world.

2.2 Europe in the world

Europe is imbedded in an economic, political, sociological and military competitive situation between Eastern Asia, the USSR and the USA. We are not free in our decisions regarding the policy of our technical developments. Competition often forces us to set targets and goals which we would prefer, in view of other more urgent problems, to solve at a later time if we were entirely free and could decide exclusively on the basis of internal European view points. The most applicable example in this area is space technology with its by-products such as communication and television satellites or satellites for weather observation and navigation.

2.3 Raw materials

In the past Europe's industrial predominance was partially based upon its own supply of coal as a basis for industrial energy and for the production of steel. Coal is no longer produced economically in Europe in comparison to the USA. It has therefore become necessary to import from areas with substantially better mining conditions. Moreover Europe must import substantial additional raw materials as e.g. oil, nuclear fuels, rare minerals etc.

and this list includes almost all important industrial raw materials with the exception of plastics.

2.4 Shift of technology trends

An increasing number of products which are still exported from Europe today will soon be produced by the rest of the world itself as a result of the reduction of our technological lead. Social, economic and political reasons will contribute to this trend towards local manufacture.

2.5 Development of population

The reduction of the birth rate in central Europe and the increase of the average life expectancy must be considered in future predictions. This is particularly important if our European economic region will have to syphon off large and possible increasing amounts for investment to the rest of the world in an effort to achieve structural improvements.

2.6 Standard of living and productivity

Increasing demands for higher standard of living and the requirements of different political groups which are aiming at a modification of the existing social structure have lead to an increase in operating costs, particularly in the cost of labor and to modifications of the baseline. We must never overlook these frequently inescapable changes in our social life and their effect upon the maintenance of our competitive position which is one of the pillars of this very social life itself. This observation becomes particularly obvious when we compare the productivity of Europe in many manufacturing areas where it is lagging far behind in comparison to the United States.

2.7 Being fed-up with technology

This movement began in the United States and we can now observe in Europe a certain degree of tiredness vs. technology if not out-right hostility. This trend will certainly not make it easier to search for new goals and targets to provide the necessary means to achieve them.

2.8 The industrial saturation process

The economic and technological processes which had their origin in the transition of rural societies into industrial societies is already showing signs of saturation in many areas with more to come. In different regions of Europe these are not all happening at the same time. First warning signals are e.g. the number of automobiles in the cities, the ever increasing life span of the products, the concentration of population in the industrial areas, the stagnation of utilization of public transportation, the average velocity of transportation which, in some instances, is already declining and so forth.

2.9 Probability range of modification of limiting conditions with time

In our rapidly changing society the prediction of the limiting conditions - which I mentioned as an example - for future ten or fifteen year increments of time is one of the most essential problems. In view of the uncertainty which besets such predictions, continuous up-dating with reality is necessary in order to be in a position to review, at an early enough time, our goals whenever we observe deviations from our predictions.

3. Goals of a European policy in the area of technological development

In keeping with the thoughts explained initially I am viewing the goals to be achieved by a policy for technology to be those who require the tool of existing or to be generated technology, i.e. goals which impose demanding tasks upon technology in order to be realized.

Already today there is quite a number of recognizable goals which have become obvious more or less on the basis of the observation of negative symptoms and of difficulties.

3.1 Goals recognizable today

3.1.1 Improvement of Traffic

Attempt at optimizing road-bound, track-bound and aerial transportation systems.

3.1.2 City Traffic

It is necessary that traffic within the cities must be oriented towards new solutions.

3.1.3 Telecommunications

Priority must go to the urgent improvement of telecommunication systems within Europe and from Europe to the rest of the world.

3.1.4 Effects of Increasing Productivity

The means and goals needed to improve the productivity of manufacturing, a subject which I have not touched upon, lead to increased sharing of work within Europe and pose additional large requirements upon the infrastructure which must be planned well ahead of time.

3.1.5 Substitution of Natural Raw Materials

In view of the short supply of raw materials in Europe we must set goals which increasingly replace the vanishing natural raw materials with artificially produced materials.

3.1.6 Production of Energy

The search for more efficient production of energy must be increased not only in order to meet the coming shortages but also in order to assure greater independence of the community from political changes.

3.1.7 Improving the Quality of Life

High priority goals are all developments which lead to an improvement of the qualitative conditions of life, the so-called quality of life, which is not necessarily the standard of living. What I am primarily talking about are the new technologies which help to maintain or improve our environment, including new ways of housing also in the direction of mobile housing. Last but not least, this question involves the achievement of an optimum balance between private individual demands of the inhabitants of our Europe and the demands of society for improved quality of life.

3.1.8 Assurance of Military and Consequently Political Independence

In spite of all plans to improve the structure of Europe we must not forget that the development of modern weapon systems which are designed to assure the economic, political, and military independence of Europe also yields technological progress and that this progress must be included in our considerations.

3.1.9 Export of Technology and Software

Europe should set for itself the goal that its strong technological position should be so expanded that the export of software and technology takes the place of the naturally declining export of hardware products. This involves service to third countries to an increasing degree. In the long term the goal must be to achieve a lead in this area. It is to be expected that the real future level at which competition will make itself felt will be this level of software.

3.2 Method of Planning the Targets

In an attempt to define targets in the sense of this paper, the following must be considered:

- The large number and variety of variables.
- The necessity for careful assessment of the band width of probability during the evolution of those variables in the future.
- Economical, political, and sociological modifications in the various multifaceted regions of Europe.
- The fact that the individual human brain is not capable of grasping the interrelationship of all these variables and of their own variations and of the resulting inescapable dependence of individual decisions upon the entirety.

The only method available today to deal with these difficulties - particularly in view of the great sensitivity of the European economy and European life to wrong decisions -

is the methodology of long-term abstract planning with modern, mostly mathematically based methods of prediction. The methods developed during the two last decades in the area of military and economic prognostication are so refined today that they can be used as reasonably solid basis for the definition of future goals and as decision criteria - provided that they are used carefully and professionally.

Only through these methods will it be possible to take the ever increasing interrelations between the economic areas of Europe into account, interrelations which have existed for a long time but the extent and importance of which was hard to identify. They will get stronger as time goes on.

Planning within Europe is rendered more difficult by the very substantial differences in the degree of industrialization and therefore the physical living standards of the population between the various economic areas. The goals to be set are strongly influenced not only by world-wide contributing conditions but also very much by the necessary creation of a European economic community. In addition, these goals are very much subject to required structural changes and the necessity of a slow but steady increase of the standard of living particularly for those marginal areas which, due to their natural environment, are less suitable for a highly industrialized society.

We must never forget that the European problem of planning for the future and planning for the maintenance and improvement of our quality of life is a much more difficult problem than it has been for the three other large centers of power mentioned earlier. In view of our poor raw material base, of the development of our population, and of the financial demands which are placed upon us from many other parts of the world because we are a highly industrialized country, and which take the form of development help or whatever other name you wish to give it, in view of this our planning must be much more detailed and much more carefully executed. We can no longer afford the luxury of the "laissez-faire", we can no longer believe exclusively in the dynamics of free enterprise and for us in Europe the principle of "trial and error" would very soon lead to collapse because our material resources and the time we have available are not sufficient.

3.3 Teams for Target Planning

The question now is who should do the planning for these targets and how such planning can be conducted on the basis of presently available experience.

Experience shows that good planning in the sense described above is only possible by large teams concentrated in one place and equipped with all modern tools. These teams must not only consist of members of the large number of institutes who primarily describe and analyze existing conditions. They must primarily be staffed with creative and constructive scientists, engineers, and sociologists. In addition to their special areas of knowledge these men must be trained in modern methods of abstract planning. Furthermore, they must be personally prepared to smoke out the necessities and possibilities of future developments cooperatively and through the use of modelling techniques. Above all they must not become victims of the fascination of today's or conceivable future technical possibilities. Figures and numbers is what they must be interested in, even if the end result of their work is only a statement of probability. Such a statement is always a better decision maker than pure intuition. However good a product, if it is asked for at the wrong time - mostly too early - it is a wrong goal. What I am talking about is fundamentally a sober, mathematically supported creative task using abstract methods.

These teams must be staffed internationally from the very beginning and must be selected from the point of view of supranational thinking. Society should try to create several such international centers and to endow them competitively with the same tasks.

3.4 Target Planning at the Level of Decision Making

For the future it is of primary importance that the decision making level, e.g. the European governments, equip themselves as contracting agencies with a sufficient number of such experts who would be capable, along with the required personal and political engagement, to give these teams the right subjects to work on. Alone or together with the teams they should moreover have the capability to recognize the validity of the input data into the models. In order to achieve this expertise at the government level, Europe should strive for increasing mobility of personnel between industry and government as it is for instance practiced in the USA.

4. Means of a European Policy in the Area of Technological Development

I have pointed out several times that an effective means to achieve technological progress is through building the hardware to fill requirements derived from European goals. Along with this as a means there is also the need (4.1) for a lot of previously discussed proposals, measures and institutions. In order to be realized, these require such long spans of time that they cannot be considered a prerequisite for European action.

Examples are for instance:

4.1.1 Documentation

Creation of European central agencies for collection and evaluation of existing knowledge and experience at the broadest level, one of the most cost-effective means for the creation and maintenance of technology.

4.1.2 Patents

Creation of a European patent law and patent office.

4.1.3 Funds for European Projects

For the financing of studies aimed at setting goals and tasks, budgets are to be set up by the community. A technology fund should be established to reduce technical developments to practice at the European level or special European credit institutes or guarantee systems should be created, whose task it would be to finance European development projects involving high risk.

4.1.4 Standardization

A schedule for standardization of dimensions, quality criteria, materials and many other items should be established as soon as possible.

4.1.5 European Companies

The increasing size and shrinking number of individual future projects as well as the increase in the number of projects conducted within European industrial groupings require international mergers in order to be postured for the future competitive situation of Europe in the world. An enforceable schedule for the creation of the necessary tax and economic legislation should be established even though, from industry to industry and from product to product, the situation and urgency may vary.

4.1.6 Support of Mobility of Personnel

I have already mentioned the necessity for increasing mobility between the working level, i.e. the industry, and the decision level, i.e. the government. But we also need to make the mobility of experts and their families from one country to another more attractive. Declarations of principle will not help, only clear legal agreements. We cannot wait for a lot of bilateral agreements.

4.2 Goals to Achieve

There is one step that can be taken as soon as the targets are identified and which is not tied to any other prerequisite: it is the establishment of demanding requirements by the European community. Based on predictions and desired goals, a requirement for the realization of the technical means must be found through which the goals can be reached. It is a fact that the state of art in the world has advanced to the point where, given enough resources, almost any tangible and economically reasonable task can be achieved today without the requirement for large additional inventions. Therefore, the establishment of requirements for new developments has to be performed with particular caution. Already in the phase of translation of abstract target planning into requirements for technology, already in that phase the cooperation of scientists and engineers is required. Only in this way those requirements which are needed to achieve the target plans can be so defined that progress in technology is achieved in the process of reduction to practice.

4.3 Working method and organization of development

Already in the definition of the requirements, the entire width of today's technology must be considered. When solving the tasks thus established, this is even more so - for instance in preliminary design, in design itself and in the creation of hardware. The time of stepwise progress by inventions has long since gone away. It has become a steady process which keeps accelerating more and more during the last decades and, as mentioned before, already shows certain saturation symptoms today.

This causes urgent questions regarding the optimum way in which the people solving the problems should work, how they should be organized and, last but not least, how they will be motivated. If we review the teams which, at one time or another during the last decades, have come up with important solutions we notice time and again how fast stagnation of the creative capability of such teams follows after the conclusion of the specific task, except if a new challenge by a new task follows on the heels of the last one.

An analysis of this phenomenon suggests the search for organizational and working methods which would exclude such negative consequences. The basic principle of such an organization is a development center which works on the basis of a matrix between technical staff and project-oriented departments. A multiplicity of different but technologically similar tasks is given to this entity and leads to continuous motivation and mutual stimulation of the entire crew. Such a crew which is oriented towards the solution of extremely demanding requirements must never fall below a critical mass of broad technical knowledge and of inspiring assignments and the size of this mass must be continuously surveyed regarding its manageability. The minimum activity in the solution of large tasks, based on experience, involves several thousand people.

4.4 The Role of Competition

There is no question that man is inherently lazy and that we must, therefore, support the concept of competition. Nevertheless, in looking into the future in the light of many the statements made above, the question does arise whether the unlimited competition which heretofore has been the decisive factor in our standard of living will still be supportable to the present degree.

The saturation symptoms of highly industrial societies which show up in many different forms in our present European life and its technical elements, could militate against unlimited competition because existing technology can satisfy almost any sensible requirement and particularly because of the specifically European weakness in raw material and financial resources.

Perhaps this question can be illustrated by looking at the industry in which I am personally working.

It seems obvious that the European economy can afford a transport vehicle like the European Airbus with its high development costs and start-up costs only one at a time in each period of time. Also it cannot afford two specialized teams and the continuous maintenance of their capabilities who would both be able to develop airplanes the size of the Airbus, airplanes for which new requirements appear but once every 10 to 15 years. Continuous employment based on such individual tasks - and this is part of the saturation process already mentioned - is simply not possible in view of the great difference between development time (4 - 5 years) and the life of the system (15 - 20 years). The road has led us and continues to lead us quite inescapably in the direction of cooperation across the present borders between the economic regions towards joining of development capabilities and beyond that, in future, towards the possible utilization of specific technical skills of development teams for different related products, properly phased in timing. But how should we then be sure that we maintain the necessary degree of competition?

The answer is that wherever cost and development time forbid comparison of prototype performance we must place the competitive activities of such tasks into phases of development in which our European economic resources still permit competition. By this I mean the study and project definition phase which follows after the establishment of requirements. During these phases the essential characteristics for the development of the project are fixed. The design solutions and the resulting technological progress falls out from this activity. As a result of the continued development of the industrialized society, competition has more and more shifted into the area of the paper and laboratory and software phases, phases which comprise as a maximum 10 to 15 % of the total development effort.

Summary

Many of you may feel that my comments up to this point may have been too abstract. They are based, however, upon working for the last 20 years with a large number of people in successful software and hardware activities. I have attempted, therefore, to show the fundamental logic and interrelation which is involved in the subject of my speech: the goals and ways toward a European policy in the area of technological development. In my view the essence of my comments is the following:

Engineering is a servant. Its tool, technology, can only be developed further by challenges coming from society.

Challenges from society to engineering are requirements which have to be developed so as to satisfy the goals of the European society.

These goals can only be established through the methods of abstract planning because our European community is so complex, because the interactions are so intransparent and because there are such long periods of time and such a high degree of multiplicity involved.

The capability to work with these abstract methods is not widely available within the industry. Also in the governments there are, until now, only few men at work who are familiar with these methods.

Along with the problem of how to maintain motivated teams who are continuously kept at the highest possible technical level, I also arrive at the inescapable proposal that the formation of large European study and development centers in the most important economic regions and for different technical areas should be furthered and perhaps even initiated. This road can only be gone by way of joining industrial interests across national borders.

It is perhaps an unusual conclusion that software activity will lead to a concentration of mental capabilities - by this I mean appropriately capable people - within Europe. This

concentration, however, must take place in centers who must not be self-serving European institutes but living teams who are deeply involved in internal and external competition, who are managed according to economic principles and who are supported by their own manufacturing facilities and experience.

Manufacturing itself is more easily spread. Experience has shown that it is possible to bring the manufacturing task to the people in a well organized way. This is particularly true when we think of the areas around the edge of today's European community.

Based on my many years of experience I believe that these findings concerning European industrial cooperation in development and production can be reduced to practice. This will require a phased approach and a solution to legal problems which still exist. All this is possible if prestige thinking, narrow vision and the urge towards popular appeal are overcome and if broad long-term goals are recognized and requirements are defined which can then be solved by the unified and - given enough time - restructured European engineering community. If we succeed in proceeding along these lines we no longer need to doubt - in view of European creativity - that engineering can be a servant of our European society and that technology can go forward.

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OBJECTIVES AND METHODS OF A EUROPEAN
POLICY FOR TECHNOLOGICAL DEVELOPMENT
- WITH PARTICULAR REFERENCE TO TRADE UNIONS

1. Objectives

1.1. Need for a common EEC policy

At their summit conference in The Hague in December 1969, the EEC member countries' heads of government and of state expressed the intention, among other important resolutions, to bring about a rapid and substantial expansion in the influence enjoyed by the Six in the field of science and technology. National programmes for research and development were to be compared with each other in order to establish criteria for future co-ordination and co-operation. The scope for collaboration in specific technological areas was to be examined, and a Community information system set up. Finally, steps were to be taken to encourage the training and exchange of scientists and technical specialists within the member countries.

The Community's previous experience with joint activities in the field of technological and scientific research and development having been less than encouraging, and Euratom - which could well have become the Community's technological centre - having failed to live up to its promise, the Hague declarations and resolutions gave real hope to all who felt responsible for the Community's strength and vigour. Sig. Spinelli, a member of the EEC Commission, aptly remarked that, following the establishment of the customs union and the common agricultural policy during the sixties, the key target for the seventies should be industrial, regional and technological policy, such policies being essential passports on the road to economic and monetary union.

The accession of four new member countries will be giving the Community an added influence, particularly through the technological capability of Britain. This is all the more reason for studying opportunities, institutions and procedures for scientific and technological collaboration, so as to pave the way for political decisions which should, in any case, not be unduly delayed.

1.11. Europe's position in the world

Though the economic balance between Europe and the United States has by now been completely transformed - and President Nixon's New Economic Policy of August 15, 1971, dramatically underlined America's fear of Europe's strength - the US technological lead over Europe nevertheless remains immense. Behind the US come, as industrial super-powers of great technological capability, Japan and the Soviet Union. Against all these keen or potential rivals Europe must hold its own - not by defiantly retreating within its own walls, but in open and friendly combat.

In the field of advanced - and highly capital-intensive - technologies, markets are no longer being contested by private enterprise firms. With direct government incentives continually multiplying, government prestige is also increasingly at stake. Since economic and technological competition and rivalry between governments or groups of governments may percolate into the political sphere and, in certain circumstances, strain international relations, this poses new dangers.

International co-operation remains least problematical in fundamental research, as well as in space and nuclear energy technology (both of which are extremely costly). The closer research and development gets to practical applications, however, the more intractable such co-operation becomes. These hidden dangers and obstacles can and must be overcome by means of a common technological policy, as those responsible for moulding Europe's future should constantly bear in mind.

1.2. Growth euphoria deflated

The idea that prosperity and progress can be measured only by high rates of economic growth has held the whole world in thrall too long. Power and national prestige have been gauged by the same yardstick. Even now, percentage increases and billions of gross national product are objects of international competition on an Olympic scale.

Slowly but surely it is being recognised, however, that both personal and national welfare and morale depend less on quantity of production and consumption than on quality. Modern welfare economics have already provided the theoretical framework for this new approach to economic management. The same trend of thinking and talking is reflected in the pun equating GNP with gross national pollution.

1.21. Janus face of technological change

Technology has eased man's life enormously. It has made national economies infinitely more productive, and brought the peoples of the industrial countries to their present level of material well-being. Yet the drawbacks of this "progress" have now become painfully apparent.

Motoring is no longer much fun for any of us. At the sight of our rivers, lakes and beaches, we are increasingly distrustful of advertising bent on making us "Whiter than White". Simple faith in progress, to which many still cling and which vested interests sturdily or subliminally defend, is in conflict with what still is, or has again become, a highly idealised resistance to technological change. It is not only the younger generation that questions the performance principle by which the western world has been guiding itself and others since Calvin. If earlier it was the dread of the machine - that monster to which men's lives ("compromise spells death") and jobs were sacrificed - that dominated people's lives, it is now the fear that their biological environment will be destroyed by technology. And this fear is more justified than the

dread of the consequences of rationalisation. Sober-minded academics meeting in the "Club of Rom" have only recently, with the aid of the computer, demonstrated to us the "Limits of Growth".

1.22. Disparity between private and public needs

Nobody today doubts any longer that economic activity so far has been unduly preoccupied with stimulating and satisfying private and personal needs. This was the only attitude which liberalism, the western world's dominant economic and social philosophy for the past 200 years, could be expected to produce. All that goes under the heading of infrastructure has been notoriously neglected. If the least affluent suffer most, public poverty depresses the living standard of us all. In order to bridge the yawning gap of investment in the public sector, all of us will in future have to make heavy sacrifices. Trade unionists can only hope and pray that this shift from private to public consumption will not be at the expense of the less well-off.

1.23. Economic management gap

Whereas earlier stages of economic development were concerned with the most efficient allocation of the abundantly available raw material resources, which then had to be amplified and converted by way of production and investment into manufactures, the need now is to create a more enlightened and responsible economy. Today's bottleneck is the management gap. The economy cannot be left to its own devices. The invisible hand, credited by Adam Smith and many of his followers with a magic power of enlightened benevolence, ceases to work in the face of the complexity of modern industrial societies. In capitalist systems it is unable, above all, to produce an equitable distribution of income and wealth. Meanwhile, the countries of the west have evolved into mixed economies, where planning is no longer deemed to be a sin against the holy spirit of capitalism.

A policy for technological development can only be conceived and implemented through planning. It is due not least to the absence

of consistent planning that the EEC has achieved so little in this field over the past 15-odd years. How this failing might be remedied we shall endeavour to show below.

To avoid any misunderstanding - it is not our purpose to call the economic system into question. Planning, economic management, the market and competition are seen purely as a means to an end.

1.24. External effects and social costs of production

New production techniques have increasingly led to external effects, notably by impinging on the natural environment. The result of these external effects is that the cost-benefit calculations of private interests and those of the public interest no longer coincide. Price ceases to be the effective market regulator. This disrupts the allocation of resources, and so may impede growth. Finally, interference with "free" commodities like water, air, quietness and relaxation is detrimental to personal welfare. Already the social costs of these aberrations are almost immeasurable.

Ways and means to (re)internalise such external effects must therefore be found with the minimum of delay. This can be done, of course, only by a system of legal sanctions imposed on the perpetrators of social costs. Purification plants for industrial effluents can hardly be financed out of taxes paid by the workers.

1.25. Technology no end in itself

All ideas and measures of technological development should be based on the principle that technology must not be an end in itself or degenerate into a giant toy of "technocrats".

The technostructure so penetratingly described by Galbraith - which, divorced from the normal disciplines both of democratic processes and of industrial ownership, is claimed to be already in control of the social and economic system of western countries -

ought to have no future in the kind of Europe that we should like to see. Those who design and operate technology should know that their job is not to rule but to serve. The primacy of Parliament, representing and responsible to the will of the people, must not be questioned. Any attempt to form an alliance between industry and bureaucracy in the interest of "technical progress" and "industrial expansion" will meet with the suspicion and resistance of organised labour.

1.3. Quality of life

It is more than an accident that I.G. Metall, the free world's biggest trade union, has just held a major international conference which took "The quality of life" as its theme. Now that our trade unions through their tireless efforts have won for their members a certain measure of prosperity, this is indeed a question which is becoming of central importance. Increasingly people are looking for the values behind the shiny material façade. Freedom, justice, security and fellowship - these are surely the basic values underlying our system of social standards. Since every policy has to set agreed standards of conduct if it is not to degenerate into government by executive fiat, we think that it is by such values that a European policy for scientific and technological development should also, and to a special degree, be governed. Only thus can the authorities prevent the people of the ten countries and their organised representatives from becoming suspicious of "Brussels", or already existing resentments from hardening into downright opposition and so perhaps impinging on political decisions taken at home.

1.31. Ecological balance seriously threatened

When eminent scientists, whose job requires them to keep their imagination in check and to rely wherever possible on measurable and verifiable facts only, see a growing and, at least in large cities, a serious danger to human life, the time is past for crying wolf. Fortunately, the problems of the environment have penetrated so deeply into the public consciousness, and the basic facts and prospects are so widely known, that there is no need to rehearse them here yet again. It should, however, be stressed at once that trade unions expect the Community institutions to take rigorous steps to protect the environment. Where biological survival is at stake, advice and statements of intent are not enough. Pollution is supranational to such a degree that the case for Community action is automatically made out.

1.32. Self-determination vis-à-vis technical bureaucracy

In a world of freedom and democracy, man is entitled to resist every external compulsion which is not specifically designed for the protection of the individual and for the viability of the social system of which he forms part. In fact, such compulsion is being exerted increasingly by the technical and bureaucratic machine - a machine which, though essential to the continued existence of our civilisation, should not make man its slave. Man must be able to keep it at a distance. But he must also be given the opportunity to shape it to his needs - not just sporadically at, say, election times or when new technologies are introduced, but on a permanent basis.

Those who earn their bread by work ought no longer to allow themselves to be treated by technical and government agencies as an object. These agencies were invented and instituted by men and for men, and so they should remain. If they have become something else, they should be restored to their original function. Those who work in and for them ought not, like an elite, consider themselves a cut above the rest of us.

1.33. Participation in all relevant decisions

The principle of participation in decision-making, or co-determination, may be formulated by demanding that decisions concerning people should never be made without those concerned having an opportunity to share in those decisions. In a democracy this principle is, as far as political decision-making is concerned, a reality. Industry, however, is still largely ruled by autocracy despite the fact that its decisions deeply and ceaselessly affect the daily lives of its workers. If the prime need of the future is to safeguard and improve the quality of life, the worker's participation in decisions concerning particular jobs, corporate strategy and economic management can no longer be denied. Co-determination, as successfully practised by West Germany's trade unions for the past two decades, also expressly involves co-responsibility for the social and economic system. It acquires an added value at times of rapid and decisive technological innovation.

1.34. Removal of hierarchies

Historical experience, social research and every-day observation demonstrate that power structures devoid of purpose or lacking in justification sap the will to work, sharpen social tensions, and thus ultimately impede economic growth. Conversely, of course, team work, managerial functions exercised for a limited period, even the election of superiors from a number of equally qualified persons are apt in a high degree to be efficiency-promoting, particularly as far as scientifically and technically sophisticated activities are concerned.

Given the present and, in future, doubtless still greater degree of specialisation in all fields of activity, and especially in that of advanced technology, the days of the (ostensibly) all-knowing and all-powerful "boss" are certainly numbered.

When a common industrial and technological policy comes to be devised, these things should be carefully borne in mind. After all, even the most modern technical equipment yields the desired benefits only if it is combined with the best available human know-how. There is much evidence to suggest that the human role in research and development, in technological innovation and diffusion is becoming progressively more important. Giving the human "factor of production" the attention it deserves is therefore clearly in the interest of those anxious to work for (and naturally also to benefit from) Europe's future development.

1.4 Trade unions and technological change

The workers' movement is an offspring of the factory. Ever since they appeared on the scene a hundred years ago, trade unions have had to come to terms with what is now known as technology. From the machine wrecking of the Luddites in England and the weavers in Silesia to the training of technical specialists in trade union colleges has been a long way. Even so, the attitude of manual and salaried workers towards technology is still pervaded by hidden fear and manifest suspicion.

1.41 Job security

The chief aim of every trade union organisation must be to assist in implementing the right to work. Anyone able and willing to work should find a suitable job. In the scale of economic objectives, trade unions give top priority to full employment.

It is therefore understandable if trade unions seek to ensure job security with all the means at their disposal. The political and contractual instruments available for this purpose are, as everybody knows from personal observation, extensive and far-reaching.

Those charged with seeking to promote Europe's technological and economic strength should take this responsibility, imposed on trade unions by their members and by the entire working population, seriously to heart.

1.42 Equitable distribution of income and wealth

The workers' movement is a reaction to the wage suzerainty of the employers. By means of collective bargaining and wage settlements between autonomous groups of workers and employers free from government direction and leading-strings, it is hoped that the tendency for the national income to be distributed solely in favour of the owners of capital will be corrected in such a way that the workers do receive their fair share of what they have jointly produced. The old argument about what is a just wage cannot be resolved by economic theory. It has to be settled by political, including if necessary strike, action.

Every investment and every innovation, if properly costed in relation to its benefits, increases the earnings potential and profits of the organisation in question. Government subsidies for research and development invariably improve companies' market positions and earnings. Hence, in issues affecting the distribution and application of the proceeds of modern technology, trade unions will stake their claim. No European wages policy yet exists, but it will probably have to come sooner than many still think. Multinational companies and groups will, as their influence continues to grow, be its midwives.

Development of a common technological and industrial policy in the EEC will also give a fresh fillip to the debate about worker participation in company assets. For all their differences of opinion concerning details, trade unions will not stand idly by indefinitely while jointly produced increments in company assets continue to accrue to a tiny class of shareholders only.

1.43 Control of economic power

The workers' movement was formed as a counter-weight to the employers' power. Economic and hence political power is, as it always has been, based on the ownership of the means of production - a fact which one can quite properly assert without being a dogmatic Marxist. Industrial concentration, which derives much of its momentum from technological change and technical innovation, necessarily leads to a concentration of power.

Trade unions, vitally interested in promoting democratic conditions in all spheres of life, and fearful of the checks and balances so essential to the democratic system being eroded, are demanding that economic power be controlled. As they set about strengthening the world influence of the Europe of the Ten through concerted measures in the technological field, the Community authorities would do well to keep this matter of economic power under close scrutiny. In this, trade union encouragement and criticism will not be lacking.

1.44 Social innovation

Workers and their unions have long been waiting for genuinely impressive signs of Community progress on the social front. To secure their fullhearted commitment to the Community, free movement of labour and the (all too laborious) evolution of the EEC Social Fund are not enough. Even committed unions would be disappointed if the massive official encouragement now being planned for research and development and for science and technology was to be unaccompanied by systematic social innovation. Indeed, they would like the latter to keep a clear step ahead of technical and scientific innovation at all times.

If European workers have become more aware of the problem, this is due not least to canvassing by the New Left, which has again, to a greater extent than only a few years ago, called the purpose and direction of "progress" in question. Beyond the claim of an increase in the general standard of living, the EEC has so far little to offer

in reply to critics of a "Europe fit for capitalists". Within the programme of more or less articulated EEC policies, the part of social policy has still to be orchestrated from scratch. No time should be lost in adequately filling the gap.

1.5 General aspects of a European technological policy

1.51 Technological and social development

An EEC Commission document on scientific and technological research and development, dated November 11, 1970, includes the following striking remark: "Pollution of the social atmosphere is no less dangerous than ecological pollution." This exposition of the danger threatening the natural environment needs to be expanded to the effect that all expenditure of mind and money devoted to scientific and technological development is futile if it does not take account of social realities. Every decision and measure taken in the economic and technical field has social repercussions which are not necessarily beneficial and according to plan. They are made up of countless individual responses of people whose lives are indirectly or directly affected by technological change.

Trade unions should insist that the EEC institutions, when working out a common technological policy, pay more attention to the social aspects than their official pronouncements have so far indicated.

1.52 Trade union participation in planning and decision-making

The Community institutions have recognised the trade unions as partners, if not yet to the extent that the unions would like to see and that might be helpful to the Community itself. Now that European development is being carried a stage further, and powerful and determined unions are about to enter the enlarged Community, it is essential for the great majority of the population, represented by organised labour, to be able to play its full part

in all phases of discussion and decision-making. Opinions and comments expressed by the Economic and Social Committee cut too little ice. Sporadic representations on question of detail and occasional meetings with heads of the Brussels civil service are not enough. Negotiations between experts often lack political backing.

New ways and means must therefore be found to involve the trade unions much more closely in the formulation of European policies than hitherto. Through their European secretariats, and through persons appointed to liaise with the national authorities, the trade unions' readiness to co-operate has also for some time past been demonstrated in institutional terms. Co-operation demands information, however, and here, it must be said, trade unions have cause for complaint. The flow of information is too dependent on blind chance and personal contacts. Nor does it help if it is supplied from national rather than Community sources.

If the trade unions' demand for more information and participation does not fit into the framework of the existing legal provisions, then those provisions should be adapted accordingly.

1.53 Community initiatives

Declarations concerning the Common Market's evolution into an economic and monetary union will remain empty words in the absence of effective Community initiatives. The driving force must, as hitherto, be the Commission. The Council of Ministers - mindful of the Hague resolutions of December 1969 and of numerous statements of intent by the national governments - should abandon its all too tentative approach and actively seek to expedite matters. Administrators and politicians should listen more attentively to the views expressed by the consultative bodies, whose frustration and Europe-weariness might otherwise proliferate, thus causing a potentially invaluable channel of communication between Community and member

countries for ideas and practical experience to be lost.

The Community institutions should latch on to any progressive initiatives by member countries and seek to make them binding on the Community as a whole. It is a matter for concern to find the Commission objecting to West Germany, after an extended transitional period, substantially reducing the lead content of its petrol. Could it be that the powerful oil lobby, having failed to influence legislation at the national level, has had something to do with this? In any case, let us hope that the incident is not typical of the attitude of the Brussels authorities. Talk about initiatives for environmental protection might otherwise be hard to take seriously.

Enjoying the backing of European public opinion, the Community's planning agencies can well afford to strike out boldly. For example, they should not allow resistance from industrial interests to deter them from insisting that manufacturers should be considerate of environmental factors. Appeals to technical obstacles should be clearly exposed as pretexts. If the Treaty of Rome is no longer equal to the increasingly pressing problems that face us, the Commission can always invoke Article 235, authorising it to intervene in fields not elsewhere specified. Besides, the European treaties are not divine tablets; they were certainly never intended by their authors to stand in the way of progress. So if, through the pressure of events, the letter of the Treaty no longer matches the reality of the situation, then the legal provisions on which institutions and procedures are based must courageously and constructively be brought up to date. The need for such updating is presented by science and technology daily. Hence the possibility, if not the necessity, of revising the 1957/58 Treaties might appropriately be included among the subjects to be discussed in connection with European initiatives in the technological field.

1.54 Co-ordination and harmonisation

For each of the six, and soon ten, member countries of the Common Market to go it alone in developing and encouraging advanced technologies seem impracticable on the grounds of costing and financing alone. Yet the fact remains that expensive projects are being pursued in a number of countries concurrently. National ambitions and rivalries are evidently not easy to eradicate. Sensible Community action nevertheless requires a maximum of co-ordination and joint effort. The European taxpayer, regardless of where in the Community he may live and work, has the right to demand that money collected from him by the government should be spent as economically and usefully as possible. Thus, if simple calculation shows Community investment in encouraging science and technology to be appreciably cheaper than national egocentricity, the case against Community projects clearly falls to the ground.

The establishment of uncomplicated but effective procedures for member countries to consult each other on all major current or planned projects of technological research and development, as well as on their practical application, is therefore now a primary prerequisite. Both the Commission and the Council of Ministers should be given access to all relevant information emanating from the member countries.

In the light of such information, the necessary next step is to set about deciding whether this or that project should be undertaken by the Community itself or jointly by a number of national entities. In this as much neutral know-how should be involved as possible. The word of independent experts ought to carry more weight than the voices of national interests, whether officials or industrialists.

1.55 Equitable distribution

Official statements about government encouragement of research and development hardly ever concern themselves with the effects of

its distribution. Evidently it is felt that government aid for projects calculated to raise economic efficiency will directly or indirectly redound to the general good. This is a view to which trade unions cannot subscribe. Since the means for strengthening the earnings potential and market position of companies or entire industries are provided willy-nilly by the general public, it is not unreasonable to ask that the general public should also enjoy the fruits thereof. The aided firms could and should in turn be made by the exchequer to honour certain commitments - which could range from price restraint to profit-sharing - designed to prevent a comparatively small class of shareholders from additionally enriching themselves out of their companies' official subsidies.

1.56 Disclosure

As essential element of a European policy for promoting technological development is that all plans and projects should be disclosed. The public has a right to know for which purpose and to what extent public funds are provided. Arguments stressing the need for confidentiality should not be taken too seriously. In any case, a wide circle of representatives of the public interest should be kept continuously informed about all details of the technological policy as it develops. Suitable candidates for this are the European Parliament and the Economic and Social Committee, which could also decide on projects to be treated as secret or confidential. Anyhow, decisions concerning the degree of disclosure should not be left to governments, let alone the aided companies or other institutions.

1.57 Competition and concentration

The industrial policy which the Community is hoping to launch, and which is now to be supplemented by a technological policy, is stated to aim at the creation of efficient industrial units capable of holding their own in world markets. Now efficiency is not necessarily synonymous with size in the quantitative or

numerical sense; examples of strongly placed small and medium sized firms abound. Very often, however, market strength can only be attained and held through structural concentration, and this is where the problems start. What is harmless or even necessary in the supranational and world market context may, and sometimes must, turn out to be anything from market domination to downright monopoly on the home market. Even though the old textbook belief in perfect competition and its alleged blessings has nowadays given way to a more realistic preference for "workable" competition, champions of a free social and economic order are nevertheless bound to ask themselves how far concentration and economic power should be allowed to extend.

The treaty setting up the EEC is based on thoroughly liberal economic ideals. It therefore contains clear-cut provisions regarding competition and market domination, though their practical influence on the Common Market's steadily accelerating merger and concentration activity has been negligible. The competent Community authorities are now faced with the difficult task of keeping a careful eye on the process of concentration and of actively intervening wherever acceptable or desirable concentration develops into unwanted or dangerous market domination. Precisely where the line should be drawn, and how active intervention should proceed, is something about which in West Germany, in connection with the proposed amendment of the Fair Trade Restriction Act, men of learning, government officials and vested interests have been arguing, without reaching a political decision, all too long. It is much to be hoped that decision on a Community solution will be quicker in the making and result in clear-cut standards that can be enforced.

Failing this, and if the trend towards concentration and restrictive practices is allowed to continue unchecked or even officially encouraged, the basic question of whether the free market economy has made an utter fool of itself, and whether it should be

replaced by a system of democratically accountable state planning and direction, will arise in all seriousness.

Unchecked cross-frontier mergers and proliferating multinational companies and groups are also questionable from an economic and monetary point of view. Such structures can easily escape national measures of political regulation at present, and would be hardly, if at all, amenable to future intervention by the Community. This is a matter which the Community should not overlook when laying down articles of association for the new type of European company.

1.6 Focal points of the technological policy

1.61 Traditional activities

In the fields of nuclear research and nuclear energy, transport and communications, data processing, automation and numerical control, meteorology, oceanography, metallurgy and materials research the Community, aided by special institutions like the Joint Research Agency and especially Euratom, has already done sensible and, in the circumstances, reasonably useful work. Their future importance alone should encourage the Community to persist in these efforts. The need for early reform in the institutional framework of Community research will be demonstrated later.

1.62 New activities

From a trade union point of view one can draw up a whole catalogue of activities which the Community should take up if its technological policy is to make a versatile, integrated and efficient whole. The Commission has, of course, already indicated the additional areas on which it plans to concentrate shortly.

First and foremost, there is the problem of pollution. On this the Commission's ideas announced so far have our full backing. The same applies to the important statements made by its President,

Mr. Mansholt, concerning the future development of human life. Trade unions are most concerned that action in this literally vital area should be prompt and vigorous!

Education and industrial training is another important field which the Community should actively help to encourage. Together with the member countries' national authorities, it could set up model institutions free to conduct experiments which, if promising, could be extended generally.

Health and public hygiene are natural objects for Community-sponsored research and activity. Man's personal and working life is under such heavy stress, and diagnosis and therapy are still so little geared to the new health hazards, that the leeway which doubtless exists can only be made up by co-operation between all the institutions concerned. Industrial and social medicine have for trade unions a special importance.

Much of the Community's attention in implementing its technological policy ought to be devoted to labour market problems. Technical change will in future require of workers an even greater degree of occupational and geographical mobility than in the past. Preparing workers to participate in this change without incurring material hardships and without loss of social status will demand a great deal of research and practical effort. Nor should the challenging task of forecasting structural changes be overlooked in this connection.

A special aspect of labour market policy is encouragement of exchanges of scientific and technical personnel. The constructive work already being done by the Community in this field should be unstintingly expanded.

The Community should go out of its way to devise and test advanced new types of work organisation. There are signs that the young workers of today are no longer quite so content as their

fathers to work on an assembly line. Equally, experience shows such experiments in worker self-government as job enlargement and job rotation to be capable of producing surprisingly good results.

Here mention may also be made of the need to adapt technical equipment more closely to physiological factors. By taking a more active interest in this, the Community could also do something to repair its own, as well as most of its member countries', past errors of omission in regard to the social sciences.

Housing, town and country planning are fields to which not only environmental considerations but also research and development incentives will accord a special importance in the future. Technical change intensifies urban sprawl. A common technological policy must therefore include measures to deal with this problem.

Workers these days have a legitimate interest in greater social security, protecting them from the major hazards of life like sickness, disability, old age, unemployment and death. The Community, having done little or nothing on this front to date, must now seize the change of making up for lost time. When some countries with very advanced systems of social security shortly join the Community, they will not be impressed to find something like a vacuum within the Europe of the Six.

In response to the continuing trend towards more participation, co-partnership and co-determination of workers and their unions in economic and social affairs, the Community should develop its own models for co-determination and throw them open to discussion. Such discussion - which could be heated - will show whether our social and economic system is capable of reform and self-regeneration, or whether it is prepared to suffer social tensions which could make its planned place in the world well-nigh unattainable.

Finally, the Community should try and work out a system of social statistics. OECD, basing itself largely on pioneering work by Britain and the United States, is now seeking to supplement the already existing economic by a "social" system of national accounts.

European workers and their unions would have their commitment to a unified Europe greatly strengthened if the European institutions fitted the programme of action briefly outlined above into their own policy for technological development. In doing so, they would help to dispel the still valid suspicion that industrial and technological policy is intended to be nothing but a more imposing version of earlier appeals to self-enrichment. Technological excellence and satisfying social conditions should not exclude each other. On the contrary, they could and should be complementary.

2. Methods

2.1 European Research and Development Council (ERDC)

Bearing in mind the fragmentation of responsibility between different institutions, the failure of the Joint Research Agency, the complete ineffectiveness of the "Scientific and Technological Research Policy" Committee, and the notorious difficulties over Euratom, there is much to be said for the Commission's proposal to combine all relevant activities of the various Community institutions - except Euratom - in a "European Research and Development Council". It is welcome that, besides officials and experts, this body is also to include representatives of the two sides of industry.

All now depends on providing ERDC with comprehensive terms of reference to monitor and plan research projects within the Community arena. Trade unions would like even now to express their readiness to co-operate in the proposed council loyally and

constructively. They basically agree with the ideas formulated in the Commission's draft of November 11, 1970. Above all, they trust that ERDC will not be set up as a purely bureaucratic institution which, like many others of its kind, would be closed and clumsy.

There is no objection in principle against the idea of simplifying the administration of research and development incentives by means of a "European Research and Development Agency". Whether the measures taken by such an agency would be sufficiently open to public scrutiny would depend on its constitution.

2.2 Euratom

In theory, Euratom is the institution in which all scientific and technical activities - first in the nuclear field, but subsequently also in all other areas of advanced technology - could best have been centralised. Unfortunately, this has been thwarted by national rivalries and frequently overlapping military and industrial interests. The indecision of the Council of Ministers, the feeble authority of the Commission, and bureaucratic red tape in general have sealed this European institution's sorry fate.

There remains the hope that the Community's precarious energy supply position may give Euratom a new lease of life. One fruitful field of activity could be the construction of nuclear reactors. Another might be co-ordination of research.

2.3 Environmental Research Institute

This brain-child of the Commission should soon be a reality. The institute ought to be largely autonomous, with a budget and staff sufficient to enable it, as European research centre for a field of critical importance, to become the hub around which all associated activities revolve. On an advisory board or governing body social interests as well as scientific experts ought to be adequately represented.

2.4 Central Office of Information and Documentation

The Central Office of Information and Documentation already harbours an enormous computer-fed wealth of documents from the nuclear field, together with an efficient retrieval system, on which outside specialists are drawing increasingly. It could well be expanded into a comprehensive system of scientific and technical documentation with appropriate data bank. Through exchange of information it could also give a powerful impetus to integration. Community money allocated to its diversification would be well spent.

2.5 Consultative bodies

Besides forming new, or reviving and strengthening existing, official Community institutions, the way should be left open for supporting the EEC authorities with ad hoc consultative bodies, where European expertise in promoting research and technology could be mobilised as required. Such bodies, assigned to ERDC and other institutions, should have no political power, but act in a consultative capacity on scientific matters. They should naturally have set terms of reference, but procedure should be left to their own discretion.

2.6 Independent research institutes

All Community departments concerned with technological problems should seek and maintain close contact with universities and non-academic research institutes, such as the French Conseil National de la Recherche Scientifique and the German Max-Planck-Gesellschaft. These have a formidable concentration of knowledge and talent in the most diverse subjects from which the common technological policy can benefit.

At the same time, in many European countries the relationship between government, university and industry is no longer as easy as it used to be. Students and research workers are asking pointed questions about what and whom research is for. They are demanding, rightly, that research should acknowledge social obligations. The Community, by allowing its research and development policies to be guided by due concern for their social implications, could do much to relieve tensions and disputes.

2.7. Industrial companies

Companies, and industrial companies in particular, are subject to technical change regardless of whether they adopt, and in their production (and administration) apply, the research and development innovations of others or engage in research and development on their own account. It goes without saying therefore that the Community's technological policy must be based to a large extent on (industrial) companies.

As has already been repeatedly pointed out, however, neither the trade unions nor presumably the general public would stand idly by if, as a result of the common industrial and technological policy, the balance of bargaining, distribution and power - which in all market-oriented systems, and hence also in the Common Market, is anyhow disturbed and distorted - was to be shifted still further in favour of companies and against workers, consumers and government.

So far, statements by the Commission concerning the allocation of development contracts to industry have done nothing to allay the trade unions' misgivings. If, as seems reasonable, grants are related to earnings, it is imperative for companies unreservedly to open their books. Ideally, audits of company accounts should be conducted by independent bodies fully familiar with the "cosmetic" arts of industrial book-keeping. The extent of the charges to be borne by companies themselves would have to be clearly defined by the contract-awarding agency in terms of impeccable yardsticks.

Eligibility for grants should be scrutinised rigorously, including both the need, if any, for channelling investment into one sector of industry rather than another and the requirements of labour market policy. Independent bodies should also carefully check whether demand for the grant-aided companies' products will continue to be adequate. Might sanctions be applied against companies shown to have allowed grant-aided projects to founder through their own fault? In the absence of any guarantee that Community-assisted companies would trade fairly and with proper regard for the general interest, there is also a case for looking at the question of patent protection.

If the Community's limited funds are to be apportioned selectively and used in accordance with its long-range plans, it is essential that the initiative in giving research and development assistance should be left primarily to the Community's own agencies. Allocations of Community funds should, in the public interest, be properly disclosed. The final decision in all things must rest with the European Parliament.

3. Summary and prospects

The enlargement of the European Communities and the Hague resolutions provide a unique opportunity, historically speaking, for advancing the ten member countries' social and economic conditions in one burst. Failure to seize this opportunity would be deeply disappointing. Europe's future - from an economic point of view - depends on high-technology, highly sophisticated production. It is a legitimate aspiration of community leaders to seek, through well-directed public assistance, to secure for Europe a leading position in the world-wide competitive struggle of scientific and technological research and development and of its commercial use and exploitation.

This aspiration must, however, be pursued on a basis of democratic freedom unless man, the pillar of the social and economic system, is to be squashed by its technical and administrative

superstructure. The tools for preserving a society which makes life worth-while are self-determination and co-determination.

The observe of the technological coin was demonstrated to us with brutal force at the end of the period of reconstruction after the ravages of the last war. The need for developing - and financing - technologies to prevent or remove the harm to the biological equilibrium of this earth done by modern technology is, of course, created by pollution. The Community's willingness and ability to cope with these ecological problems will largely establish its right of existence.

Making European institutions and procedures more democratic must go side by side with spreading the fruits of government aids to industry through society. The European cause would be ill served if the only effect of the proposed technological policy was to reinforce the bargaining strength and economic power of industrial companies. The public has a right to be fully informed about how public funds are used; this applies equally to funds provided for research and development.

To translate the few points outlined in this paper (and capable of elaboration in detail) into concrete terms and into political and administrative practice will require rare courage and imagination. The Community's founding-fathers displayed these qualities in full measure, as even those to whom their philosophy - or ideology - was distasteful are bound to admit. The next generation of architects of a bigger Europe face a harder challenge - not only to forestall the threat to biological life, but also to do justice to the sharpened critical awareness of the man in the street.

The growth euphoria of the fifties and sixties is clearly fading. It is being recognised that personal and national welfare depends not so much on gross national product per head as on the social product's quality. Industrial and technological policy is

also social policy, i.e. social innovations are just as important as scientific and technological ones, if not more so.

Europe's democratic trade unions will follow the Community's future policy on technology with sceptical sympathy. They offer the hand of co-operation, but wish to be taken seriously as representatives of the Community's workers. They certainly do not wish to be a stalking-horse for others.

CONFERENCE
"INDUSTRY AND SOCIETY IN THE
EUROPEAN COMMUNITY"

REPORT N° 8

AIMS AND MEANS OF A EUROPEAN POLICY
ON TECHNOLOGICAL DEVELOPMENT

by
Sir Richard CLARKE

COMMISSION OF THE EUROPEAN COMMUNITIES

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AIMS AND MEANS OF A EUROPEAN POLICY FOR
TECHNOLOGICAL DEVELOPMENT

Report by Sir Richard Clarke

Personal Introduction

1. It is a great honour to be invited to contribute to the Venice Conference on "Industry and Society in the European Community", particularly because this is the first occasion on which British people are participating in functions organised by the Commission as full members of the Community family.

2. I am speaking as an independent person. I retired in March 1971 from the service of the British Government; and I am now working as a non-executive director of several industrial and financial companies all of which hope to exploit fully the opportunities for expansion and development presented by the extension of the Community to include the United Kingdom and the other new members.

3. My experience in the field of this Conference is as follows. In the first twelve post-war years, I was heavily engaged in the collective European enterprises to bring about European economic recovery and later to create a European free trade area as an extension of the original Community. I was chairman of the committee of officials in London which had the task of instructing our delegations in Paris, first in the sweltering hot summer of 1947 in the Franks Committee which formulated the European response to General Marshall's historic offer (which it was my privilege to put into language in the report of the Committee of European Economic Cooperation); then in the creation of O.E.E.C. and then in the division of aid and other operations of the Organisation.

4. Ten years later, I was again chairman at the London end of the negotiations in O.E.E.C. for a free trade area linking the Community of the Six, which was then being negotiated with

the other members of O.E.E.C. - a sadly missed opportunity, I have always thought, both by the British and by the Six, which if taken could have advanced European unity by at least 12 years. So I start as one who has had the exhilarating experience of work in European cooperation for great objectives, both when it has gone right and when it went wrong.

5. On the technological side of the subject of this report, I had nearly five years as Permanent Secretary - the top civil servant - first of the Ministry of Aviation and then of the Ministry of Technology, in which we were engaged in working out a policy for technological development for the United Kingdom; and much of this experience seems to me relevant to the problems of this report.

Technology as a Tool

6. Subject No. 8 of the Conference is important; for the extended Community must surely state its position about technology and technological development very definitely. We are now in a period in which technology is under attack. Technology is sometimes presented nowadays, indeed, as an ogre which is destroying the quality of life - polluting the air and the rivers and the seas, making our lives unbearable with petrol fumes and traffic jams and aircraft noise, adulterating our food and undermining our health. If one is to judge by the opinions of some of the scientists who speak on these matters, the only question left open is whether technology will boil us to death or freeze us to death. There is nothing unusual in these attacks. All of us can remember when technology has been the ogre that creates war. The older of us can remember when technology was the ogre which created unemployment. There have been periods also in which technology was presented as an angel, creating a miraculous cornucopia of goods and services, the driving power for economic growth and the increase in human welfare and the standard of living, and the only hope for both checking the growth of the world's population and freeing the people from poverty and early death.

7. Technology is in fact all these things and none of them. It is neither "good" nor "evil", neither "ogre" nor "angel". If instead of using an abstract word like "technology" one used practical words like "engineering" and "chemistry", the truth would emerge more easily. "Technology" is in fact a tool, which has no moral or social or mystical attributes of any kind.

8. When we talk about a "European Policy for Technological Development", therefore, what we have to decide is whether European Governments should have a common policy for the use and application (or for the improvement or suppression) of the tools of technology (i.e. engineering, chemistry, etc.). One cannot start by stating European aims for technology : one must start by saying what we want in Europe, and then go on to consider how the tools of technology can be applied to bring about our aims.

Aims of the Extended Community

9. We would all concur in two Community objectives :
- (a) economic growth - to increase the standard of living of everyone in the Community, taking this in the broadest sense of supply of goods and services, privately and publicly provided to individuals or to the society as a whole and taking into account overseas investment and our responsibilities to poor countries;
 - (b) the social objective of quality of life - the distribution of goods and services for the welfare of the whole community and the balance of freedoms and constraints to restrain some people's use of freedoms from damaging others'.
10. For (a), despite all the talk of an "affluent society", it is obvious that a great expansion of the output of goods and services in the next ten years is indispensable to satisfy the needs of our population. The increase in productivity (output

per worker) will be more difficult to get than in the last decade, with less scope for switch from low-productivity agriculture to high-productivity manufacture, and more movement to constant-productivity educational, medical, professional services. So the tools of technology will be as important as they have ever been : and this must come high on the European agenda.

11. For (b), we must certainly hope that Europe will devote more resources to the problems of pollution. The tools of technology are as important for this as they are for economic growth. The existing pollution cannot be remedied (cannot even be measured and diagnosed) without major application of the tools of technology. The prevention of future pollution is in essence the enactment and enforcement of laws (like the Clean Air laws in Britain if I may give an example) which are practicable in terms of technology, i.e. which do not present offenders with impossible problems; coupled with the improvement of the tools of technology to permit a steady increase in the standard prescribed by law.

11a. Another example from our experience in Britain is in aircraft and engine noise. For several years past, research to reduce noise has continued at well over £ 1,000,000 a year for work at Government research establishments (mainly the National Gas Turbine Establishment) and by manufacturers. Besides this direct research into noise, the British Government have financially supported the RB 211 engine, one of whose major characteristics is an exceptionally low noise level. One concept is to try, always ineffectively, to abolish aircraft because of their noise : the other is to enlist the tools of technology to make aircraft more silent.

12 The answer to the pollution problem must lie in the combination of enforceable laws with the application of the tools of technology to make it possible for people to carry out the laws and for the standards to be steadily improved. To think of improving the quality of life by measures which are hostile to industry and which seek to suppress technological advance will be self-destructive, and will lead both to bad economic performance (i.e. failure to achieve the rate of improvement of standard of living and welfare upon which the public insists) and to bad quality of life.

13. Yet another aspect of "quality of life", specially relevant to Europe, the cradle of the industrial revolution, is the economic

and social reconstruction of the oldest industrial areas founded on the great industries of the early 19th century, an immense task of physical redevelopment of entire areas; a task in the oldest-established industrial and urban areas of Europe not unlike that of creating a new economic and social life in the poverty-stricken undeveloped rural areas of Europe.

14. In all these problems of "quality of life" the application of the tools of technology is overwhelmingly important. This too must come high on the European agenda.

Europe and the World

15. A third objective of the extended Community, as I would see it, is to enable Europe to play its historic part in the world. Indeed, this is one of the concomitants of (a) and (b), for without economic growth and without a quality of life appropriate to our advanced group of countries, Europe can hardly expect to have her voice heard.

16. There is a fundamental point here for technology policy. The world may be entering a new phase, in which there are no longer two super-Powers, U.S.A. and U.S.S.R., contending or combining to exercise world power, but in which there may be as many as five or six such Powers, with U.S.A. and U.S.S.R. much less overwhelmingly preponderant than they were in the 1950's and 1960's, and perhaps less willing to take responsibility for the solution of the world's problems. In such a world, Europe's role should be profoundly important; and Europe's policies should surely in these circumstances be dominated by the needs and responsibilities of our world situation. For Europe to be self-centred and to concentrate its energies on its own internal institutions and parochial problems, and to approach the rest of the world from a nationalistic and indeed chauvinistic viewpoint would truly be the abdication of Europe, and in the end its disappearance.

17. This chauvinism has expressed itself with some force in recent years as an anti-Americanism (from time to time in Britain and in the Six alike) which has been related particularly to a kind of technological chauvinism. The purpose of "a European technological policy" has sometimes been stated as a "need" to build up advanced technology in Europe to counter the "imperialism" of U.S. technology and to preserve Europe's "technological independence".

18. One may perhaps hope that the events of 1971 have put such concepts in their true perspective. It ill suits Europeans to attack American technology which for 25 years has been the only effective defence of Europe, and continues to be so. It is certainly spectacularly clear that the U.S. performance in advanced technology has brought with it no great commercial or competitive advantage: it has not even enabled the United States to resist a 20-year deterioration in its balance of payments. Of course in some products the United States has gained a commercial ascendancy, often with the powerful reinforcement of European subsidiaries and associates and research establishments, which are now an indispensable part of the European economy. But in other advanced technology products Japan has gained an equal ascendancy; and in others again European producers are in a no less powerful position.

19. To develop a self-centred "European technology policy" aimed at making Europe "independent" of American or Japanese technology would therefore in my opinion not only be a wrong policy from the commercial and economic point of view (and therefore doomed to failure from the start) but would also be wrong from the wider political standpoint of Europe's future role in the world and worldwide political and economic interests. The question of "technology policy" raises very clearly these long-term issues of Europe's future.

The European Market

20. The strengthening of technology (i.e. of the engineering and chemical industries) in the extended Community will follow primarily from the keener competition and possibilities of consolidation which result from the removal of trade barriers and the adoption of more uniform rules governing competition. These are the same issues as those of industrial policy generally which are discussed elsewhere. There are however some regulatory areas of particular importance for the advanced technology interests, e.g. company law, patents, protection of trademarks, removal of technical barriers to trade. The last-named is specially relevant. The development of standards and quality assurance procedures becomes increasingly necessary, for without some form of certification how can the buyer of a highly complex advanced product know that he is getting a reliable product and so make a reasonable choice? But these provisions, enacted by law to protect consumers, can easily become new protectionist devices, both within the extended Community and between the Community and other advanced industrial countries.

21. New concepts of public interest (e.g. safety in motor cars, reliability of pharmaceuticals, accuracy of instruments, purity of food and drugs, avoidance of effluents, protection of customers) call for more regulations, and the introduction of new advanced products calls for quality assurance procedures. These right developments open up possibilities of piecemeal national action which can easily frustrate the effects of the removal of tariffs within the Community; and unless negotiated keenly in particular with the United States and Japan could result in another series of obstacles to world trade. The Commission must surely have a large role here, both within the Community and internationally.

Public Procurement

22. The pressures of the free market, upon which the Community must rely for the spreading and strengthening of technology, are

unlikely to apply very effectively to some sectors of industry and trade, important in advanced technology, where the customers are Governments, other public authorities, or privately-owned public utilities. Defence equipment electricity generation and distribution plant, telecommunications equipment, locomotives and railway rolling stock, civil aircraft and aerodrome equipment, waterways and ports equipment, broadcasting equipment etc. come into this category. In all industrial countries, there is a strong tradition that Governments and near-Government authorities buy from their national industry. This is so when the utility is managed by a Government Department (as is normally the case, though not in Britain, in posts and telecommunications); or by a nationalised industry (railways and electricity in Britain and France); or by private industry (electricity in Germany).

23. Experience in G.A.T.T. has shown that the State trading rules can only rarely be brought into play; and where the utility is privately owned, there are no international rules except those that constrain Governments from requiring the utility to discriminate against imports. Utilities in the United States have in the last ten years bought significant amounts of equipment from Europe. In E.F.T.A., British utilities have made a number of purchases of Swedish equipment. In the original E.E.C., there have so far been very few purchases either by the publicly-owned French utilities or by the privately-owned German utilities from other Community countries. There are deep national traditions here, which are not readily responsive to international regulation. No manufacturers of these equipments will ever believe that the State or near-State purchaser is carrying out the regulation fairly unless some purchases are in fact made from abroad.

24. This weight of tradition will not be moved at all easily. On the national plane, the State- and near-State agencies have difficulty in framing their procurement policies in a manner that deals soundly and in practical terms with their manufacturing

industries, bearing in mind the need to support the latter's export capability; and to introduce a further dimension of import competition (except in very special circumstances) would be a further source of great difficulty. Taking all these considerations together, therefore, it seems to me clear that the nature of the national situations is unlikely to be changed by international regulation.

25. If the extended Community is to make progress in this field, it is most likely in my opinion to come from an "industrial" rather than a "trade regulation" approach. A more active consultation between the various public utilities within the extended Community - e.g. electricity supply, railways, telecommunications, airlines, airports - to bring about more standardisation of equipment and to improve their appraisal of competing equipment systems, could both be advantageous in itself in reducing the variety of competing systems and stimulate these customers to think in a less "national" way. The recent creation of Euro-H.K.G., by the British and German electricity utilities, with the Italians likely to join later, to work together on the problems of high-temperature nuclear reactors, may be a useful first step in this direction.

26. Looking far ahead, if we could envisage the relevant manufacturing industries becoming organised into a few European companies, or at least European consortia, working across frontiers rather than as "national" undertakings, a situation might develop in which the utilities throughout Europe would be buying their equipment from a small number of great European groups (each of which would have a foot in the main industrial countries). Looking at Europe as a whole, the situation would not be unlike that which now holds in the United States. The utilities would be selecting their systems and placing their contracts without having to choose between a "national" supplier or a "foreign", just as the United States utilities choose between General Electric and Westinghouse.

27. Whether the extended Community could work in this way, and the manufacturing industries and the utilities develop along these lines, would of course take years to determine. But the manufacturing industries which are dependent upon public procurement are very important ones for the future of European industry, both as producers and as creators of technology, and both in the supply of European utilities and the supply of the world market against United States and Japanese competition; so a solution of the public procurement problem along lines that contribute to the health and strength of the manufacturing industries is of great importance.

Aerospace

28. The aerospace industry (both aircraft and advanced electronics) was founded even before World War I by the needs of defence. The exacting conditions in which military aircraft must work, the stringent performance standards that they must observe, and the immense experience gained from Service flying operations, and the application of large Government funds to research and development with substantial Government orders for production aircraft have meant that the technology and the performance have always advanced much faster than would ever have been justified for civil aviation alone. In this group of industries there is a unique mix of defence and civil considerations, of politics and business, and therefore one cannot generalise from it.

29. Aerospace is sometimes regarded as the core of "advanced technology"; and the U.S. preponderance in aviation and computers and micro-electronics which has resulted from the great U.S. defence and space programmes of the 1950's and 1960's is sometimes thought to represent a more comprehensive technological lead than is in fact the case both vis-a-vis Europe and Japan. Aerospace is certainly of great importance for technology as a whole, but it is not of the overwhelming significance that is sometimes claimed for it; and many Americans now think that the concentration of American resources on aerospace has on balance weakened rather than strengthened the advanced technology and competitive power of United States industry as a whole. This point is of great significance for the extended Community. The allocation of very large resources to one technological area can create great strength in that area, but that allocation can be made only at the expense of other areas, and if the objective is economic (and not political, military or prestige) there is more to be gained from an advance across the whole front than from concentration upon one area, especially one which is so dependent upon Government and upon non-economic considerations.

30. There is no reasonable doubt, however, that for a variety of reasons - defence, civil aviation, technological competitiveness etc. - a strong European aerospace industry (both in aircraft and in advanced electronics) is necessary. None of us in the extended Community could be content with a situation in which Europe was wholly dependent upon the United States, the Soviet

Union and Japan for our aviation equipment, whether for defence or for civil aviation. But there are many different ways of achieving this. They all presuppose a substantial European air defence effort, for without a large defence demand there cannot be an effective aircraft industry; and indeed without a large defence requirement it is difficult to argue that there is a powerful case on grounds of European policy for requiring an indigenous aircraft industry any more than any other industry. European defence and industrial considerations come very close together here, for unless there are common requirements for the Air Forces of the European countries and a common procurement policy, it will never be economically justifiable to do the research and development and production in Europe, for the scale of each country's individual requirements is unlikely to be large enough. Thus, the purpose of having an effective European aircraft industry cannot be achieved without a great deal more unity between the Air Forces and the procurement of their supplies than exists today. On the other hand, if it is possible to bring the requirements and procurement of the Air Forces together this becomes a first-class economic foundation for the European aircraft industry, provided of course that the industry is not so fragmented that it cannot take advantage of this.

31. For civil aircraft, the problem is more difficult. For the aircraft which will carry the bulk of the world's traffic in the next two or three decades, the sales required to justify the research and development cost are

much greater than the total demand of the European airlines even if these requirements could be unified and if their procurement policies could be dictated by the Governments. The European airlines are moreover working in conditions of keen competition with the United States and other airlines, and the needs of the civil aviation industry cannot be subordinated to those of the aircraft industry. It follows therefore that the European development and production of civil aircraft makes practical sense only if these aircraft can be sold in substantial numbers in the rest of the world, and notably in the United States, which is by far the largest market and is likely to remain so for as far ahead as we can see. A "self-sufficiency" policy for the European civil aircraft industry would require the enforcement of a common European-only procurement policy on the airlines; and it is very likely that even if this were achieved it would require subsidies to the manufacturers (because of inadequate markets) and subsidies to the airlines (because of higher operating costs). The stronger the military aircraft industry, and the less the industry in Europe is fragmented, the more likelihood would there be that this industry could be successful in producing large civil aircraft competitively. But the difficulties of even the extremely powerful American industry shows the size of the problem.

32. The solution may perhaps ultimately be found in the growth of a very small number of international European aerospace industrial undertakings independent of European Governments (though closely linked with them, just as the great U.S. aerospace companies are linked with their

Government), each with its alliances with U.S. and possibly Japanese and other firms. The European defence requirements would be handled by a common procurement policy, which would procure these requirements normally from the European aerospace undertakings. These undertakings would develop civil aircraft to supply the world market rather than to be aimed at a European airline market which would be too narrow to provide an economic basis for development and production, but the European airlines would consult together to determine their requirements and to appraise competing systems, and it would be generally understood that they would "buy European" if the European undertakings were offering competitively efficient equipments. It may be possible to find a satisfactory basis for Europe on these lines, but there is not very much time in which to do it; and this is probably the most difficult of all the problems of advanced technological industries which are facing the extended Community.

Computers

33. The computer industry is the other advanced technological industry in which the United States is predominant, and in which there has been widespread opinion that an indigenous European industry is essential. This is much more important than the aerospace industry in its impact upon industry and upon society. But it is the use of computers, whatever their origin, that has this impact; and there is a considerable distinction between the design and production of the computer hardware and the planning of their

application and operation. The demand is of course mainly civil, but Governments are important through the defence and space uses but also in the widespread uses for normal governmental work. However, unlike the aerospace industry which is intrinsically a Government-supported industry, notably because of the predominance of defence demand, the computer industry is a "normal" one which should be profitable.

34. The main characteristic of the computer industry in Europe is that it consists very largely of subsidiaries of I.B.M. and other U.S. companies and of companies producing under licence from U.S. companies. The British company, International Computers Ltd., has been the only indigenous European company producing its own equipment. The problem of building up new European undertakings against the great technological and commercial strength of I.B.M. is a formidable one; and although in recent years much attention has been given to this, and European Governments have devoted large subsidies to research and development, we are still a long way away from real European strength. There are powerful electronics firms in Europe, and the lack of progress in computers is striking.

35. Those who have favoured energetic steps and Government subsidies to create an indigenous computer industry in Europe have in my opinion made a mistake in thinking of the major problem as one of "advanced technology", and thus in focussing upon the creation of a giant computer. The demands of scientific research establishments for great

computing power are important, but the true industrial problem is not that of producing a few super-computers but that of producing large numbers of computers for business uses of all kinds, and the software that goes with them, and the servicing facilities, and the financing of their hire or purchase. It is much more important for there to be undertakings in Europe which can compete effectively with I.B.M. and its European subsidiaries in the market as it is, than to be moving into the technically exciting areas where there is not yet a commercial demand. There is no doubt that in this commercial field, the economies of scale are very great; and the question does arise of whether it is realistic to expect comparatively small purely European undertakings to be able to compete effectively with I.B.M. over more than a narrow range of products.

36. One must ask the question whether this, like civil aircraft, is not really a single world market, in which the true competition will not be between U.S. companies and European companies and Japanese companies (which have been more successful than anybody else in establishing themselves) but between large groups or consortia operating worldwide, either (like I.B.M.) with large European undertakings as part of an essentially U.S. enterprise, or as consortia with U.S., European and Japanese members. Certainly if a structure of world groups, developed on these lines, the technology would be available in Europe (and indeed created there, as it is

now in the I.B.M. research establishments in Europe); and the business organisations would be of dimensions which would make possible genuine competition, instead of defensive action on an insufficient scale. In my opinion, the allocation of very large Government funds to research and development is unlikely to have the effect of building up a powerful indigenous European computer industry unless the R & D effort is concentrated on the development of techniques to assist the economic manufacture of volume production types of computers rather than the development of higher and higher capacity computers for which the needs will always be small and specialised. There may be more advantage in discussion between the purchasing agencies of the European Governments, on the lines which I have suggested above for public procurement generally. It is unlikely in my opinion that I.B.M. will be able to maintain its present world-wide ascendancy. But the capability of European firms to play their part in an effective world-wide competition will depend much more upon commercial than upon technological factors.

Research and Development

37. Governments have a decisive part to play in the financing of research. What should be our objective here in Europe? In basic scientific research, carried out in universities, research councils, and institutes, the true role of government is limited to providing money. In these kinds of research for the furtherance of knowledge, with no clear impact upon industry or public welfare generally for, say, 20 years ahead, there is no reason why government should concern itself with the direction or content of research. It is simplest for the Government to decide arbitrarily how much money to provide for this purpose - essentially to provide the seedcorn for the technological advance of

future generations, and to ensure that an appropriate proportion of brilliant young men and women are attracted into science - and to appoint scientific advisors to distribute it. This work is all published and truly international in character. There is no reason to suppose that Europe devotes too little resources to it; and the most significant role for an international body is in the provision of projects like C.E.R.N. which are too large to be done by one country although there may be scope for international action to rationalise research programmes and avoid duplication.

38. The role of government becomes more selective at the next stage, when the research is either directed to specific industrial and social requirements or is of a nature which is likely to have a specific impact in a reasonably short period of time. For all national Governments, there are clear questions for decision of whether they should finance research of various kinds. Governments of countries with a substantial research capability will normally devote substantial resources to defence research and development, and will devote some resources to medical research. The rest depends very much upon the Government's policies in general. In the United Kingdom, very large resources are devoted to civil aerospace research and development (notably CONCORDE), to nuclear reactor development; and some resources are devoted to a wide range of industrial, agricultural and environmental research, in the Government's own research laboratories and also as grants to other research work in the private sector. In some other European countries, the composition is entirely different. But these differences are in the various Government's needs for research and development, in just the same way as the composition of the aggregate private expenditure on research and development results from the private firms' and organisations' needs.

No Government decides how much research and development outside the sphere of basic research it will undertake, and then decides how this sum of money should be spent. The natural and correct procedure (unless there are over-riding physical limitations to the amount of research and development which the Government should undertake) is for the Government to decide in each of its areas of activity what research and development it needs to do. This is not a matter of "science policy" or "technology policy" at all : the determining factor is the economic and social objective of the Governments and the nature and amount of research and development that is required to carry out these objectives. The operation does not start with consideration of how scientists should be used : it starts with consideration of what Governments want to do, and how scientists can be mobilised to achieve these policies.

International Projects

39. For international agencies in Europe as elsewhere, the question is always whether it would be possible to make economies and to prevent duplication among the individual Governments' research programmes by doing internationally what the individual Governments are doing nationally. Related to this is the question whether there are research projects of potential collective value which are not done because no single country wants them enough to finance them itself, or if they require resources far beyond the scope of a single country.

40. The European experience has been disappointing, certainly in the multi-national projects. I am not here referring to the great Anglo-French military and civil

aerospace projects, such as CONCORDE and JAGUAR, or indeed to any of the aircraft projects. But the European space projects cannot be regarded as having been successful, and the only real multi-national success has been C.E.R.N., which has been from the start a basic research project, designed as a contribution to knowledge and not in support of economic or political or social objectives - that is to say, it is not really in the category which I am discussing.

41. The conclusion which I draw is that if a project has an assured economic or social benefit, the Governments of the larger countries will normally prefer to do it themselves, keeping it in their own hands, both for the costs and for the benefits. If there is no such assured benefit, and if the international project is an unprofitable one, launched for political or prestige or other non-economic reasons, the members' motives for supporting it are likely to differ so widely that as soon as something goes wrong with the project (as is bound to happen in any large project sooner or later) they become nervous about whether they are going to get what they want from it and become critical of it, and the project is unlikely to come to fruition. The projects may be under way when this happens, like the European space projects, or the disadvantages appear before the project ever starts; and in either case the result is neither friendship nor understanding. In my opinion, the experience is strongly against ambitious multi-national scientific and technological projects; and I would myself be surprised if any were successfully launched in Europe in the next decade. The more fruitful

line of approach is likely to be to find fields in which an international agency or an international financing programme could help to solve specific problems which are troubling Governments or industries. The emphasis should in my opinion be on finding research requirements from Governments and other public authorities and private enterprises in Europe in which action by an international agency can play a constructive part.

42. In the industrial field, I believe there are important areas which could be explored with advantage. Obviously it is impracticable to enter fields which raise important questions of business secrecy; or which are within the natural scope of the great European industrial organisations. But we found in the United Kingdom when we were considering very much the same kind of problem that there were many subjects of research to which no individual company was ever likely to devote its own resources but which would nevertheless be valuable to a wide range of firms and industries; and if this is so of the United Kingdom, it might well be so for the extended Community. One such subject is materials research, a subject that comes near to the "basic research" category. Another is a variety of subjects, which in Britain are called "intermediate technologies", such as tribology, maintenance engineering, welding, corrosion - places in industry where improvements of practice could make great improvements for industry as a whole, and where the yield from education and research can be very large. Another is computer software information. These are all industrial subjects to which the United Kingdom Government has

devoted resources in recent years with a reasonable amount of success; and I list them here as illustrations of the sort of thing that might be considered on a European plane.

43. I mentioned earlier the possibilities of cooperation between the various public utilities in the Community countries - electricity, telecommunications, transport, airports. Is this cooperation likely to lead to requirements for research in excess of the facilities that these utilities have available? If so, there would be advantage in having a procedure available for placing and financing contracts. In my opinion, there may be a field here for co-operative research in what might be called the "pre-commercial" stage - the examination, for example, of different kinds of transport system to form a judgement of which may be the most promising line of development: this is work that industry cannot do itself, for it is much too far ahead of the demands for industrial products; and which would involve great duplication if all the national public utilities tried to do it themselves. There is a Communities proposal for the creation of "common enterprises" largely in the public utility field which could be of considerable importance.

44. Again, standards and quality assurance, a field which must be cultivated intensively, but with great wariness lest it becomes a new barrier to trade within the extended Community. This subject is obviously suitable for collective treatment, for this would remove at one stroke the protectionist danger. But this needs its apparatus of research facilities. The essential point is that one does not begin by thinking how to find research work to do to occupy the Euratom laboratories or to stimulate European collective action: one starts with the responsibility for establishing standards and quality assurance procedures, and then considers the tools of technology which are required to carry out this responsibility.

45. Large research facilities will certainly be needed if the European Governments develop an active campaign against air and water pollution. In the United Kingdom, our Department of the Environment has its own Water Pollution Laboratory; and the central point for the clean air policy was the laboratory

work. The question is whether Europe has enough research capability in this field to support a major campaign; and if so where it is and how it can be mobilised; and if not whether it would be desirable to provide central facilities or to finance the work centrally, or whether it is best left to the individual Governments.

46. Weather forecasting is another such subject, one of a number of interesting subjects initiated at the C.O.S.T. Conference in November 1971. But here again, the requirements for research must flow from the needs of those who have the responsibility for the work.

A European Technology Policy

47. At this point of the report, I must pull together my concept of what should be the technology policy of the extended Community. This may be expressed in six points :

- (a) The application of the tools of technology is of decisive importance for the objectives of the Community :
 - (i) economic growth, i.e. the increase in the standard of living of the people of the Community, and the creation of the resources which will enable the Community to play its full part in the world,
 - (ii) the improvement of the quality of life, all the main elements of which call for

the application of the tools of technology much more effectively than in the past.

- (b) The technology policy should be based upon a positive and cooperative policy for Europe in the world, and should not be directed towards technological self-sufficiency.
- (c) The spread of technology is achieved mainly by the creation of the common market, with particular reference in advanced technology to company law, patents, protection of trademarks, the removal of technical barriers to trade (e.g. the creation of a European system for standards and quality assurance, and prevention of protectionist devices purporting to stop pollution).
- (d) Co-operation of public utilities and regrouping of the manufacturing industries which supply them in order to help a European widening of public procurement policies and a strengthening of these manufacturing industries.
- (e) Policies for aerospace and computer industries based upon cooperation of public procurement and the creation of an effective European component in the organisations supplying the world market, and not upon European self-sufficiency.

(f) Technological research programmes should be derived from the needs of Governments and other institutions for research to carry out their responsibilities : we should not start by seeking "European" research projects but by developing the policies in Europe from which research needs may flow.

18. The proposal of this report, in short, is that the essence of a "European technology policy" is to make arrangements wherever this can be done for ensuring that the tools of technology are available and applied to deal with the problems of European Governments and industries, where appropriate on a Community basis. Technology is seen as a tool for handling the Community's problems, and not a subject in itself. It is the action to handle the problems that calls for the application of technology; and what is needed is an apparatus to ensure that technological resources are available when required, and not a "technology policy" as such.

Community Organisation

19. What is said in this report so far is consistent with my own experience in seeking to develop policy for technological development primarily in the United Kingdom but with substantial international implications also. In considering organisation, I start with much less assurance, for I am not yet familiar enough with the organisation of the Commission and the division of responsibility between

53. For my 47(d), the public procurement conclusions call for much closer and more positive consultation and cooperation between the public utilities of the Community countries on the one hand, and the cross-frontier cooperation of manufacturing undertakings on the other. It would seem natural for the Commission to have a role in the former, if only as the provider of a convenient meeting-place; and this role could develop in time. The latter is of course an important element for the Commission's industrial policy; and if the policy in this report were adopted, the Commission would of course require to take this into account in dealing with specific cases in which the Commission's jurisdiction was required. For 47(e), aerospace is essentially a matter for Governments, and the centre of my proposals is in the defence field : computer policy is also a matter largely for Governments, but the public procurement aspects are very important.

54. Finally, in 47(f) many possibilities are listed to illustrate how requirements for technological research might develop from the work of Governments and public authorities and private enterprises and from work on the European plane. I cannot say how far the research establishments within the Commission's own responsibility could assist, and how readily an apparatus could be devised to place development contracts with member Governments' own research establishments or with universities or private research facilities. The Communities are already formulating their ideas about development contracts, with the possibility of defraying the cost of some of this work, where it is clearly devoted to Community purposes, from the Community budget : there may well be an important role for the Commission in this field. But I must conclude by

emphasising once more that this is not at all a question of "science" or "technology". If the extended Community - Governments and Commission - really tackle the Community's industrial and environmental problems vigorously to make the next ten years a period of great progress in carrying out the objectives of the Community, then there is no doubt at all that a great deal of research and development will be needed, and that the Commission will have a formidable task in ensuring that these requirements of research can be effectively satisfied. Technology will provide the tools, but it is for the institutions of the extended Community to decide whether they are going to make the progress towards the Community's objectives which will call for their fullest use.

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the Commission and the member Governments to make an informed judgment on what should be done.

50. However, the organisation of the Commission seems to me well designed in the major relevant aspect for the purpose of this report, in that one Director-General, Mr. Toulemon, is responsible together for industrial policy, research and the environment. Thus, the organisation of the Commission avoids making an artificial distinction between "industry" and "technology" or between "the environment" and "technology". This fits in admirably in my opinion with the concept of treating technology not as a subject in itself calling for its own policy but as a tool to be applied to help solve the problems of industry and of the environment.

51. The policies in my paragraph 47 (a) and (b) are questions of approach, and do not require organisation as such. If the importance of the tools of technology for carrying out the Community's objectives, both internally and in relation to the rest of the world, is fully appreciated by the Governments and by the Commission itself, this would greatly affect the way in which they tackle their problems and the effectiveness with which they solve them.

52. My 47(c) is part of the normal work of the Commission, though its powers may need to be increased to enable it to carry out these functions, particularly in relation to standards and quality assurance effectively.

