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CONDITIONS FOR THE DEVELOPMENT OF ADVANCED-TYPE  
REACTORS WITHIN THE EUROPEAN COMMUNITY

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CONDITIONS FOR THE DEVELOPMENT OF ADVANCED-TYPE  
REACTORS WITHIN THE EUROPEAN COMMUNITY

We have just heard professions of faith in the success of electricity from nuclear sources, and we share this faith. Like others, we are happy to be able to found it upon the economic realities of the near future, without needing to adduce our concern to preserve, for the hundredth generation to come, the now known natural resources, but with the satisfaction deriving from awareness that these resources exist and cannot fail to be increased by the ingenuity of our descendants.

There is less unanimity when we come to details. In this connection, I would simply like to subscribe to the opinion that advanced thermal-neutron units will have an important place in an optimized nuclear industry. I would add that this conviction is not based in the slightest degree on the fact that Euratom is extensively engaged in the study of such reactors, and would even claim that the converse is true.

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The optimism which we are justified in feeling today is the result of long years of research, particularly on industrial and semi-industrial development.

For the six countries of the European Community alone, the value (ex power plants) of all the electricity produced in 1964 is about 4,000 million EMA u.a. In the same year, nuclear research

and development cost about 800 million EMA u.a.\* Without even taking into account the sums spent on the development of conventional plants (which were responsible for 99% of production) it will be seen that research into the main future processes for obtaining electricity absorbed about 20% of the market value of the total production\*\*. This is a very high proportion, which is hardly to be found anywhere in any industry, and rarely for the most advanced products of a heavy industry (artificial textiles, pharmaceutical products, etc.). The phenomenon is all the more striking in that it has persisted for almost 20 years, and is not confined to Continental Europe; it is known in the United Kingdom and even in the United States - despite their high electricity consumption.

All this underlines the importance of energy, particularly in its most highly developed form, in economic life, and explains why the sums invested have come primarily from public funds. Now that profitability has been achieved, but there is a consensus that research and development must continue, it is necessary to ask the following questions :

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\* Public expenditure (and as far as I know this figure only comprises non-military research) totalled 730 million EMA u.a. and I assume, arbitrarily, that private expenditure of the same nature came to about 10% of that amount.

\*\* I am aware of the criticisms that may be levelled against this estimate (which goes further than nuclear energy proper), and also of the comments it may elicit; I know that the results of this research may transcend the electrical industry's sphere. But none of that makes any difference to the order of magnitude, and I do not claim here to be submitting a financial theory of research.

1. Has the money been well spent ?
2. What structure as regards research resources must be maintained or created ?
3. What part must private financing play in the future development of nuclear energy ?

Complete replies would in fact constitute an overall nuclear plan for the Community (since it is in the Community area that our primary interest lies). It is not only lack of time which prevents me from expounding such a plan here: I do not have the material, or at least all the material.

Furthermore, some people think, and even maintain, that there is no need for such a plan to exist.

I will confine myself to an initial examination of the three foregoing questions, hoping that facts and arguments will speak for themselves.

1. Has the money been well spent ?

I am ready to affirm that the reply is yes, generally speaking. But it would be no to the question : "Has the money been put to the best possible use ?"

Our nuclear industries and our research centres owe their existence to public expenditure, without which none of the private investments in our field would be feasible.

As it is, we can now make reactors and fuels at prices acceptable to electricity producers. Furthermore, under the stimulus of nuclear energy, we have considerably increased research facilities in Europe. In particular, nuclear energy has caused us to extend the range of establishments in which numerous specialized groups and composite instruments supplement a powerful technical and administrative infrastructure, and which have now become a normal instrument of research and development in all fields. Almost nothing

of this kind existed in Europe 15 or 20 years ago.

But nuclear energy, although it led to the creation of these establishments, has not always been the real subject of their activities: some of the centres to which we have just referred are not really engaged in reactor development. Correspondingly, the multiplication of centres in the last 10 years has increased the burden of the infrastructure, as regards money and personnel, to the detriment of productive expenditure. We have created too many too-small centres too quickly. That is why the European Atomic Energy Community has from the outset urged the setting-up of its establishments without any increase of infrastructure.

2. What structure should be maintained or created ?

It is therefore clearly advisable, in my opinion, to strengthen existing establishments, rather than to create new ones.

But the advent of economically viable reactors has in its turn led to consequences which, although they had been foreseeable for many years, had too frequently been neglected or brushed aside.

Of the numerous possible types of reactor all those which, a priori, seemed viable have in fact proved to be so, provided that sufficient resources are devoted to their development.

2.1. The choice of industrial lines has thus been a matter of opportunity rather than of principle. But this has led to the stabilization of existing types, a fact which has for a long time been stressed by Sir Christopher Hinton. Incidentally, this is a stabilization without stagnation, for the evolution of species plays a part in this particular form of biology, in both the short and the long term.

2.1.1. From the moment a market exists, under our economic system, the responsibility for short-term development rests indisputably with manufacturing industry. It has the duty to organize itself to produce at a reasonable price, taking into account the amortization of its research. Will this organization take the form of a concentration of the Community's resources, leading gradually to a dialogue on equal terms between European and American firms ? Or will it, on the other hand, be effected by way of internal competition within a system of commercial and technical links with the United States based on an economic map disregarding the fact that the entire nuclear common market has been in existence since 1 January 1959 ? You will not be surprised that my preference is for the former hypothesis. I will confine myself for the moment to asserting that it alone would make it possible to amortize the rapid research without which Europe will be unable to develop or maintain a personality of its own in the field of proven-type reactors.

Moreover, such research could perfectly well be carried out, in part at least, in public research centres acting under contract for industry. This would save time and money, and would ensure the full employment of existing resources. The situation would be the reverse of that in the "pre-competitive" period, in which public centres were placing study contracts with industrial laboratories, more in order to prepare them for present circumstances than because of any vital need for the results of their researches.

2.1.2. Things are less clear as regards short and long-term development. Major clashes of principle may occur on whether the public or the private sector should be responsible for choosing studies, financing them and owning their results.

But here again an important factor affecting the decision must be the full employment of research resources, for obvious reasons of sound management of national or Community assets.

2.2. The same applies to reactor types which are not yet recognized, but which it is generally agreed will be developed and used on an industrial scale in the coming twenty years. They must be the subject of very thorough-going research if Europe is not to arrive too late, and such research must be sufficiently varied not to entail an undue risk of accumulation of unfortunate choices, while at the same time sufficiently concentrated to avoid the opposite error of losing sight of the objective, or of irremediably jeopardizing the profitability of the whole project.

2.2.1. The problem focusses on the prototypes. Each of these is a long-term undertaking, calling for technical decisions, and expensive in both construction and operation\*.

Nothing is better for mobilizing a research centre than the preparation of the prototype and the analysis of its operation - in the broad sense. There is no need for the prototype (which must function on a quasi-industrial basis) to be constructed in the centre and operated by the centre. The centre must simply have the responsibility for research on a family of reactors and the supervision of the studies required, and then permitted, by the prototype.

It may therefore be thought - as I think - that any centre which does not within a fairly short time acquire responsibility for at least one prototype has no reason to exist.

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\* It has been demonstrated that the total deficit involved in a prototype is to quite a large extent independent of its size. This favours large prototypes, more akin to first industrial models

2.2.2. Now "nuclear" centres, within the Community, are obviously more numerous than those prototypes which today it would appear technically and economically justifiable to put in hand in the coming five years. Anyone may have his own way of calculating, and I shall not give mine here.

Of the existing centres, some are firmly engaged on studies of lines logically including prototypes, while others by contrast are dealing with very "futuristic" reactors. There are even some which are not studying the reactor family under construction in their own territory.

This situation, combined with the comparatively steep cost (see above) of nuclear research with respect to the electricity-production turnover, makes a rationalization of structures inevitable and urgent. This is not surprising, since similar crises have been witnessed in England and the United States. I would only say that ours is more serious owing to the extreme dispersion of our resources, which unfortunately cannot be held to reflect the success of Euratom.

2.3. The worst solution would be to dilute responsibilities by distributing the work on a prototype among several centres\*.

The multiplication of prototypes (by a free-for-all) would be almost as bad, for most of them would prove abortive. Their deliberate and over-hasty accumulation would entail a polarization of technical development which would be dangerous on two accounts - financially (and on the human plane) if sufficient efforts were to be maintained in the other fields - technically if an excessive predominance were assigned to the nuclear field.

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\* I do not mean among several establishments of one and the same centre, rationally organized and firmly directed.



To kill the centres off, or allow them to rot away, would be a shabby way of treating staff who are doing their work well and would be absurd from the standpoint of administering a collective asset.

It is therefore essential to make progressive reconversions, beginning at the earliest possible moment and spreading them out over five to ten years.

2.4. Such operations are never simple, but their difficulty is greatly reduced in our own case by the following circumstances, which enable them to be carried out without endangering the moderate and continuous growth of each establishment:

- scientific and technical expansion is going ahead; the study of materials, of terrestrial, marine, atmospheric or spatial media, of communications and mental processes, and of life in all its forms, both for the pleasure of learning and because of the need to act, calls for ever-greater resources;
- nuclear centres are suitable for the general study of materials required in very many fields;
- they are suitable for the continually expanding use of large computers, and they possess such machines;
- they are especially competent as regards the effects of radiation and radioactivity, whose field of application is growing every day.

This list is enough in itself to show that efficient reconversion, as opposed to the anarchic creation, albeit by government decisions, of a multitude of new institutions at national, Community, poly-national or world level, demands an overall view and the choice of lines of advance in the fields of scientific and technical development.

### 3. Future rôle of private financing

3.1. As we have already stated, short-term development is the responsibility of the manufacturers.

3.2. As regards the medium-term - and even more the long-term - the financial risks are closely connected with the research structure.

3.2.1. Joint financing (public, private but cooperative, or mixed-type, makes it possible to cut down expenses, and especially in view of the limited capacity for research, to give Europe a chance of not systematically arriving too late at the stage of industrial production. The adoption of this method leads logically to the foundation of what I have been accustomed since 1956 to call the "Community of the prototypes". This in turn leads logically to giving full effect to inconspicuous articles of the Euratom Treaty (Articles 2a, c, g, h; Articles 4, 5, 6, 7; 40, 41, 43, 44; 45 et seq.) which relate to programmes and research projects, investment and joint enterprises.

3.2.2. This in turn means lending the expression "Community research programme" its full significance and assigning the Consultative Committee on Nuclear Research its full rôle. For the decision of the Council of Ministers which established it, far from restricting it to the task of supervisory adviser to the Commission, allows it (and even, in my opinion, enjoins it) to be the permanent architect of the Community's nuclear plan.

3.3.3. Outside the Community, the United States and the United Kingdom offer us two examples of a modus vivendi between public authorities and manufacturing;

industry. Economic realities and the necessities of industrial efficiency have proved to be compatible with the principle of general access to knowledge obtained with tax-payers' money.

3.3. Europe ought to be no less capable of finding a solution appropriate to its situation, having regard to the fact that it has formed itself (even if it forgets this from time to time) into a Community in the field of atomic energy. By means of the formulae of association and shared-cost contracts, of which the Euratom Commission (among other public bodies) has gained experience with governmental, and private, partners in the six countries, and the rational use of the centres to which I have alluded above, it seems perfectly practicable to select the sources of financing case by case. Systematic discussions between the parties concerned, within the bounds of a properly adjusted plan, should thus avoid both the rigid centralization so much feared by some people that they see its spectre in every organizational measure and the inefficient dissipation towards which lack of thought or of will has already caused us to drift dangerously near.

J. GUERON