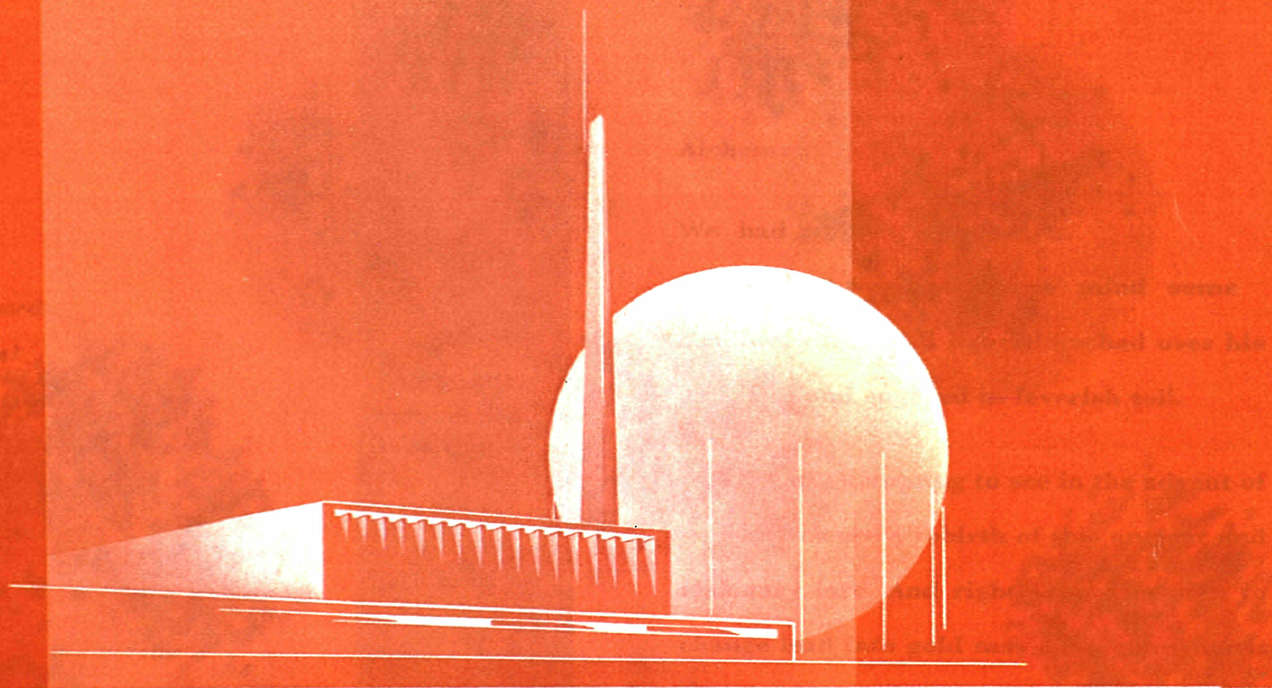
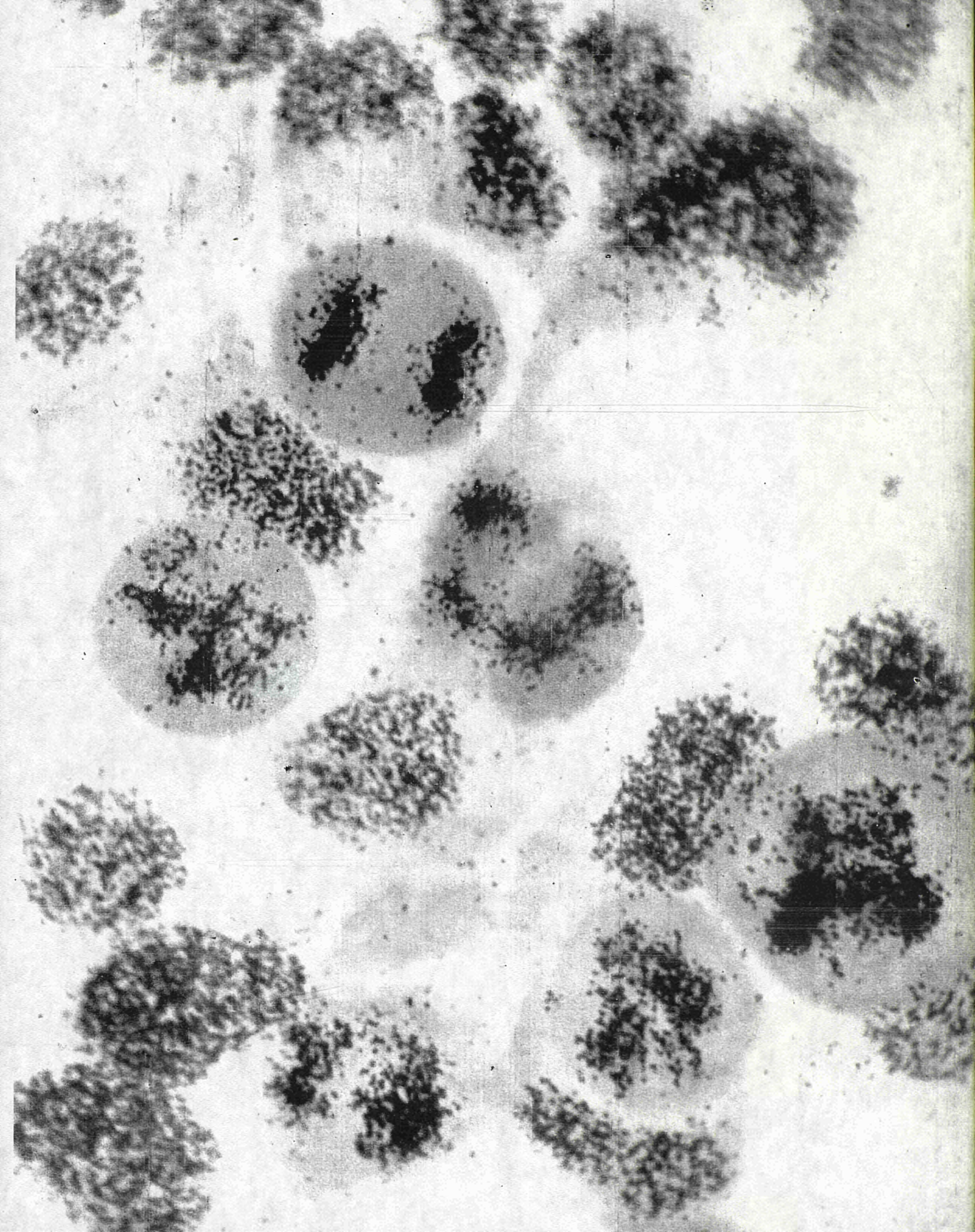
1962 No. 3



euratom
BULLETIN

EUROPEAN ATOMIC ENERGY COMMUNITY



euratom

Bulletin of the European Atomic Energy Community (Euratom)

1962
No. 3

Contents:

Edited by:

Euratom, Dissemination of Information Directorate,
51-53 rue Belliard, Brussels.
Telephone: 13 40 90

Published by:

A. W. Sythoff, Leiden, Netherlands

Autoradiograph of cultured cancerous cells containing thymidine marked with tritium (a radioactive form of hydrogen). The black spots in the picture represent the marked molecules; consequently, since thymidine is a basic ingredient of the nucleic acids, it is possible to obtain accurate information on the internal mechanisms of these cells.

(Photograph by courtesy of the Institute for Experimental Cancer Research of the University of Heidelberg)

Quarterly

Five editions:

English, German, French, Italian and Dutch

Yearly subscription:

United Kingdom 18/—

Western Germany DM 10.—

France NF 12.—

Belgium B.fr. 125.—

Italy Lit. 1500

Netherlands *f* 9.—

United States $ 3.50

Single copies:

United Kingdom 6/—

Western Germany DM 3.—

France NF 4.—

Belgium B.fr. 40.—

Italy Lit. 500

Netherlands *f* 2.75

United States $ 1.—

Printed in the Netherlands

euratom

Information Bulletin of the European Atomic Energy Community

1962
No. 3

On the 25th March 1957 in Rome, six states, namely:

THE KINGDOM OF BELGIUM
THE GERMAN FEDERAL REPUBLIC
THE FRENCH REPUBLIC
THE ITALIAN REPUBLIC
THE DUCHY OF LUXEMBOURG
THE KINGDOM OF THE NETHERLANDS

signed the treaty which instituted the European Atomic Energy Community (Euratom).

Power reactors

Nuclear Physics

Reactor Technology

Nuclear Fusion

Radioisotopes

Mineralogy and Geochemistry

Ship Propulsion

Biology

Automatic Information Methods

Health Protection

Law

Insurance

Economics

Education and Training

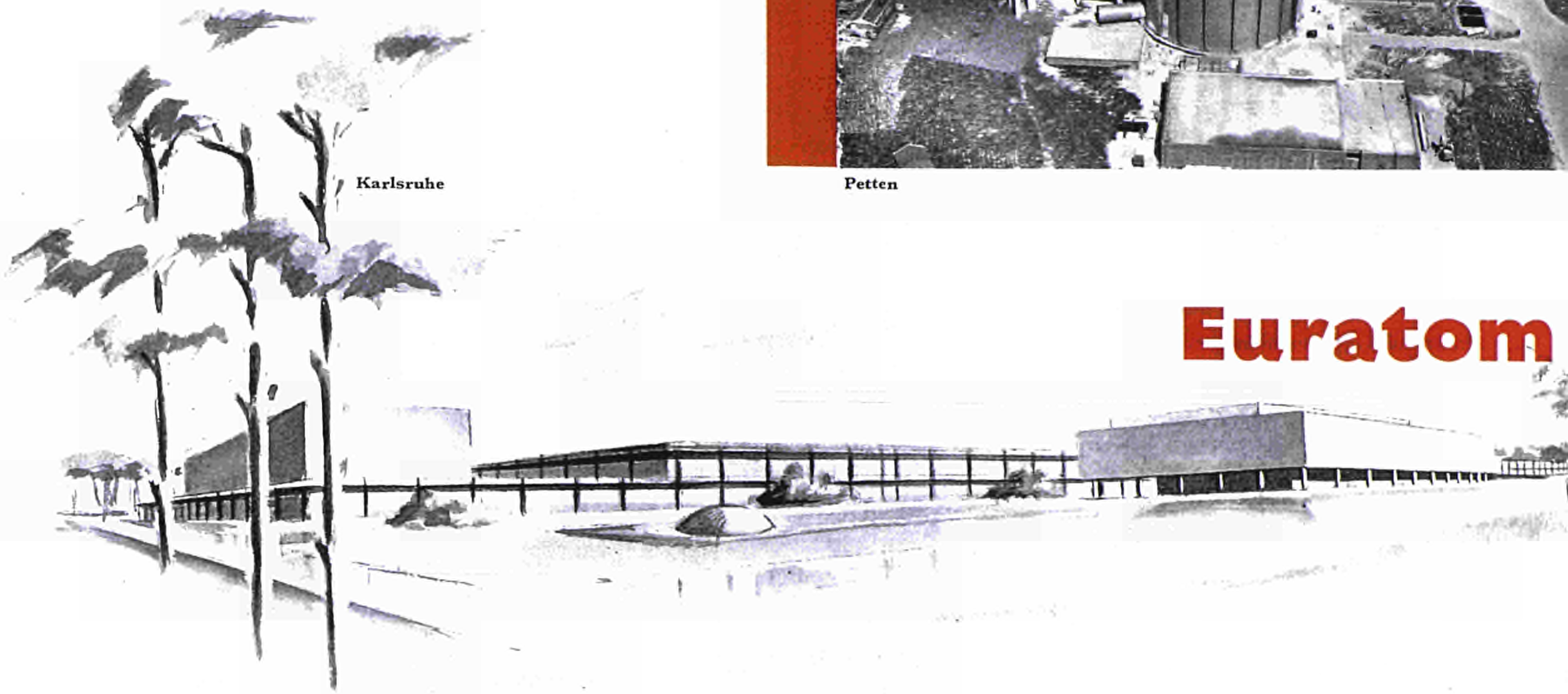
Alchemy!

We had almost forgotten it. At best the word brings to mind some shadowy mediaeval figure hunched over his alembics and engaged in feverish toil.

And yet it is tempting to see in the advent of nuclear science a rebirth of this ancient and visionary lore. And rightly so. The urge to change lead into gold may have gone, but it is beyond doubt that the atom has opened the way to prodigious wealth.

In order to advance along this path, six countries have united. Joint endeavour! The interplay of minds! The pooling of knowledge! These are all facets of the philosopher's stone of a new alchemy, a human alchemy which is gaining in substance day by day.

Petten



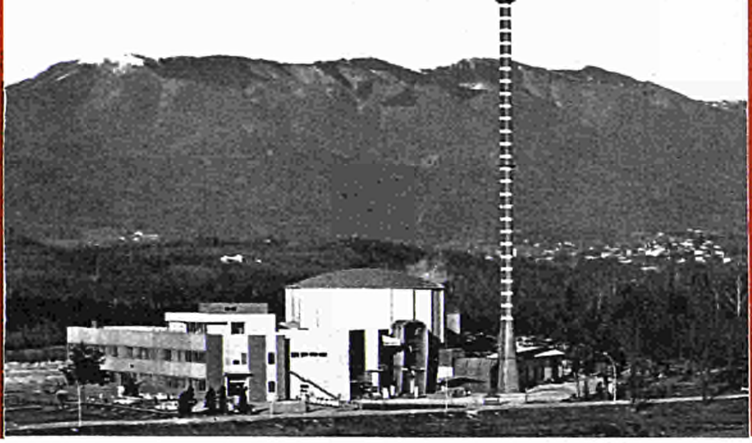
Karlsruhe

Euratom

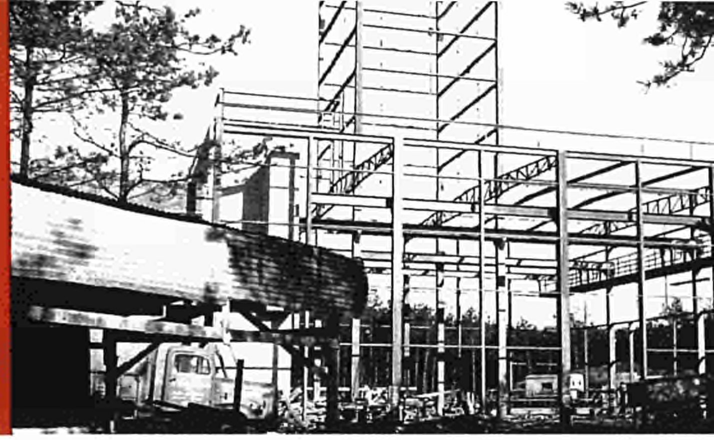
Dr. Jules Guéron, Director General of Research and Training at Euratom addressed the "Arbeitskreis für Recht und Verwaltung" of the German Atomic Forum in Bonn on 20th March 1962. This is the text of his address.
Some readers may be surprised at the brevity with which some important aspects of Euratom research are treated. On the other hand they will realize that it is impossible to give a full account when the aim is to make it comprehensive.

1 Since Euratom came into being, somewhat over four years ago, two significant sets of facts have occurred in atomic energy in the European Community.
First, the national atomic programmes have progressed. Research establishments have been finished and have assumed full activity, or continued their work. Some industrial action has developed, both in design and in manufacturing. Some reactors have been completed and have started operation, but they are all test reactors, or reactor experiments. None of them deserve to be considered as industrial machines, or even as prototypes, in the true meaning of the word. However the construction of a few such machines has continued, or has been started, during the period under review.
This state of affairs stems, of course, from the well known comfortable situation of the conventional power industry. But, especially if the delays and troubles which befell the experimental machines are borne in mind, it emphasizes the youth and immaturity of atomic development. It brings out the magnitude and diversity of the problems which must be solved before a huge new industry can be created: not only new machines, but new materials, and new safety problems must be studied, mastered and reduced to manufacturing and operating conditions all at once.
Secondly the Community has become a reality and, as a scientific and technical working organization, it has overcome its worst teething troubles. While you may legitimately accuse me of being at the same time judge and party, I shall take the liberty of saying that we are, now, on a level with most national organizations, and that we are considered as valid and serious partners by them as well as by powerful atomic energy establishments outside the six countries.

2 2.1 We are now finishing our first five-year programme (1958-62); by the end of the year we shall have committed practically all the money which the Treaty had stipulated for us, namely $215 million. As, for various reasons, the preparatory and build up periods have lasted over two years of the five, it means that this spending will have taken place mostly in two-and-a-half years, starting in mid 1960.
While this is a great amount of public money, let us not forget that it is well under one fourth of what the member states will have spent on similar activities during the same time. And this ratio takes added significance when you remember that the atomic business is widely different



Ispra



Geel

and Nuclear Research

From the first to the second Five-year Programme

Jules Guéron

from one country to another, not only when one looks at the overall amount, but also if one considers the expense in relation to population or to gross national income.
It is therefore clear that we are now a significant factor in the field, but by no means a major one, and, still less, in a position to dictate policy even if we wished to do so —which is not the case.

2.2 Since we are now approaching the end of our first five-year programme, and about to start on our second, this is a convenient time to summarize what we have done, explain why we did it so, and state what we want to do, and how.

2.3 According to the provisions of the Euratom Treaty, which happen to coincide with those of common sense, we have, on one side helped national programmes, and, on the other, carried out independent actions.
These latter are unavoidable for two reasons. First, many things need doing which are not included in the national plans, and we are doing some of them—not all, by far. Second we could not wisely and efficiently help, advise, or associate with, national activities if we did not possess independent means of action and of judgement.

2.4 2.4.1 Our own activities are carried out in, and through, the establishments of the Community's Research Centre. There are four such establishments: the main one is at Ispra (Italy); another one will start at Petten (Netherlands); the third, at Geel (Belgium) is the Bureau of Nuclear Standards and the fourth, at Karlsruhe, now under construction, will be the "European Institute for Transuranium Elements". The names of the last two explain clearly what they are destined to do, and I shall not say any more about them now.
The first two are described as "general purpose establishments". This means that they should be able to do all sorts of things in atomic energy. It does not imply that they have license to do *anything*. We aim, on the contrary, at clear cut programmes.
In addition some projects are managed from Brussels by my direct assistants, together with the smallest possible staff, and with the help of the establishments.

2.4.2 A fundamental feature of our establishments is that they are based on previously existing national centres. This was imperative for many reasons, namely:

a) it emphasizes the fact that the Community is not distinct from the member countries;—

b) it saves time;—

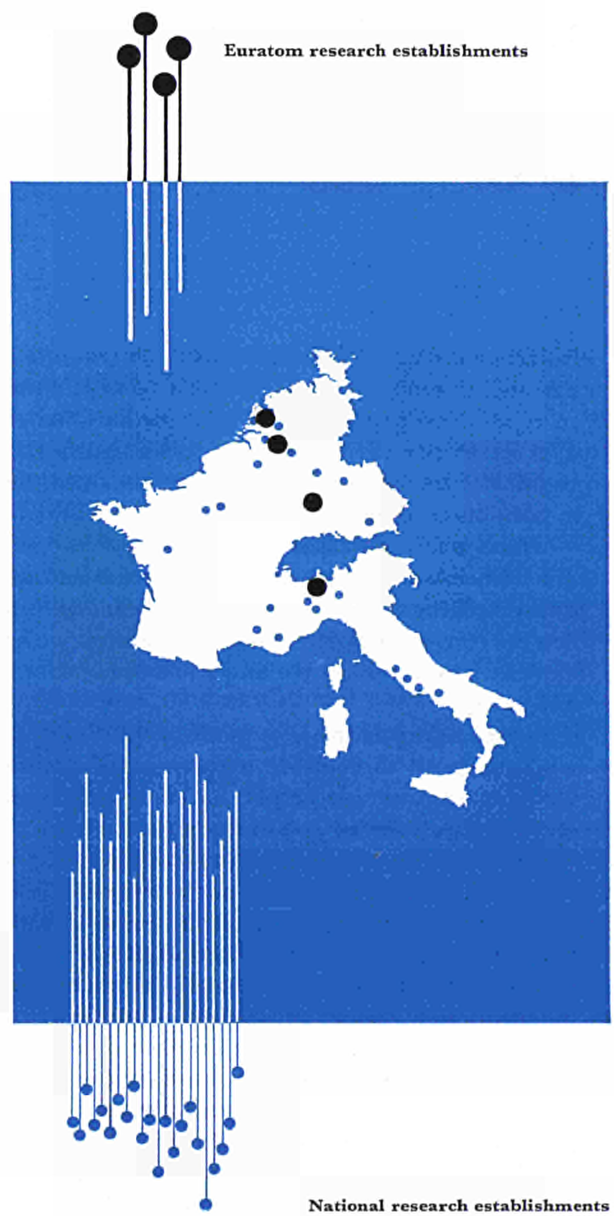
c) above all it gives us means of our own without adding to the dispersion which, in our judgement, handicaps the development of an independent European nuclear industry in comparison with the situation in the other great atomic powers.

At the same time such transfers must not diminish national efforts; this is why a special national contribution is always provided for in the agreements. Thus our original $ 215 million have been appreciably increased.

2.4.3 The first task of an establishment is to live, namely

to create efficient and thrifty general services—administrative and technical.
The next is to carry on the operation of the special facilities existing there. This applies in the case of the Ispra and Petten reactors.
Finally, an establishment must have main aims in life. They direct its activities; their achievement gives a measure of the efficiency of the organization; they create a sense of urgency and polarize the team work. At the same time, the various technical needs create nearly infinite opportunities for the fundamental studies which maintain the scientific standard, and are necessary to morale in a population of skilled engineers and scientists. But it is a basic rule with us that to divorce applied and fundamental research would be fatal to an atomic energy research establishment.
2.4.4 Ispra possesses important computing machines (digital and analogue) which are needed for reactor work, but they are also used for computations asked for by the other European Communities, by national centres and industries. They are also at the service of an independent research programme in automatic translation and automatic documentation. The first derives from the Babel situation in the world, where the need for a common vehicular language has not yet been recognized and cared for. The second is a necessity in front of the exponential increase of the factual capital of science and technology. These two very active programmes have provided us with valuable and stimulating international connexions.
2.4.5 The main centre of interest for Ispra is the development of the "Orgel" type of reactors. They use natural uranium as fuel, (in the form of ceramic compounds, perhaps even of alloys), heavy water as moderator, high boiling-point organic compounds as heat transfer media, and special preparations of light metals as structural components. This combination holds reasonable promise of an industrial future. At the same time it can profit from, and contribute to, the development of other heavy water reactors developed at the national level.
I shall limit myself here to saying that the main departments in Ispra (reactor physics, materials, engineering) are for the time being mainly or wholly engaged in Orgel problems. The work, coordinated under my direct supervision by a project leader and his staff, gives rise in addition to numerous and important research contracts placed in the member countries.
Orgel is also the occasion for very active cooperation with American and Canadian laboratories. This shows — if it were necessary — that the Orgel concept is considered of value by respectable organizations.

C.E.T.I.S. (European Centre for the Treatment of Scientific Information), Ispra



2.5 A great fraction of our funds (over one third) are spent outside our own establishments*. But our outside spending never takes the character of grants. Giving grants is the business of numerous national and international organizations. While this is an efficient and valuable method of promoting and orienting research, it is not ours. We deal either through definite research contracts, through "associations" aiming at wide objectives, or through the power reactors participation scheme.

2.5.1 The main body of research contracts is linked with the US-Euratom agreement. This aims at the construction in Europe of American type reactors, it being understood that European industry must take the greatest possible share in construction as well as in related research and development work. However part of the work is to be carried out in America. The Euratom Commission pays for work in Europe, the United States Atomic Energy Commission pays for work in the US, and the amounts are to balance at the end. Decisions on the selection of projects are taken by a joint US-Euratom board; results are available without restriction to both parties.

So far, 94 such contracts have been placed, most of them in the Community. They deal with problems related to water reactors, and mainly concern fuel elements, reactor tank construction, special materials, fuel chemical processing, recycling of plutonium and waste treatment.

In addition to good quality research in Europe — and to the construction of one boiling and one pressurized water reactor — this agreement has led to the increase of intimate relationship between European and American laboratories.

2.5.2 The general condition of the power industry, alluded to above, has led the Commission to recognize that, in order to promote in good time a European nuclear industry, incentives are now necessary for the building of nuclear reactors. The participation programme is, therefore, open to electricity producers who intend to build industrial nuclear plants — I mean good enough and big enough plants — and who accept to share completely the know-how so obtained with others, under the aegis of the Commission. The Commission contributes moderate amounts towards various expenses which will help establish European industries. Three reactors have been so far accepted in this framework (one graphite gas-cooled; one boiling water; one pressurized water).

2.5.3 As for "associations", they are created when the Commission finds national long term research projects which can usefully be extended. This is done in the following way: the national undertaking is transformed into a joint operation in which the two parties contribute to funds and to management. In addition, and this is the most important feature, the actual work is carried out by a mixed team, the original group being increased by non-nationals belonging to, or sponsored by, the Commission. The proportion of such Euratom staff may reach 50% of the graduates working on the project.

Such associations have been established, or are being negotiated, in many important fields.

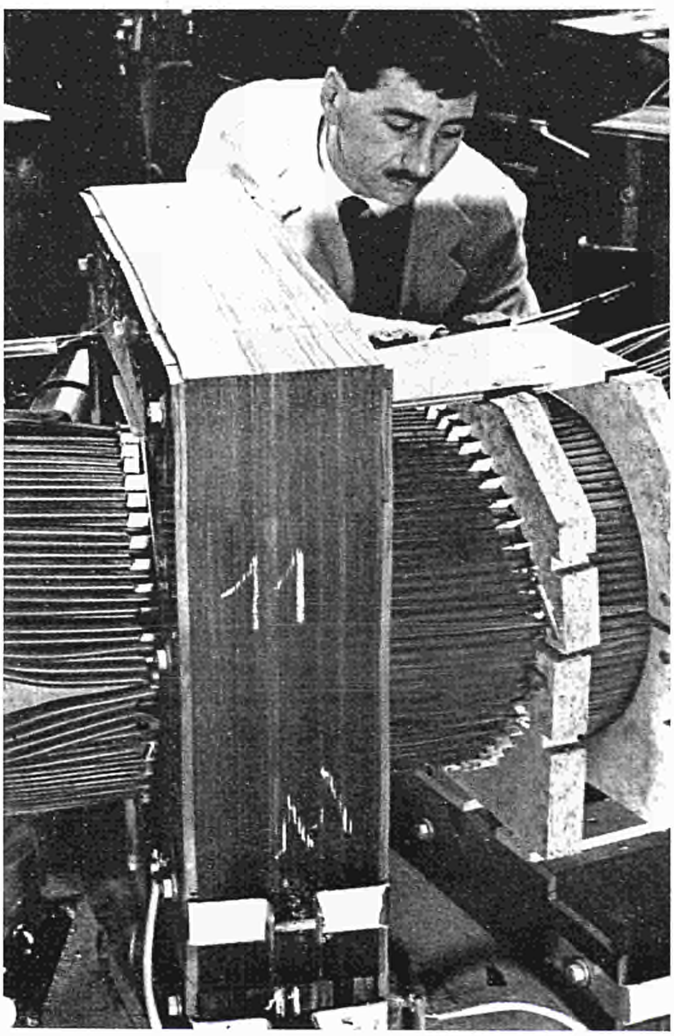
But before giving some details, I would like to say that: *a)* the experience so far is a success. While such set-ups do have their problems, the results are good, as well

* In addition to this, one must of course take account of the important development and construction contracts placed by the establishments themselves.

from the scientific as from the administrative and — why not say so — political points of view; —
b) a very great amount of patience, diplomacy and firmness of purpose has often been necessary to persuade the desirable partners. Many years of persistent efforts have sometimes been necessary. This is one more case when it would have been easy to yield to the temptation of isolated action, and it shows again how strongly we are toiling towards cooperation and coordination.
Associations cover the following fields:

Thermonuclear fusion

Nearly all non-military research in this field is, or will soon be, carried out in the framework of Euratom associations. This is already the case in France and Italy and partly the case in Germany. Another German association and one in the Netherlands are in the making. Belgium has found it sufficient to send good scientists to the staff of our associations.



Fast reactors

We can hope for a similar consolidation of all Community work, in the near future, in the most important field of fast neutron breeder reactors. An association with the French CEA (Commissariat à l'énergie atomique) is nearly ready and negotiations are getting under way with Germany. Such a consolidation will, of course, help to establish and increase collaboration with the US and UK in this field.
As always we have not waited for formal agreements before starting on actual work.
Here again, the pressure in favour of and temptation toward undertaking independent action were very strong and we have steadfastly had to resist many of our advisers or senior staff members in order to follow the above described course.

High flux reactors

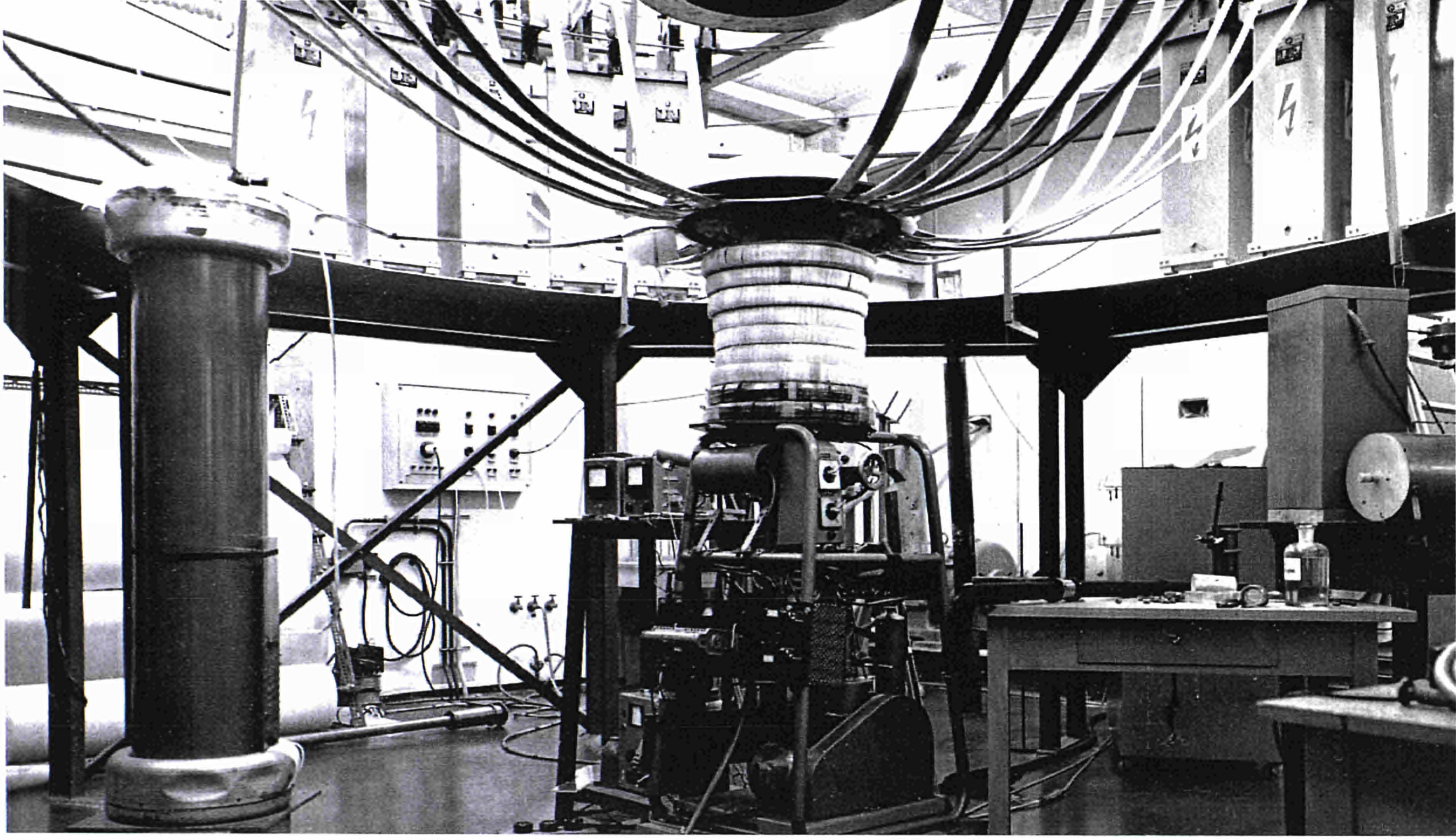
The most modern of such reactors in Europe, BR 2 in Mol, is run by an association between Euratom and the Belgian CEN (Centre d'étude de l'énergie nucléaire).

Miscellaneous

Homogeneous reactors, some nuclear physics, applied radiobiology in agriculture and in animal studies, as well as isotopic geology have given occasion for other associations with French, Belgian, Dutch and Italian organizations. Some exist also (in particular in Germany) in the most controversial field of nuclear merchant ships.

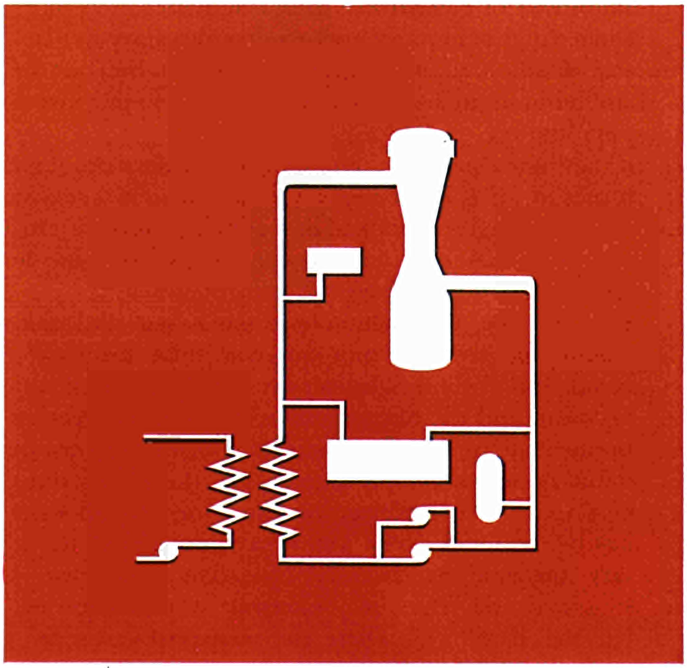
OECD undertakings

We can consider as associations the Halden and the Dragon OECD projects (in which the Commission has joined on behalf of the six countries) because these projects, like our associations, are characterized by a national start, followed by joint financing, joint management, and international teams.
The Halden project (in Norway) concerns a modest reactor experiment on boiling heavy water reactors.
The Dragon project is an important development towards high-temperature, gas-cooled reactors. It derives from a British project. It should logically be linked with the BBC/KRUPP AVR undertaking. This is another asso-



Thermonuclear fusion – a view of the Garching laboratory (German Federal Republic)

Diagram of the BR 2 materials testing reactor in Mol (Belgium)



Thermonuclear fusion – a research device in the Fontenay-aux-Roses Laboratory (France) ciation which we have been looking to, for well over three years now, and which has been recently accepted, at last, by the German authorities.

3. Having thus given a short — yes, short — account of what has been, and is being, done since 1958, I would like to present some general basic considerations underlying the second five-year plan proposals, which should bring us from 1963 to the end of 1967.

a) The activities described above are under way but they are far from being finished, and thus will be the major undertakings of the second plan. Some of them have nearly reached a steady operation volume (Orgel); others must increase considerably (fast reactors).

b) While the scope and rhythm of past development has been gratifying, we must realize that Euratom is living dangerously, in particular as far as senior staff is concerned. Men having at the same time the necessary general calibre and the particular training and experience are very scarce. But the success of our action lies in our ability to recruit enough of them, or, failing this, in our daring and good judgement in promoting young men to positions of responsibility. Both courses of action are not too much helped by the conditions of service at Euratom (salaries as well as recruitment and promotion procedures), which, more and more, become less favourable than those offered by public or private atomic enterprises to the key men we are considering.

c) This makes it all the more imperative to maintain a minimum rate of growth in our activities so as to ensure the feelings of urgency and opportunity necessary to healthy establishments, and without which the best of the staff are tempted to leave. A 10 to 15% yearly increase is none too big.

d) In the same connexion, and with unforeseen developments in view, it is necessary to provide for a reasonable amount of unprogrammed and of marginal research. This does not cost much in equipment, as no new heavy machines can be involved at early stages.

e) The time has definitely come when national and Community programmes can and must be intimately connected. It is possible because, as we said, both national organizations and the Community's Research Centre are mature institutions. It is necessary for obvious reasons of sound management of our resources. It is therefore a duty of all of us to perform, casting away on all sides all institutional selfishness. The Treaty provides all the necessary mechanisms, particularly after they have been supplemented by the "Consultative Committee for Nuclear Research" where the men responsible for programmes in the member states and in the Commission jointly discuss all matters relevant to plans and budgets. This Committee, and its sub-committees, have been very active and useful in the last year. It will have reached its goal when it has really become the joint planning group, for nuclear affairs, of the whole Community (member states *and* Commission).

The Second Five-year Plan

4 It is now rather easy to figure out what the second five-year plan must look like.
Its three main features are:
a) active furthering of activities already in hand;—
b) within the minimum healthy rate of growth;—
c) with just enough leeway to maintain a sensible measure of exploration in new fields.

4.1 Both a global approach and an item by item reckoning led us to total appropriations of the order of \$ 480 million for the five years 1963 to 1967. At the same time the staff numbers should progress from somewhat over 1900 to over 3500, with an average number under 3000.

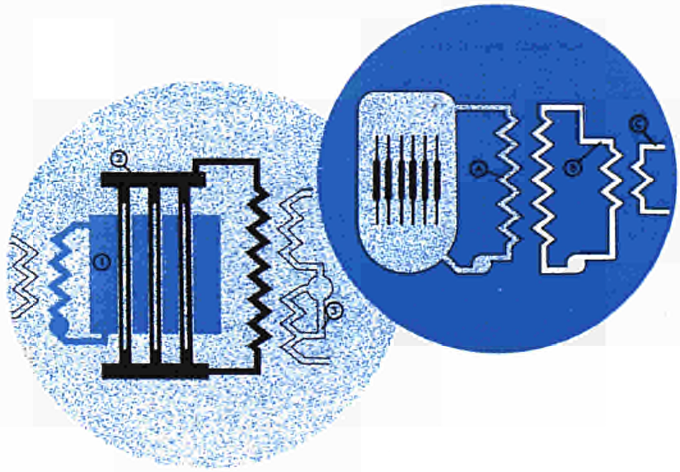
4.2 4.2.1 No new establishments of the Community's Research Centre should be created; those already in existence should reach a rather steady condition of activity.

4.2.2 The main lines of reactors to be developed should be those already defined, namely:

Two reactors rich in promise for Europe's nuclear future:

Left: an ORGEL circuit.
1. Heavy water moderator
2. Organic coolant
3. Steam-generating system

Right: a fast reactor circuit
A. Primary liquid sodium circuit
B. Secondary liquid sodium circuit
C. Steam-generating system



a) "Orgel" mostly by our own work in Ispra and by contracts;—

b) fast reactors, using plutonium as fuel, mainly by association contracts, gathering the forces of the Community in the national projects already under way;—

c) high-temperature gas-cooled reactors, again by the development of existing or new associations.

4.2.3 Accessorily other industrial reactor types will be considered or contributed to:

a) The research and development programme already under way in the framework of the US-Euratom agreement should be continued, and adapted to industrial and technical circumstances as they develop.

b) Variants of reactor types can be usefully worked on without involving the same sort of expense as the setting up of an entirely new family (that is up to $ 400 million from first experiment to really industrial models). Nevertheless one must be very careful—perhaps all the more careful—in embarking on such work. This is why further development of ordinary water, or heavy water reactors, involving for instance integral superheat, spectral shift, or fog cooling, must not be entered into without full consideration.

However some development work along these lines is useful and does not commit too many resources.

So-called reference designs and/or economic studies can be very badly misleading when, as is too often the case, they are based on insufficient nuclear and engineering data. The construction of very small industrial plants may be a somewhat more expensive manner of making essentially the same mistake and we shall try to avoid encouraging it. Let me give a somewhat excessive example of what I mean: does anyone here imagine that the construction and operation of a nuclear-powered fishing trawler would be a significant step towards the advent of a nuclear merchant fleet? Might it not rather ridiculize the whole undertaking?

Let us therefore commit ourselves to an open-minded but lucid and deep exploration of any such schemes, and resolve not to be drawn into operations which, from the start, are insufficiently well defined in their scope or insufficiently desirable.

Most likely any such operations would be of a definite industrial character. They would therefore go beyond the Commission's research programme. But they might be dealt with as "joint enterprises" as defined in Chapter V of the Treaty, and they might need a research and development programme in which the Commission could take an active interest.

4.2.4 The Commission will continue to operate, or share in the operation of materials-testing reactors. It will also further cooperation in this field and in the neighbouring questions of ancillary equipment and of "hot" laboratories.

4.2.5 The knowledge of solid materials, in particular metals, ceramics, and cermets, can very much be enhanced by the use of neutrons both as probes to explore structures and as projectiles to disturb them. It has therefore been suggested that Euratom, alone or in association with member states, might build in Ispra a "hyperflux" reactor for studies of that sort. This most interesting project shall be very carefully examined, because such a reactor raises by itself important and difficult problems, and because its operation and use would exert a great influence on the very spirit of the Ispra establishment.

4.2.6 We should keep alert and informed in some side-lines which may assume importance in the future, so as to be ready to get into action when needed. The auxiliary power sources for space probes, for instance, fall naturally in the field of the Karlsruhe Transuranium Elements Institute from the chemical point of view, and, from the physics point of view, in that of the direct conversion group of Ispra.

Our interest in high-temperature reactors may lead into the very high-temperature machines which are considered for space propulsion.

When member nations decide to get together for their endeavours in space it might be considered logical, and appropriate, that they entrust to an already existing and competent Community the relevant nuclear parts of such programmes.

4.2.7 Without going into details the following must be mentioned, for the sake of completeness:

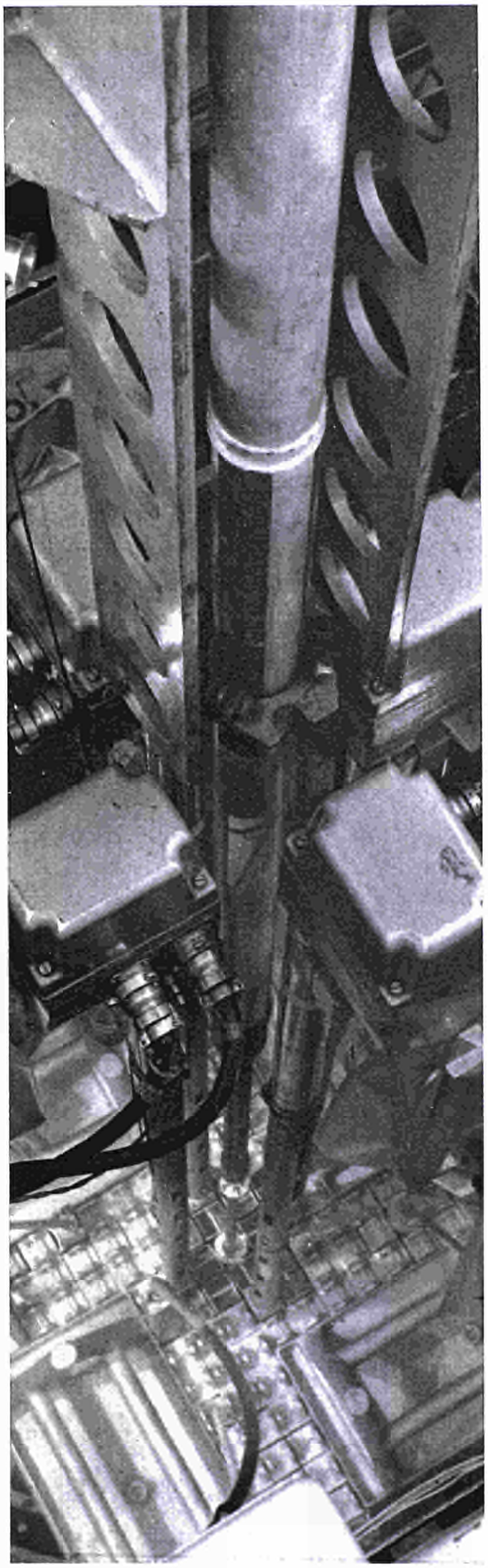
a) thermonuclear work will go on;—

b) activity will be maintained in the various branches of chemistry associated with atomic energy, from fuel processing to waste products treatment and disposal, and to isotope applications;—

c) in addition to the regulatory role entrusted by the Treaty to the Commission in matters of safety and public health, research relevant to these problems will be maintained. From this stems a biology programme which, prepared and begun in the last 18 months, should go into regular steady operation during the second five-year period. Here again we shall mostly work by association with national institutions.

4.2.8 Documentation (current and futuristic) and teaching cannot be neglected.

Documentation must inform all, and first those who give us the means of working, on what we are doing. We shall take the greatest pains to provide quick and accurate



information on worthwhile matters. We shall take no lesser pains to avoid overloading the communication channels with irrelevant or immature material.

Documentation must also digest and direct to its place of use information on what the rest of the world does. We shall therefore keep up the work mentioned earlier on machine-processing of non-numerical data, including languages.

In teaching, our job is not to increase the formal university and engineering school courses (although we are, of course, willing to help in harmonizing specialized nuclear departments). We would rather concentrate on furthering the links between universities, engineering schools, and nuclear centres (this is the trainee system already in operation) and to contribute, in all possible manners, to the transformation of specialists of all disciplines, at various stages of their professional life, into nuclear engineers, or into users of nuclear and paranuclear techniques.

Since we have issued, somewhat over three months ago, the first outline of our second five-year programme, active and continuous discussions have been taking place between the member states and the Commission.

It has been a great satisfaction to us that the exchange of views has been lively, but that—in our opinion—there has been no fundamental opposition to our proposals. Indeed, in quite a number of cases, they have been considered too modest, and we have been urged to increase the intended appropriations.

This exchange of views will continue. A revised edition of the tentative programme will be prepared, and we hope that it will be possible to have a decision from the Council of Ministers before the summer holidays. We could then prepare and submit in due time the 1963 budget estimates, which would embody the new thrust of the Community towards its nuclear aims.*

So far we have considered the Community as it exists now. We all are deeply aware that, early in the second five-year-period, it might be increased by the entry of new partners, among them the United Kingdom, the major nuclear nation of Western Europe.

Fortunately the nuclear world is now open enough for us to know that such an event, however momentous, would not change the basis of development outlined above. Of course many adjustments would be necessary, including major ones. But I am confident that the main lines would stand and only be strengthened. It is too early to say any more on this subject which, however, could not but be mentioned here to-day.

* Since the date of this address, the Council of Ministers has taken a decision on the second five-year programme, keeping to the broad principles outlined above, but including a few other items. The total sum has been brought down to $ 425 million until the end of 1967, which will necessitate several adjustments.

Radiation can bring about minute molecular changes in the basic components of living organisms. These changes, when amplified by the continual renewal of living matter, can result in very serious disorders and even death. Research has in fact demonstrated that biological systems have a very low tolerance of changes sustained by their constituent elements.
In an attempt to study this tolerance factor, biologists have conceived the idea of inducing the organism to incorporate a series of "false" components.

Can tricks be played on life?

Albert J. Bertinchamps

Biology Division, Directorate-General for Research and Training, Euratom

Living matter is composed of a limited number of chemical elements accounting for a relatively constant percentage of the total mass in the body of an individual — a fact which may be most clearly demonstrated by comparison between individuals of the same types (same race, same weight, same age, same sex). But even between very different species there is a certain tendency towards uniformity in chemical structure. This invariability in chemical make-up is found in cells and is therefore even more apparent on the molecular level. For instance, the quantity of nitrogen and phosphorus contained by a given number of cells of a rat's liver is relatively constant. The quantity of iron present in a haemoglobin molecule never varies.

All these elements, however, are in a constant process of renewal and they are maintained at a steady level by means of a dynamic equilibrium. This immutability in the chemical composition of living matter is not due to inertia but to the incessant interplay of a complex but exact system of checks and balances designed to ensure that, irrespective of the structure and physico-chemical state of the external medium with which the unceasing exchanges are effected, the organism will maintain a constant make-up and continue to function in a regular way. The living organism has been defined, with some justice, as merely the momentary meeting place for elements of a given medium. For all that, such meetings are not of a fortuitous character. They occur as if each atom entering the organism has first been subjected to an extremely rigorous process of selection in line with precise criteria. And indeed, besides useless or even harmful elements, there are a number of simple elements whose presence is absolutely essential to the preservation of life. They are sometimes extremely unobtrusive and many of them appear only as traces in living matter. These traces are, however, indispensable, for otherwise the organism would suffer serious disorders, or even death. This applies to such elements as copper, zinc, manganese, etc.

These absolute requirements may relate not only to simple elements but also, and especially, to the more complex molecules, such as amino-acids, vitamins, etc. that some organisms are incapable of synthesizing themselves despite the availability of the simple constituent elements.

The molecules in question, then, enter metabolic chains whose purpose is to ensure continuity of important functions such as the generation of energy, growth, reproduction, etc.; for this reason they are called essential *metabolites*.

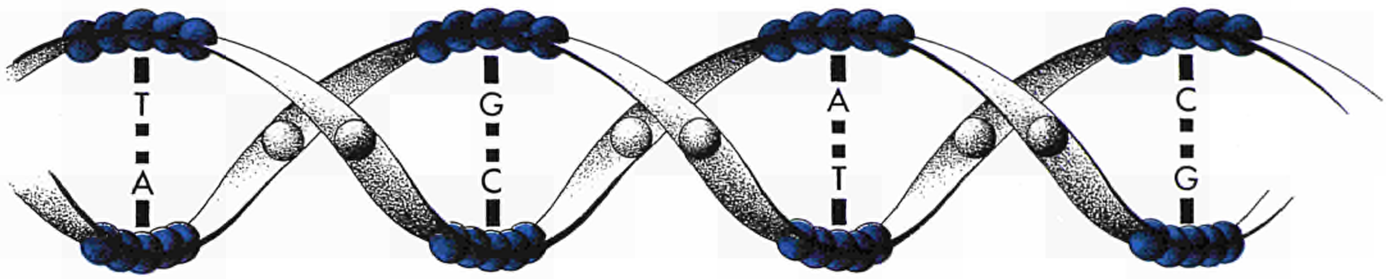


Fig. 1. Diagram representing a DNA molecule

The DNA molecule may be likened to a long ladder warped in the direction of its longitudinal axis. The uprights are composed of a sugar (the deoxyribose) and phosphoric acid. Some of the rungs consist of adenine (A) and thymine (T), others are made up of guanine (G) and cytosine (C)

A habit which is becoming increasingly popular these days is the use of slot-machines. For a few francs, it is possible to obtain in many places, at any hour of the day or night and without any human agency, a variety of goods or services.

This is assuredly a most convenient device and we should be very grateful to those whose ingenuity has made these machines available to the general public, thus benefiting both anonymous parties in the transaction.

If all our fellow-humans were honest, it would have sufficed to put cigarettes, chocolates and thousands of other articles on display everywhere, with a label, showing the price in each case and inviting customers to put the required sum in a receptacle conveniently placed for the purpose. All the shopkeeper would have had to do would be to restock his display counter from time to time and to collect his money. Unfortunately, allowance has to be made for the lightfingered, and the goods have to be protected by making delivery subject to the prior payment of an adequate amount of hard cash. For instance, if the price of a stick of barley sugar is three francs and if instead of three one-franc pieces you try to put in only two coins, or if you try to get the machine to take three 25-centime pieces or three peppermints, in every case you will fail to obtain delivery of the article you covet. Even supposing you endeavour to insert three five-franc pieces or even a 1,000 franc note, you will have no better luck. If, on the other hand, you make a series of attempts with pieces of metal having the same general shape, approximately the same diameter and thickness and roughly the same weight as a one-franc-piece, and if by gradually filing them down you come nearer and nearer to achieving the ideal one-franc-piece, the probability is that your efforts will finally be crowned with success. The machine will accept your spurious coins and will give you a real stick of barley sugar.

The trouble that you have to take to cheat the machine depends on how sharp the designer is. It would not be beyond the wit of man to devise machines which would check not only the shape, weight, diameter and thickness of the coins but also the number of grooves around the edge, the fineness, etc., thus virtually ruling out the possibility of fraud.

We have seen that, in the same way as these highly perfected machines, living organisms are extremely exacting as regards the entry of elements into their metabolic chains. This, however, has not prevented biologists from attempting to "cheat" and to "put one over" on this well-nigh perfect machine. The purpose of the present article (and we apologize for the rather roundabout analogy which we have adopted) is to describe a number of instances in which they have been successful, to the greater benefit of biology and medicine.

The idea of replacing a diseased or useless organ by a similar organ originating from a different organism is by no means new. By all the rules, however, all attempts of this kind are theoretically doomed to failure.

Any alien protein introduced into the organism is immediately recognized for what it is and judged undesirable. It triggers off a complex immunological response which sooner or later culminates in its rejection. The sharpness of this reaction is directly proportionate to the difference between the donor and the host.

Uniovular twins, however, are an exception to this rule. If an organ taken from one is properly grafted on to the other, there is no immunological reaction and the graft "takes". It is probable that, in such an instance, the word trickery is not applicable in its strict sense. The tissues are no doubt as alike in all respects as the twins are themselves.

Attempts have also been made to minimize or eliminate the immunological reaction by chemical or phsyical means (e.g. radiation). These efforts have on several occasions met with a limited degree of success. In the case of a corneal or plastic grafting, the organism's immunological reaction is precluded by the absence of any blood circulation in the organ grafted. As we know, it is possible, and has even become quite a usual practice, to transfuse all the blood or elements of the blood (erythrocytes, platelets) from one person to another. This practice is, generally speaking, permissible subject to the observance of a number of rules arising from the more or less pronounced incompatibility between the various blood groups and sub-groups to which the individuals belong. Moreover, it must be pointed out that the fact that a transfusion causes no reaction does not in any way mean that nature has been "taken in". The refinement of immunological techniques has led to the discovery of a very considerable number of sub-groups, which shows that nature is well aware of what is going on. It simply tolerates these happenings, which is quite a different thing.

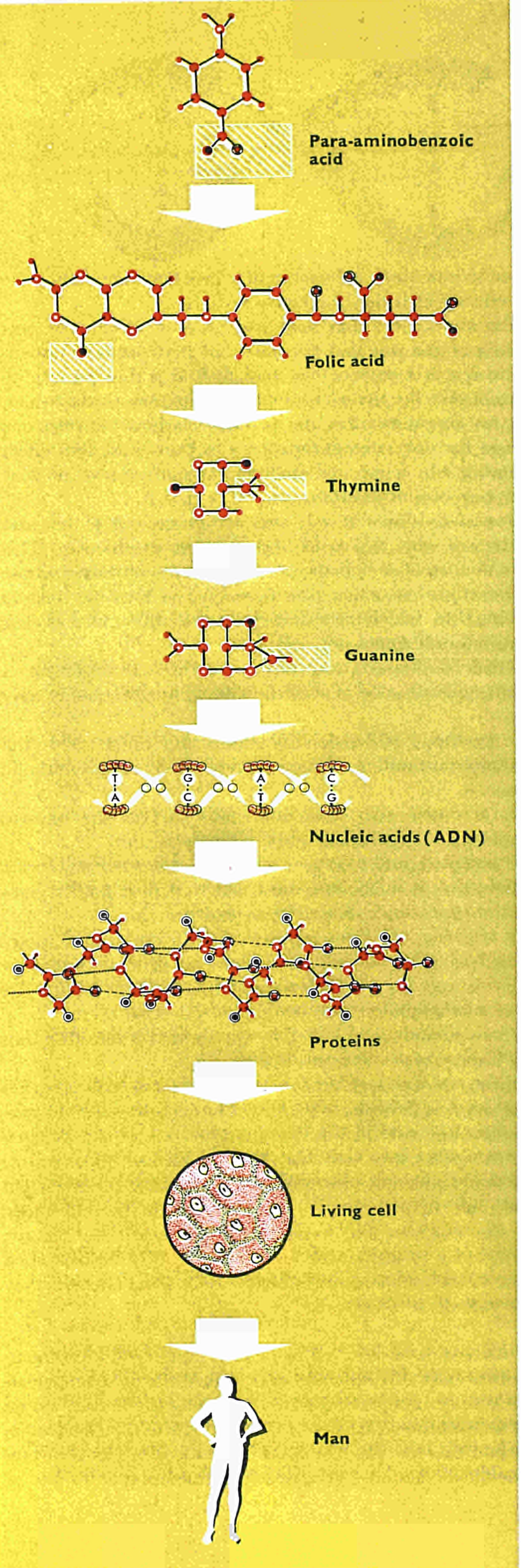
Deoxyribonucleic acid (DNA) is present in the nucleus of every cell and is involved in cell division, protein synthesis and the mechanisms which operate to transmit hereditary characteristics. The DNA molecule may be likened to a long ladder warped in the direction of its longitudinal axis. The uprights are composed of a sugar (deoxyribose) and phosphoric acid. Some of the rungs consist of adenine and thymine, others are made up of guanine and cytosine. There are thus four kinds of rungs, corresponding to the four possible configurations (see Fig. 1). It is the sequence of these rungs which constitutes the *code* governing the structure of the various proteins. The DNA molecule is a very long one. Its weight is several million times that of a hydrogen atom. There is therefore a multitude of rungs and an astronomically high number of possible sequence permutations. This accounts for the extraordinary diversity of living creatures. When the cell divides, the DNA ladder splits longitudinally and each daughter cell takes with it a single upright to which all the half-rungs remain attached in their initial order. The code is thus handed down from one generation to the next.

It can therefore be seen that any interference with this system may result in the synthesis of abnormal proteins, the impairment of the hereditary characteristics or the blocking of the cell division process. Radiations may for instance induce these anomalies precisely because of the direct effect which they have on DNA.
It is also known that folic acid plays a part in the synthesis of guanine and thymine and that para-aminobenzoic acid is a precursor of folic acid. It is thus possible to establish a sketchy picture of the metabolic chain, which in no way prejudices the precise relations between one stage and the next, except for a certain cause and effect relationship which we shall intentionally leave unclear for purposes of simplification (cf. Fig. 2-A).
One must admit that it was very tempting to try and interfere with this apparently perfect mechanism. This is why a number of molecules have been synthesized whose overall chemical structure resembles each of the links in this chain but which nevertheless betray more or less pronounced differences (fig. 2-B).
When these bodies are introduced into the organism in sufficient quantity, one of the following phenomena may result:

1. The synthetic molecule differs too much from the natural molecule and is not incorporated in the metabolic process.
2. It is accepted, plays the same part as the natural molecule and no discernible anomaly ensues.
3. It is accepted, and produces no noteworthy metabolic alteration, except in the last stage, where it finally gives rise to the appearance of abnormal proteins.
(4) On entering into competition with the natural molecule, the synthetic molecule gives rise to a deficiency in one of the organism's essential metabolites; hence the name of *anti*metabolite commonly given to them.

One is immediately struck by the various interesting uses to which these molecules can be put:
During the research into the functions of certain essential metabolites, it is possible, using a judiciously selected *anti*-metabolite, to create in the living organism a deficiency of the metabolite involved. The anatomical, biochemical or functional changes observed may subsequently yield valuable information on the function of the substance under examination. When these changes resemble the symptoms of a disorder which can readily be described but whose mechanism is unexplained, some pointers may be gained as to its cause.

Scientists have been led to believe that certain antimetabolites exist naturally and take part in the control mechanism of certain syntheses by preventing the accumulation of an excessive quantity of the products of such syntheses. It can be seen how the final molecule of a chain of biochemical reactions, because of its resemblance to one of



the source materials, inhibits the entry of this material into the metabolic chain.

In some cases, antimetabolite research has shed a certain amount of light on the nature of infectious diseases. There is a tobacco plant disease caused by *pseudomonas tabaci*. The toxin released by this organism is an antimetabolite of methionine, which itself is an essential amino-acid.

Serotonin is a hormone which causes contraction of the unstriped muscles. More particularly, this essential metabolite is present mainly in the nervous system. Successful attempts have been made to synthesize a whole range of *anti*serotonins which have the remarkable property of bringing about mental disorders (depressions, attacks of epilepsy, hallucinations, etc.).
It has further been discovered that several products long known for their effects on the nervous system, such as yohimbine, certain alkaloids of ergot of rye, etc., are antimetabolites of serotonin.
These considerations prompted Wooley and Shaw to advance the hypothesis that schizophrenia is the result of a disorder of the serotonin metabolism. This is still an extremely controversial question, but there can hardly be any doubt that antimetabolite research will provide a substantial contribution to our knowledge of this serious affliction.

Sulphanilamide exerts a highly depressing effect on the development of many microorganisms. This phenomenon, which has been turned to considerable advantage in infectious disease therapy, is probably attributable to the antimetabolite part played by sulphanilamide in relation to para-aminobenzoic acid, an essential metabolite for such microorganisms. The absence of this inhibitory effect in the higher animals is probably to be ascribed to the fact that they are by themselves incapable of synthesizing folic acid from para-aminobenzoic acid and use only exogenous folic acid.

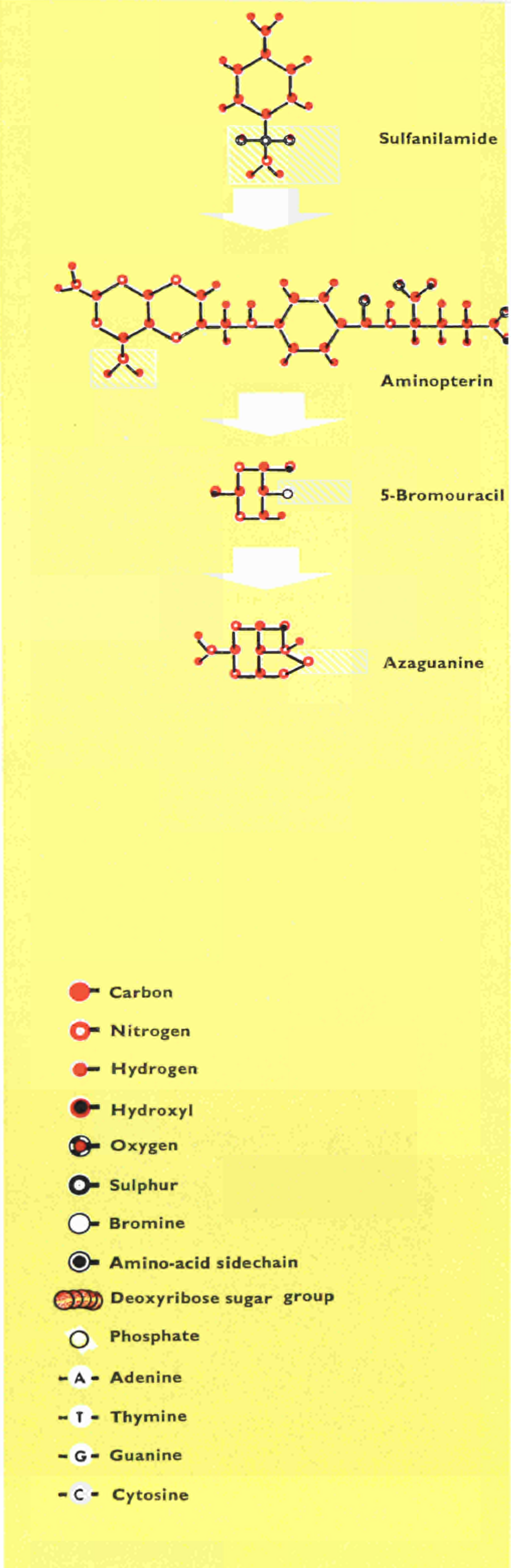
Many other examples could be adduced of "false" *molecules* being put into circulation by biologists. However, as we shall see, they have not stopped there; with the advent of nuclear energy they have conceived the idea of experimenting with "false" *atoms*.

Iodine is a constituent of the hormones which are synthesized in the thyroid and exert an influence on the energy process in living cells. The iodine atom, like all atoms, consists of a nucleus and peripheral electrons. In

Figs. 2-A (left) and 2-B (right)
Fig. 2-A is a sketch of a natural metabolic chain. On the other hand fig. 2-B shows synthetic molecules whose overall chemical structure resembles each of the links of the natural chain, but which nevertheless betray more or less pronounced differences (hatched areas).

this case there are 53 electrons, while the nucleus contains 53 protons and 74 neutrons. As soon as it enters the organism, this atom is quickly seized upon by the thyroid and incorporated in the thyroid hormones, which in turn are distributed via the bloodstream throughout the organism. In this way, a number of iodine atoms are taken up into the metabolic chain of the thyroid hormones every second. As a general rule, they are never accumulated. The hormones are disposed of steadily as they are produced, so that the quantity of both the iodine and the hormones remains constant. As the chain is unbroken and never stops, and as, moreover, it is impossible to observe a single atom in isolation, it is also impossible to form an idea of the rate at which the chain progresses or how much it produces. No solution could be provided to the question of whether certain diseases did not originate from a slowing-down, a stoppage or a speeding-up of thyroid hormone synthesis until one day biologists, with the connivance of the physicists, hit upon the notion of mixing with the innumerable iodine atoms a number of atoms a chemist would identify as iodine but which differ from the normal element: instead of 74 neutrons, they contain 78, which means that they are radioactive and hence detectable and measurable to a high degree of accuracy. It appears that this time the organism was duped and accepted this counterfeit as legal tender. Insofar as the radiation effect can be discounted, radioactive iodine is metabolized in the same way as stable iodine. However, it emits discreet signals which enable biologists and doctors to follow accurately the rate of production of the thyroid and to detect any alterations which it may undergo.
The countless uses to which radioisotopes are being put in modern biology are thus based on what is at bottom nothing but a swindle, a swindle which has enabled us to study a tremendous variety of metabolisms and to fathom many secrets.
It must not, however, be thought that the organism is wholly blind to the changes which take place in the atomic mass of its constituent parts. In the case outlined above, the radioactive iodine only weighs about 3% more than the stable element. On the other hand, when dealing with heavy water, whose molecules weigh 10% more than those of light water, most organisms clearly discriminate between the two, giving rise to what is known as an isotopic effect.

As will be seen, one can scarcely reply by a simple yes or no to the question put in the title of this article: can tricks be played on life? The best answer, no doubt, is: yes, but it is very difficult. At all events, it seems to be worth trying.



Euratom and the questions of liability and insurance

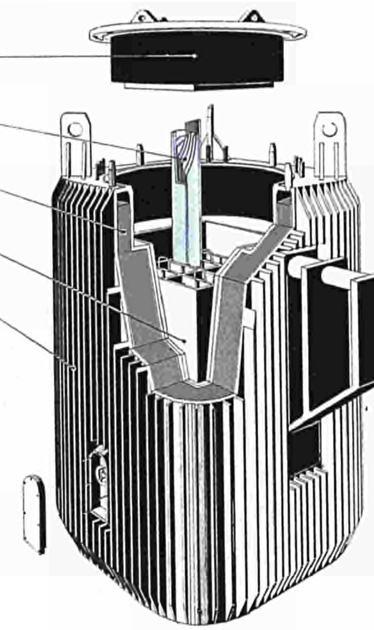
Reinhart Bauer
Directorate-General for Industry and Economy, Euratom

The start-up of the Belgian reactor BR-3 in Mol shown here depends on a solution of the nuclear liability problem

The problems of liability and insurance

It was the Hiroshima bomb which made the public aware of the existence of nuclear energy; it is therefore not surprising that nuclear risks should be exaggerated. Although any occupation which has to do with the atom, even in its peaceful applications, tends to be considered by the layman as particularly dangerous, it is a fact that only very few nuclear incidents have occurred. Among these not even one can be singled out as disastrous. The experts agree that in the case of the reactor types adopted hitherto an explosion such as that which is set off by an atomic bomb is completely inconceivable. Thanks to the comprehensive safety provisions laid down in all states, even the possibility of a chain reaction running out of control in an atomic reactor is highly unlikely. Similarly, radiation hazards are so effectively restricted by safety regulations that from available statistics it is apparent that the accident rate in nuclear installations is lower than in conventional industrial enterprises. However, in spite of all precautions, the possibility of incidents cannot be completely ruled out and account must be taken, at least in theory, of the fact that they may yet reach greater proportions. Therefore, apart from accident prevention, one must tackle the question of dealing satisfactorily with damages which could be sustained by third parties. Moreover, prescriptions regarding liability must be adapted both to the nuclear risk involved and to the available insurance facilities.

...e in nuclear energy



A container designed for the transport of fuel elements

The usual legal principles relating to accident liability do not satisfy these requirements. For instance, if the usual concept of negligence is accepted, liability is contingent on the injured party's ability to prove the negligence of the party causing the damage. When one considers the complexity of the processes occurring inside a nuclear reactor and the consequences to which the radioactive contamination of an installation might lead, how would it be possible to follow up a claim? Conversely, unlimited liability could burden the responsible party with excessive risks, perhaps to the extent of threatening his very existence. Even the suppliers of certain parts of the nuclear installation or branches of industry which contributed to its construction or operation, would have to carry a risk which could exceed, many times over, the value of their share of the work.
Apart from these difficulties, the coverage of nuclear risks through insurance cannot be effected in a conventional manner because special uncertainty factors are involved. It is particularly difficult to estimate what technical reserves have to be made available in the absence of statistical data on case histories. Moreover, the dominant principle of insurance, namely the spreading of risks, cannot be fully applied: there are as yet only a small number of nuclear installations both inside and outside the Community. The present state of our knowledge does not allow us to rule out the possibility of a particular type of damage requiring the deployment of resources beyond the capacity of a single insurance company. Hence no insurer has alone assumed the third party risk for nuclear installations; individual companies have preferred to form pools on a national basis and combine their resources for the coverage of nuclear risks. Although these pools achieve a good measure of coordination between companies and make them, thanks to mutual reinsurance, capable of handling larger business, they can only guarantee a limited cover. Self-insurance is also ruled out in most cases.
In the case of far-reaching damage the operator of an installation could therefore very well find himself without sufficient cover. It is clear that no one would be prepared to plan, build or operate nuclear installations if he found himself exposed to the risk of having to meet liabilities against which he could not fully cover himself. This is why a reasonable solution to the problem of liability and insurance is an essential condition of the development of a nuclear industry.

The solution of the liability problem

a) Fully alive to this correlation, a number of states concerned with the development of nuclear energy have tried to resolve these questions through national legislation; this applies in particular of the German Federal Republic, Japan, Sweden, Switzerland, the United Kingdom and the United States. They have either developed new principles concerning liability or amplified the existing principles.
It goes without saying that national legislation cannot, in a satisfactory manner, cope with the consequences of nuclear incidents the effects of which extend beyond national frontiers. This is true, for instance, in the case of an accident bringing about the formation of a radioactive cloud, of the infiltration of radioactive substances into waters which border several states, or of liability problems raised by the transport of radioactive materials from country to country.
It is evident that purely national solutions were quickly felt to be unsatisfactory in such a small and geographically divided continent as Europe. This is why work was begun in 1957 within the framework of the European Atomic

The reactor of the Società Elettronucleare Nazionale (SENN) on the banks of the Garigliano in Southern Italy. The reactor will soon be completed, and yet it will not be possible to start it up until a satisfactory solution has been found for the liability problems involved.

Energy Agency of OEEC on an international convention dealing with third party liability in the field of nuclear energy; the discussions culminated in the signature of this convention in Paris on 29 July 1960 by sixteen European states. The most important principles of the Paris Convention, which is not yet in force, can be summarized as follows:

— Liability exists even when no negligence can be proven (absolute liability);

— Only one person is liable, namely the operator of the nuclear installation which caused the accident. In particular suppliers are free from liability (channelling liability);

— Recourse against third parties is ruled out on principle;

— Liability is not only limited in time by prescription but also in extent; it is in principle limited to 15 million units of account ($ 15 million);

— In order to cover his liability the operator of any nuclear installation is bound to obtain a financial guarantee (insurance policy or another guarantee) up to the amount laid down;

— As for the transportation of radioactive materials on the territory of one or more of the contracting parties, liability devolves on the operator effecting their dispatch until such time as they have been taken over by another operator.

b) The member States of the European Atomic Energy Community have signed the Paris Convention. They are, however, of the opinion that it needs to be supplemented because the liability ceiling of 15 million units of account could prove to be too low. They have therefore decided to conclude another agreement, supplementary to the Paris Convention, on the basis of a draft submitted a few years ago to the member States by the Commission of the European Atomic Energy Community.
The spirit of this agreement consists in supplementing the cover which must be obtained by the operator by bringing up to 120 million units of account the ceiling of compensation. As this amount cannot at the moment be raised through private insurance, only individual states or all contracting parties together come into consideration as guarantors.

The system of liability arising from this principle is as follows:

1. In accordance with the Paris Convention, the operator must cover himself up to the stipulated ceiling through insurance or some other form of financial guarantee.

2. Compensation over and above this amount is dealt with in two stages:

— For the amount between the previously mentioned ceiling of 15 million units of account and 70 million, the state on the territory of which the installation responsible for the damage is situated guarantees compensation.

— Between 70 millions and 120 millions the member States are collectively responsible for compensation.

The supplementary conven ion is applicable to all nuclear installations operated for peaceful purposes. As this may lead to difficulties of interpretation, the installations covered by the supplementary convention must be entered on a special list.

At the present stage of negotiations compensation will be applied if

— the installation causing damage is situated in the territory of one of the contracting parties,

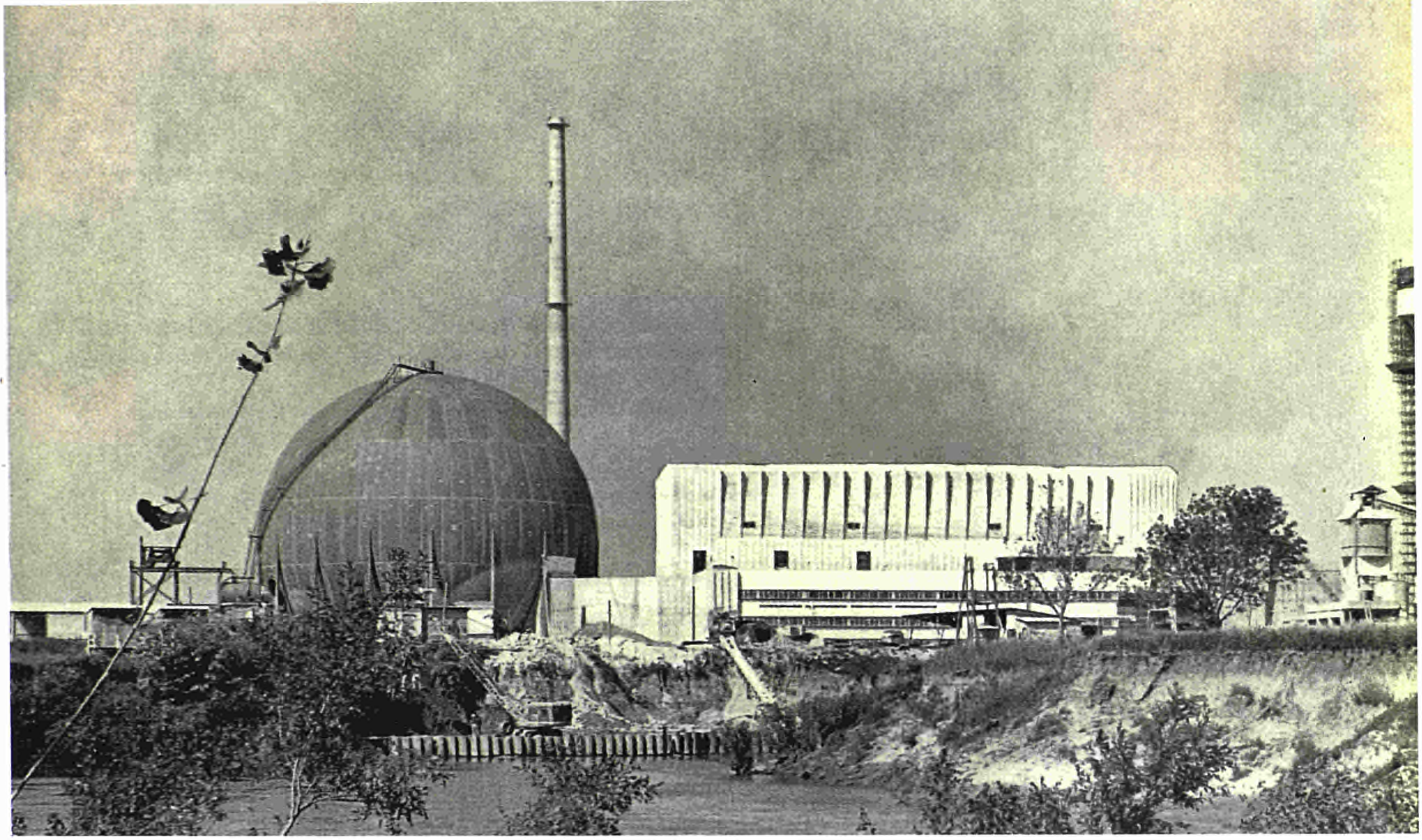
— the nuclear incident has occurred on the territory of one of the contracting parties or on the high seas (important in the case of transport) and

— the damage has been suffered on the territory of one of the contracting parties or on (or above) the high seas, on board a ship or aeroplane registered in one of the contracting countries, or, without reference to the means of transport, when

— the victim is a national of one of the contracting parties.

These provisions are applicable only in so far as a court of a contracting party is competent to pronounce judgments on claims for reparations.

A special difficulty arose in connection with the stage where the contracting parties guarantee payments collectively (i.e. between 70 and 120 million units of account), because it was necessary to determine in the text of the convention the financial contribution of each contracting party. The following system was finally established: one half of the contribution is a function of each state's gross national income, and the other half a function of the installed thermal power of the nuclear reactors situated in the territory of each contracting party. The advantage of this system is that, even should other states wish to join the supplementary convention, it can



be immediately applied without any need for amendments or additions.

This supplementary convention is "open", i.e. even states which are not members of the European Atomic Energy Community may join, provided they have ratified the Paris Convention. Towards the end of 1961, as negotiations between the six Euratom countries had reached an advanced stage, representatives of other countries which might be interested were invited to take part in a meeting held in Brussels, in the course of which they were informed of the results of these negotiations. Since then Austria, Denmark, Greece, Norway, Spain, Sweden, Switzerland, Turkey and the United Kingdom as well as the European Nuclear Agency of OECD have been taking part in the discussions and it would be a gratifying outcome if these states were to adhere to the supplementary convention, which could well be signed this very year.

c) Apart from the task of preparing the supplementary convention, the Euratom Commission is following with particular interest the efforts deployed by other organizations in order to promote similar international agreements. In this context, special mention should be made of the international convention on third party liability for nuclear ships. Indeed, both the Paris Convention and the supplementary convention are confined to land-based reactors. The shipping convention was submitted to a diplomatic conference, first called by the Belgian Government in the spring of 1961, which completed its work in May 1962. Mention should also be made of the draft convention of the International Atomic Energy Agency in Vienna which aims at a world-wide agreement on liability for land-based reactors; this draft is to be examined by a diplomatic conference in the course of next year.

Practical insurance problems

Even after the above-mentioned conventions come into effect, many problems will still remain to be solved, especially in the field of nuclear insurance. There are now many research organizations and industries, in Europe, which have to tackle them from a practical point of view. Article 98 of the Euratom Treaty, while specifying that the member States must take all possible steps to facilitate the conclusion of insurance contracts aiming at the cover of nuclear risks, states that the Euratom Commission is to submit proposals on this subject to the Council of Ministers. This is why the Commission has been anxious to discuss nuclear liability and insurance questions with European industrial organizations concerned with the design, construction and operation of reactors. Most important, in October 1961 it informed the nuclear insurance pools formed in the member States, as well as the representatives of

European insurers, of its problems, and created a permanent Euratom/Insurance Companies working group responsible for a thorough investigation of the many questions raised on this occasion.
At the present time this group is dealing with the particularly topical question of insuring the transport of radioactive materials. Radioactive substances are frequently carried over long distances through the territory of several states. This applies particularly to irradiated enriched uranium fuel elements, which at the present time can be reprocessed only in the USA. From the beginning of 1963 onwards such elements may have to be carried overseas, in ever increasing quantities, in special containers weighing up to 70 tons. The insurance of the material itself does not present any problem since the value of the irradiated fuel elements is relatively small; this is therefore something which can be left on the free insurance market to be handled by individual companies. On the other hand, third party liability in connection with transport is a matter for the national insurance pools. They are actually applying themselves at the moment, in collaboration with the above-mentioned working group, but under their own responsibility, to the task of developing standard proposal clauses for the buyer of insurance, and working out a unified system of conditions and rates, with a view to creating a firm basis for third party liability coverage. On the other hand, the insurance of the actual means of transport against the risk of contamination by the transported material raises a number of problems for which no solution has yet been devised. In the case of air transport, it is possible to obtain a sufficient guarantee inasmuch as only relatively small quantities of material are involved. As for sea transport, it is not yet clear whether the risk of contamination of the ship should be borne ultimately by the insurance pools or by transport insurers. As this could lead to serious difficulties, the working group is at the moment trying to find a satisfactory solution.
Other problems will have to be tackled by the working group. Cases in point relate to the establishment of insurance policy terms for stationary installations, the insurance of nuclear ships, the insurance of radioisotopes and the compilation of actuarial data.

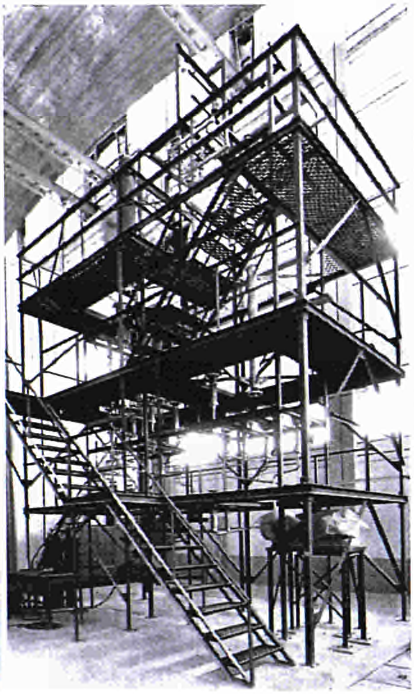
Euratom as an owner of installations

An account of the nuclear liability and insurance problems which have to be faced by Euratom should not fail to emphasize the special interest which it has in the matter as an operator of nuclear installations. Euratom is in fact creating the Community's research centre which consists (or will consist) of four establishments in Ispra (Italy), Karlsruhe (Germany), Petten (Netherlands) and Geel (Belgium).
Basically the Community is subject, as the operator of such installations, to the same rules and regulations as any other operator in the member State concerned. It must comply with national legislation concerning nuclear liability and insurance. In cases where the Euratom installations are governed by the conventions on liability which have already been mentioned, the Community will have, as soon as they come into force, to comply with them and take out an insurance policy or similar guarantee to cover the first stage of the liability system; beyond this the member States assume responsibility in accordance with the principles outlined earlier.
On the other hand, every time Euratom participates in a project outside the Community's research centre, it is not responsible for covering the risks involved. Particularly in the case of so-called "association contracts", such as that which the Commission has concluded with the Belgian "Centre d'étude de l'énergie nucléaire" (CEN) covering the operation of the BR 2 reactor in Mol, it is up to Euratom's partner to take the necessary steps. Similarly in the case of so-called "joint enterprises" (a special form of contractual enterprise provided for in the Euratom Treaty) it is improbable that the Community will be required to assume responsibility.

Many other questions could be raised in connection with liability and insurance; the object of this paper has been to high-light the most important aspects of the problems which have to be solved by operators, Governments and the European Atomic Energy Community.*

* This article was written in June 1962.

Experimental liquid metal circuit



This is the text of a lecture given recently by Dr. Grass before the Kernenergie-Studiengesellschaft in Hamburg

the ispra research establishment

Günther Grass, *Head of the Heat Exchange Department, Ispra Research Establishment*

Research and training represent the fundamental means now at the Euratom Commission's disposal for furthering the development of a European nuclear technology. Ever since its foundation, it has therefore been Euratom's endeavour to follow up the various activities carried out in the individual member states and, with these programmes in mind, to develop a line of its own which could complement these activities and at the same time avoid duplication of effort. Since 1959, in conjunction with the Scientific and Technical Committee, the Commission has defined certain main trends to be pursued, as laid down in its second five-year programme (1963-1967), which is at the moment being discussed by the Council of Ministers.*

The following possibilities are open to the Euratom Commission for carrying out its programmes:

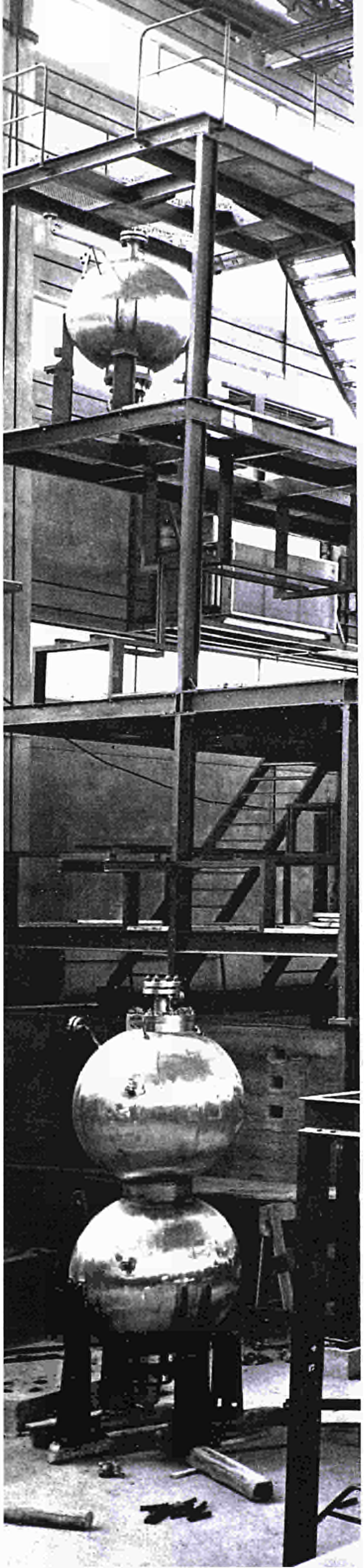
1. the granting of research contracts to national research laboratories;
2. the granting of research contracts to appropriate industries in the six countries;
3. the drawing up of contracts of association with national organizations in the six countries for the solving of groups of problems;
4. collaboration with non-Community partners, e.g. under the US/Euratom agreement, agreements with Canada and Great Britain;
5. work in Euratom's own research establishments such as those at Ispra, Petten, Karlsruhe and Geel, which together form the "Joint Research Centre".

History of the Ispra Establishment

Ispra is the first and largest research establishment set up by Euratom and will remain the largest until at least 1967. After its foundation by the Italian Nuclear Energy Committee (CNEN), it was taken over by the Euratom Commission under an agreement which was signed on July 22, 1959, but which did not take effect until July 20, 1960. The first Euratom engineers did not start work until September 1, 1960. Euratom assumed full responsibility for Ispra on March 1, 1961, after a transition period of approximately seven months.

At the time it changed hands, there was a total of about 9200 m^2 of laboratory and office space, 5600 m^2 of which was available to Euratom. The premises already standing, including the infrastructure, represented a value of $ 6 million, in addition to which the CNEN made available a further $ 9 million, the budget for which has

* Since the date of this lecture, the Council of Ministers has actually taken a decision on the second five-year programme (see p. 31).

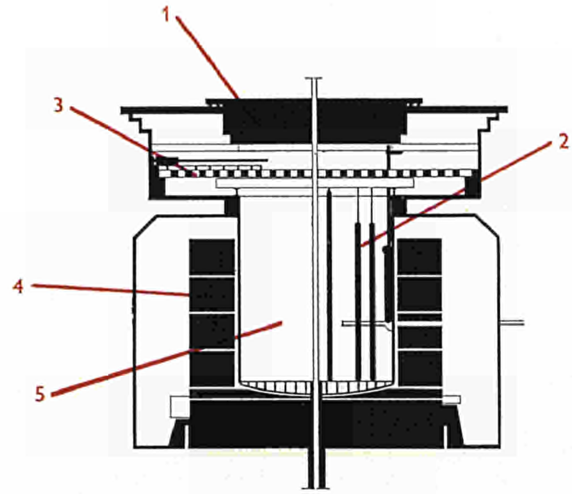


since been drawn up and which will have been spent on building by about the end of 1962.
At the time the establishment changed hands, there was a total Italian staff of approximately 470. Ispra now employs about 1100 people, and this figure will rise to 1250 by the end of 1962.

An example: history of the Heat Transfer Department

It would probably be of some interest to you if I were to give you an idea of the way in which these various departments have grown up by describing the one with which I am particularly well acquainted, since I am responsible for it, namely the "Heat Transfer Department" (referred to henceforth as HTD).
The spiritual birth, so to speak, of the HTD took place in June and July 1959. On September 15, 1959, I finally transferred to Euratom, together with several engineers, physicists and technicians, who formed the nucleus of our present staff of approximately 75.
The appropriation for construction work and experimental equipment was fixed at approximately $ 2,500,000 and it was decided to start work first of all on the equipment of four scientific departments for organic coolants, boiling and pressurized water, liquid metals and gases.
By the end of 1959 about 10 people had joined our staff and in Brussels in January 1960 we set about the designing of the test installations and embarked upon negotiations and calls for tenders in the six countries with all the satisfaction to be obtained from a combination of stringent official regulations, technical difficulties and an "underdeveloped" knowledge of foreign languages.
By the middle of 1960 the bulk of this work had been completed and the orders drawn up for all the essential equipment, although the date for the handing over of Ispra had not yet been fixed. It was thus not until the agreement had been ratified at the end of July that we in Ispra could embark on the detailed design of the buildings, the electrical equipment, the cooling plants and the air-conditioning plant for our test installations. An experimental room with an area of 2100 m² without equipment was already completed, together with two office and laboratory blocks which are now occupied solely by the HTD. All the buildings had already been planned by the CNEN, albeit for other purposes.
Since January of this year everything has been ready for the installation of the test equipment, which had been ordered from various firms of the European Community. Some of it has already been set up and is now in use, and I hope that by the end of this year all of it will be in operation.
That, then, is roughly what happened to one group of the Ispra establishment, which after going through 8 months of preparations in Brussels and 16 months' start-up difficulties in Ispra now hopes to be able to get down to some real productive work.

◀ **An experimental organic liquid circuit under construction**



Schematic section of the ECO reactor vessel (Orgel Critical Experiment)

1. Rotating cover
2. Fuel element
3. Automatic pitch adjustment
4. Graphite reflector
5. Heavy water

As I have already pointed out, the first HTD programme covered work on the four major reactor coolants; as for other questions, such as those concerning molten salts, suspensions and direct contact cooling, they are being handled meanwhile only through the literature on the subject and by means of contacts established with other European laboratories.
This programme, which is also reflected in the structure of the HTD, seems perhaps too ambitious from some points of view and yet from others rather incomplete. It is our endeavour, first to keep track of all developments achieved in our field in Europe by experienced independent specialists and, second, to adapt ourselves to further Euratom programmes. I shall revert to this subject later when talking about the programme of the Ispra establishment.

Human problems

With people from six nations working and playing side by side with a population which at least at the beginning is strange to them, with technicians and workers from the various countries, some of them knowing no foreign language, having to set up a new home, and with over 600 families looking for apartments within the space of a few months, difficulties are obviously to be expected, and I should therefore not like to pass over this question. The fact that these problems have led to no appreciable difficulties in Ispra, that, on the contrary, a healthy esprit de corps has grown up, and that the families feel at home and the children can already sing and talk together in all these languages, constitutes a human and European achievement, which should not be ignored even in a critical examination and is a good omen for the future. The European School opened on September 15, 1960, with 90 children and nine teachers and now has about 350 children and a staff of 20 (in addition to 20 visiting teachers, who take individual subjects). The school began functioning without proper premises, in private dwellings which had been hastily equipped for the purpose. Children from six countries, used to the most varied educational systems, were taught in classes which were constantly being swollen by new additions every few days. If any proof be required of the possibilities of a United Europe the European School would in my opinion provide perhaps the best.

Another particularly welcome development is that of the Ispra workshops. If about 40 Italian employees, together with 40 colleagues of other nationalities, can put on an international exhibition of machine tools and proudly expound the advantages offered by all these machines (some of them completely unknown to them beforehand), this too may be interpreted as a European achievement.
Despite this encouraging overall picture, it is obvious that there are still several problems to be overcome which have their roots in the international character of the establishment. In addition to the normal difficulties facing a research centre in the initial stages of formation, mention should be made here of the medical question, for example. Whereas for the purposes of all other business language difficulties can be overcome, shades of meaning can frequently be of great importance when one has to consult the doctor. The problem has since been solved for the German and Dutch staff members by the appointment of a German-speaking doctor. We hope that it can soon be solved also for our non-German-speaking colleagues.

Present Programme of the Ispra Establishment

The laboratories' main efforts are at present focused on the ORGEL project, with which I shall deal in greater detail later. At a rough estimate I should say that well over half of the scientific personnel are at present working on this project. The most important of the laboratories involved are those for reactor physics, physical chemistry, chemistry, metallurgy, mechanics and heat transfer.

Apart from this participation in the ORGEL project, Ispra is also engaged in complementary studies of a general character. The work coming under this heading is partly the result of the Ispra establishment's own requirements; it consists also of smaller projects which are helping the Commission to prepare the later phases of ORGEL's development. Many scientists at Ispra are participating in the execution and planning of research contracts awarded to national firms or laboratories. Furthermore, a large group is working on the development of new automatic calculation methods to serve as the basis for automatic documentation and translation. For these purposes Ispra has the IBM machines 7090, 1620 and 1401, an analogue computer and other equipment. Mention should also be made here of a group of geologists and mineralogists.

The Italian groups taken over by Euratom have so far kept part of their work programmes as they were. Some programmes, however, especially those concerning solid physics, high temperature chemistry, electronics and radiation chemistry, have already been adapted to dovetail with Euratom programmes.

Some of our colleagues are working on problems connected with the protection of the Ispra establishment against radiation (radioactive effluents, radioactivity measurements of the water of Lake Maggiore, etc.).

ORGEL (ORGanique, Eau Lourde)

Euratom has been engaged on a study of the ORGEL power reactor project since January 1960, and in July 1960 the Commission decided that this project should constitute the first task to be tackled by the Ispra establishment. The Commission, however, also decided to carry out this project in close collaboration with European industrial concerns in order to round off the research and development work undertaken in the member countries and to prepare Industry for its future role in the building and start-up of power-reactors.

The ORGEL project was born of a desire on Euratom's part to make a direct contribution towards the construction of a thermal power reactor which could produce energy at a reasonable cost. No such reactor has yet been developed in the Community. As is the case with any other type of thermal reactor, it is as yet impossible either to prove or disprove the superiority or equality of the ORGEL reactor in comparison with other types. It should be stressed that in view of its combination of heavy water moderation and organic cooling the ORGEL reactor will considerably add to the technical knowledge of the European Community and will provide the Ispra establishment in particular with experience of inestimable value for the formation of such a young organization.

As regards natural uranium reactors (without reprocessing if possible), extensive programmes were under way in France and Britain for graphite moderation.

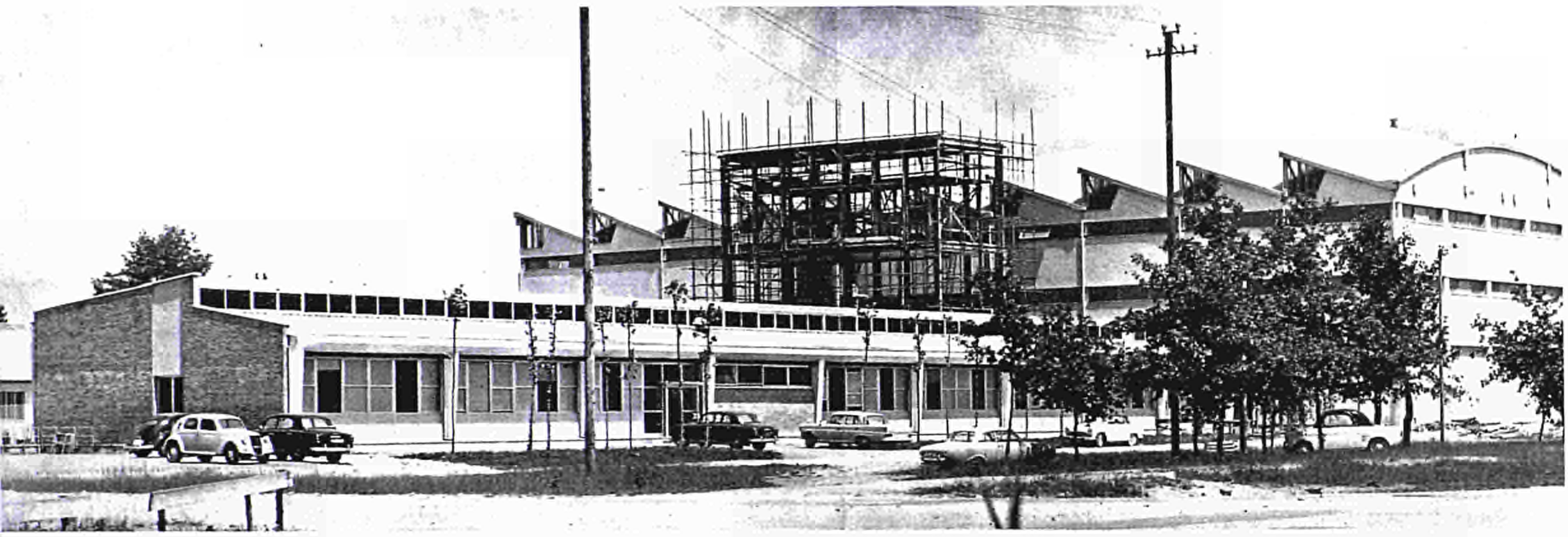
This fact prompted the Commission to sponsor heavy water moderation which, because of the compact designs which it permits, seems to offer definite advantages as far as the containment of the reactor is concerned.

The following advantages argue in favour of the organic coolant: low pressure, low corrosion, little activation, high operating temperature, small heavy-water losses. Apart from Euratom, interest in this type of reactor is shown by Canada, Spain, Denmark and India. Euratom now has a contract of association with Canada concerning exchange of information.

Another interesting aspect of the ORGEL project is the proposed use of uranium carbide as fuel. This material, which has been explored so little hitherto, may also be worth considering for other reactor types (e.g. organic moderated *and* cooled, or fast reactors), so that the investments for its metallurgical development would not be wasted even if nothing were to come of ORGEL.

As has been pointed out, the Commission is endeavouring to induce as many European firms as possible to take part in the ORGEL project, as the construction of a power reactor of the ORGEL type is something which affects not only Euratom but also the industries concerned as well as electricity producers. Euratom's aim is simply to develop this type to the point at which, if considered worth while, it can be produced industrially. This decision will depend entirely on economic factors.

In 1960 and 1961, the part played by industry chiefly took the form of research contracts and the construction of experimental plants. Industry will soon be receiving further large-scale orders, such as the construction of ECO, an organic-liquid-cooled critical experiment, the possible building of the experimental reactor ESSOR and the fabrication of the necessary in-pile loops, which either instead of or together with ESSOR, will be used for part of the tests required for ORGEL. In the case of



Laboratory and testing bay of the heat exchange department in Ispra

ESSOR, the development contract has already been awarded. The decision as to whether to go ahead with the construction of ESSOR will be contingent upon the results of these tests and also upon an additional profitability study to be conducted by an industrial study group on a power reactor of the ORGEL type.

The critical experiment ECO (with heavy water moderation) will not only be available for ORGEL research but will also be suitable for all heavy-water moderated types (irrespective of the coolant).

ESSOR will be a special experimental reactor for testing ORGEL fuel channels. It will contain 8 to 12 ORGEL-type channels in a zone called the "ORGEL Zone". The neutron flux is maintained by a feed-zone, which is to function along wholly conservative lines, i.e. involving no unknown hazards. Another feature of ESSOR is that it can be used, circumstances permitting, in research relating to other heavy-water-moderated reactor types. ESSOR—assuming that the decision is taken to go ahead with construction—should be ready for commissioning by 1966 and should then furnish the experience necessary for the building of an ORGEL-type power reactor.

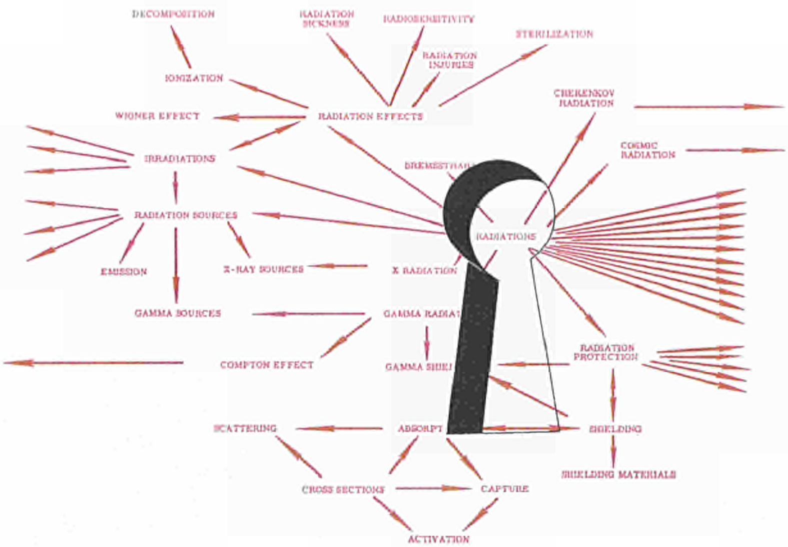
Outlook

To outline Ispra's programme beyond its activity under the ORGEL project and the current basic programme would be extremely incautious, since a general discussion is now in progress between the Commission and the Council of Ministers, i.e. between the six member countries, on the second Five-year Programme (1963-1967) to come into operation when the the first Programme expires at the end of this year. It is understandable that the six countries should want to know exactly what their money is being spent on.

It is for this reason that it was decided in 1961 to set up a Consultative Committee for Nuclear Research, composed of representatives of the Governments of the six member States. This Committee examines the programmes proposed by the Commission and endeavours to coordinate them with national activities.

Moreover, in accordance with the terms of the Treaty, a Scientific and Technical Committee meets regularly to advise the Commission in the drawing up of its programmes. The members of this Committee are eminent personalities chosen because of their personal qualifications from the scientific and industrial circles of the Community.

We hope that under the scheduled programmes Ispra will be allotted worth-while tasks over and above those upon which it is now engaged, since in the final analysis a research centre can only be a success if it is continually participating in programmes of importance for the future as well as the present.



Words and Keywords

Michel Gibb,

Directorate for Dissemination of Information

There are many ways in which Man's superiority over other beings has been defined. Definitions range from the modest claim that he is a two-legged animal to the assertion of his soul's immortality. While refraining from discussing the relative merits of these various definitions we shall mention one among them which is directly relevant to the subject to be discussed here: this is the view that Man distinguishes himself from other creatures by his ability to speak. Most creatures can *utter sounds;* only man knows how to *speak.*

This kind of statement combines with its commonplace nature the dogmatism of all generalizations: although it is true to say that only Man can speak, there is no denying that many animals are capable of communicating, especially through the use of particular sounds which have a *meaning*, just as the words which make up Man's speech can be said to have meaning. It is perhaps more correct to say that Man's use of sounds as a means of communication is much more highly developed.

Among primitive peoples, words are invested with magical powers. Though members of more advanced societies may tend to look upon this with derision, it would be unrealistic, in the context of the history of civilization, to ignore the paramount rôle played by language; it is its very importance which naturally makes it liable to the attribution of magical properties.

In the context of the development of knowledge this importance is particularly manifest. Even if we refer to the standard image of the father handing his skill over to his son, the use of language has its relevance. But how much greater is this relevance when it is not a skill, but a body of scientific or technical knowledge which has to be bequeathed? The recorded observations and conclusions of the early philosopher-scientists formed a basis for the work of their successors. As long as the results of this kind of work are written down and made accessible, knowledge can grow.

In our technological age, almost every scientist, engineer or technician has some useful knowledge to impart in the particular field which occupies him, and it has become not only a professional but also a kind of social duty for such men to record the results of their work and make them available on as wide a scale as possible, usually in the form of reports or articles. Although the sophistication of certain branches of inquiry has led to the development of esoteric systems of expression, making use of symbols rather than words, it is still ordinary language which is the standard medium for the communication of knowledge. Even the exponent of pure mathematics cannot write an article consisting entirely of mathematical formulae.

This practice of recording results in the form of documents, although salutary in its essence, has brought its own problems. Whereas of old, the scientist had few (too few) documents at his disposal to assist him in his endeavours, he has now access to an inimaginably large volume of information. His problem is thus to sort out from this mass of material the items which are relevant to his own work. It is particularly important that he should do this if he happens to be engaged in research: it is only common sense that execution of an expensive research project should be preceded by a thorough investigation of all material describing the latest advances made in the relevant field of inquiry. Cases could be quoted of investigations of this kind leading to the abandonment of research projects because it turned out that the questions to be tackled had already been answered.

The existence of this problem has led to making a profession of the task of information retrieval: the "information officer" is there to supply the scientist with the data he needs. The information officer is the natural product of an age which sees specialization as a means towards greater efficiency: if he is adequately trained and equipped, he can, not only relieve the scientist of work which distracts him from his main task, but do it faster and better.

What is the information officers "raw material"? Quite simply stated it is the whole body of published matter relevant to the branch or branches of knowledge with which he is concerned. In the case of Euratom's documentation centre, for instance, this raw material is just "all literature which has to do with nuclear energy and its peaceful applications". This is not such a clear-cut definition as it sounds: nuclear energy is finding practical applications under an ever-increasing variety of headings; conversely the list of disciplines which have a contribution to make to the advancement of nuclear energy, although at first sight foreign to it, is steadily lengthening. The nuclear documentalist who loses track of this "fringe-literature" does so only at the risk of being unable to provide his clients with complete information.

A documentation centre is not a library. It does not store books and reports, it stores knowledge of their existence, contents and whereabouts. If it has something in common with a library it is perhaps the need for catalogues. In the case of a library these catalogues list authors and titles and this is normally quite sufficient, as its primary purpose is to satisfy specific demands from customers for particular books or articles. On the other hand the demands which are made of a documentation centre are much less specific. Let us take an imaginary example: a research team is to launch a project whose aim is to investigate the corrosion effect in reactors of steam on beryllium metal. The documentation centre will probably receive a bland note requesting it to be good enough to trace all existing literature on the subject. There follows an elaborate search through indices and card-files, carried out by a group of people with a wide grasp of scientific and technical matters. The result of their search is a bibliography, i.e. a list of references to books, articles etc., complete with titles. This bibliography is sent to the "customer" who can proceed to order the relevant documents and extract from them the information he needs.

There is obviously room for improvement here; firstly a mere title is often an incomplete and sometimes even a misleading pointer to the contents. The corresponding work, on perusal, may turn out to be quite irrelevant, which entails a waste of time: or else (and this is more serious), a completely pertinent document will have been passed by because of the inadequacy of the title. Secondly there are so many sources to be searched that it is not always possible to do this within the time alloted to the information officer.

On top of that, as is the case in most disciplines, a number of operations are of a routine nature and therefore unworthy of the qualifications required from those who have to do the searching, although necessary.

How then is an improvement to be made? The inevitable answer is: "by using machines, of course". This is why extensive research is being carried out by several organizations with the object of "mechanizing" documentation. As far as Euratom is concerned, the main effort in this field is being made at the Ispra nuclear research

establishment by "CETIS" (Centre européen de traitement de l'information scientifique), a part of Euratom's Research and Training Division. In the field of documentation the goal of this group is complete automation; not only is retrieval and selection to be mechanized, but also the storage of the material and even the "reading" of the documents in order to make abstracts. Translation will also be done by machines, so that it will be possible for the "customer," some day, not only to receive a rapid and complete answer to his question, but to receive it in the language of his choice.
This is an extremely ambitious project and it cannot for this reason be expected to mature until many years have elapsed. In the meantime, the "show must go on"; literature searches must be carried out by conventional or at least available methods and this is the responsibility of Euratom's Centre for Information and Documention. Although this department is primarily concerned with the day-to-day task of supplying information, it is indulging in its own brand of futurism, much more modest and short-term than that which is the hallmark of CETIS. A section of this department is indeed preparing a documentation system which might be termed as "semi-automatic". This system, which will come into operation relatively soon, will bridge the gap between the conventional methods and the fully automatic processes which will be the results of CETIS's research.

We have seen how a report or article could be referred to, and to some extent described, by titles. But better descriptions of texts are currently available, namely summaries, or, to use the term more usually employed, abstracts. Abstracts do not make good reading, but on the other hand were never meant to do so: they are time-saving devices which allow a busy man to absorb the gist of a text and assess with reasonable accuracy its relevance to his purpose. Their usefulness is such that in many subject fields systematic collections of abstracts have been created; they appear periodically and give an overall picture of what has been published in a particular field of knowledge. In the nuclear field, special mention should be made of "Nuclear Science Abstracts", produced by the United States Atomic Energy Commission, which covers a remarkably wide range of nuclear literature. The first object of the semi-automatic documentation system is to shorten the retrieval time considerably and thus eliminate as much routine work as possible.
As by-products can be mentioned the greater reliability of a machine when it comes to making a proper selection, and the possibility of providing very easily for means to serve the "customers" with a compilation of abstracts instead of just a list of titles.
We will now describe briefly the whole procedure, and start with a typical example of "raw material", an abstract from "Nuclear Science Abstracts:

Surface Exhange Reactions of Silver and its Ions

The exchange reactions between silver and its ions in solution were investigated by the use of radioactive tracers. Silver of highest purity was cleaned carefully and immersed in a radioactive silver nitrate solution. The course of the early adsorption process and subsequent diffusion of the ions into the interior of the metal was followed in detail, and the diffusion coefficient at room temperature was calculated. The penetration depth was determined by controlled electropolishing of the metal, and the reverse movement of active ions from the metal into inactive solutions was also observed.

(*Nuclear Science Abstracts* 15, 1961, 201)

This is an abstract of a report consisting of 32 pages; it would therefore be unreasonable to condemn it as verbose. Yet for the purpose of mechanical retrieval it must be made still shorter. The abstract is made up of sentences which contain not only words denoting objects, elements, processes etc., but also words which, although necessary to give the sentence its articulations and its general shape, are superfluous for retrieval purposes: it is obvious that words like: "were", "was", "the", "and", "also" etc., which appear several times in the quoted abstract, are not characteristic of it. On the other hand words such as "Surface", "Exchange reactions", "Silver", "Radioactive tracers" and a few others are directly relevant to the contents of the report. They are truly the *key*-words which reveal the subject under discussion.
The actual keywords which have been attributed to the abstract taken as an example are:

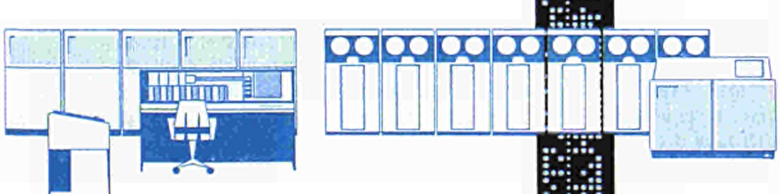
Surfaces
Ion Exchange
Silver
Silver nitrates
Tracer techniques
Silver isotopes
Adsorption
Diffusion
Determination

It is worth making further remarks about the reasons why this particular list was selected, but they will perhaps be clearer after something is said of the use to which the keywords are to be put.

The keywords cannot be utilized by a machine (in this case a computer) in their normal printed form. After being punched into cards they eventually reappear on a magnetic tape which constitutes the computer's permanent "store of information". It must be admitted that this is rather a misleading statement: what is in fact recorded on the tape is the essential information that is needed for retrieval purposes, namely the fact that a particular keyword "belongs" to abstract x, abstract y, abstract z, etc.

When an inquiry is received, its substance will be formulated by means of keywords, on the same principle as the text of an abstract. If the machine is fed with these particular keywords in the appropriate manner, it will compare them with the magnetic tape constituting the store of information and select those abstracts (or rather the numbers used to designate them) which happen to contain the keywords figuring in the question. The result at the output end of the machine will be a list of the numbers selected. Once this list of numbers has been produced by the computer, it is only necessary to refer to the "abstract library", where each abstract is reproduced on a separate card, and pick out the corresponding abstracts. It is planned to do this manually as there is no mechanical method available at the moment which is either economic or sufficiently rapid for the purpose. The clerk responsible for this operation will thus bring to the documentalist the answer to the inquiry in the form of a pile of cards. At this stage the human thinking element will be reintroduced: the documentalist will make a quick relevance check, as it is not unlikely, especially in the case of inquiries which could somehow only be turned into a small number of keywords, that a substantial proportion of the abstracts picked out by the machine will turn out to be beside the point. These abstracts will be rejected. As for the "good" abstracts, they can be reproduced in card form or in book form and sent to the customer.

We may now come back to the method of choosing keywords. It will be noted for instance that, although the abstract talks of "uses of tracers", the actual keyword selected is "tracer techniques". This brings up the problem of synonyms; the machine could of course be "taught" to recognize any members of a particular set of synonymous words and phrases as equivalent and "react" accordingly. This would be necessary if we were concerned with a fully automatic system, as the machine would then carry out the whole process from beginning to end and be expected to "read" the abstract (or even the full text of the report or article) and pick out for itself the



. . . of old, the scientist had few documents at his disposal . . .

main ideas contained in it. On the other hand in the semi-automatic system which is our immediate concern, the selection of keywords is, as we have seen, not a matter for the machine, but for the documentalist. It will at once be obvious to him that "radioactive tracer applications", "uses of labelled compounds" etc. are synonymous phrases and he therefore adopts the standard keyword (or in this case keyphrase) "tracer techniques". This greatly reduces the demands made upon the machine. It may have seemed odd (at least to those who are reading this paper in another language than English) that the abstract selected as an example should be in English. This is because the standardization which has just been mentioned, and which affects synonyms within one linguistic system, is hardly sufficient in a polyglot community. The existence of different languages creates a "synonyms problem" on a very vast scale and its solution would involve programming the computer so that it can recognize, to take a simple example, the words "steel", "Stahl", "acier", "acciaio", "staal" etc. as equivalent. This sort of solution will undoubedtly be reached in the future, but is not available yet for the satisfaction of our immediate needs. Hence a *key-language* has had to be selected. Since the mass of nuclear literature which has grown in the Western world since 1945 is mostly in English, it is natural that this language should have been chosen.

The semi-automatic information method which we have briefly surveyed will cut out much of the routine work of a documentation centre. The documentalist will only have two main tasks: the first will be to analyze abstracts and turn them into keywords, and the second to check the final answer given by the computer. These tasks demand high intellectual qualities from those who are to carry them out: not only must they possess analytical minds but their practical experience of science and technology must be as wide as possible. No doubt, in a large centre it is possible to build up a staff of specialists each of whom is responsible for a branch of knowledge with which he is familiar. But, however large the centre, there are still limits to the extent to which a field as vast as that of nuclear energy can be portioned off into allotments. A minimum of versatility will always be required of the documentalist.

Nevertheless even operations of the type just mentioned, however high the demands they make upon intelligence, may yet be mechanized. Their logical complexity is considerable and, as we mentioned earlier, the task of unravelling all the strands belongs to such research groups as CETIS in Ispra. The final result will be an awe-inspiring automat of which it will be difficult to speak without succumbing to anthropomorphism. Yet everything in this machine will be strictly inhuman: any choices it may be called upon to make will have been carefully conditioned by its constructors and its programmers. The modest "Semi-automat" which has been the main subject of this paper will seem puny indeed in comparison. However it will have had the merit of satisfying the immediate needs of research teams.

EURATOM NEWS

Euratom second five-year programme

Approval by Council of Ministers

On 19th June 1962, The Euratom Council of Ministers authorized the expenditure of $ 425 million for the execution of the Community's second five-year research programme.

The $ 425 million are to be allocated as follows:

	$ million
ORGEL (Heavy water moderated organic liquid cooled reactor experiment)	57
Advanced gas reactors (including participation in the "Dragon" project)	25
Fast reactors	73
"Proved" reactors	29.5
New reactor types	9
Operation of BR2 materials testing reactor	12
Processing of irradiated fuel	14
Treatment of radioactive waste	5
Nuclear ship propulsion studies	7.5
Health protection and biological research	17.5
Radioisotopes	5
Thermonuclear fusion	31
Research establishments of the Community's Research Centre	
Ispra	72
Karlsruhe (Transuranium Elements Institute)	25
Petten	19
Geel (Central Nuclear Measurements Bureau)	11
Training	3
Documentation	9.5

Of the total sum, about $ 200 million will be devoted to work in the establishments of the Community's Research Centre and $ 225 million to work under ordinary or association contracts.

The Commission is authorized to recruit 3,200 research staff for the execution of this programme.

Negotiations for accession of the United Kingdom to Euratom

Opening statement of Mr. Edward Heath

The meeting which took place in Brussels on 3rd July 1962, between the Governments of the Member States of the European Atomic Energy Community and the United Kingdom Government, constituted the start of negotiations for the accession of the United Kingdom to Euratom.

After recalling the great European tradition of fundamental nuclear research, Mr. Heath went on to point out that the multiplicity of the problems posed by the development of atomic energy entailed that no one country could hope to solve them all successfully. Hence the development of important co-operative projects between the free countries of Western Europe. After mentioning the successes of the European Organization for Nuclear Research (CERN) and the European Nuclear Energy Agency (ENEA), Mr. Heath said: "... The establishment of your Community in 1958 marked a further step in the development of European co-operation which was to some extent different in kind from the earlier steps."

Although the United Kingdom has already enjoyed close co-operation with Euratom and its Member States, British accession would make this co-operation not only closer but more comprehensive, with great advantages to all.

At this stage, Mr. Heath presented a brief account of the development of nuclear energy in the United Kingdom, stressing first the important practical experience which was being acquired, thanks to the British nuclear power programme, the largest in the world, and then reviewing the main activities of the UKAEA in the field of research.

"We are ready to accept the substantive provisions of the Euratom Treaty as they stand", Mr. Heath said. Any special arrangements which may prove necessary could be dealt with by protocols or understandings.

In this connection, Mr. Heath turned to three points which were of major importance to the United Kingdom.

The first concerned arrangements for co-operation in atomic energy matters between the members of an enlarged Euratom and other West European countries.

Secondly, there was the question of reviewing the recently approved programme of research and investment for the five year period 1963-1967 in the light of the new circumstances which would be created by the accession of the United Kingdom.

Mr. Heath's third point concerned defence. As the European Atomic Energy Community was solely concerned with the peaceful applications of nuclear energy, it was assumed that the British nuclear defence programme would remain outside the ambit of Euratom.

Mr. Heath concluded: "We intend to work wholeheartedly to bring the discussions on which we are now embarking to a successful conclusion. I am sure that there will be ready agreement on many of the points which I have mentioned this morning. In so far as there are problems, I am confident that we shall be able to find solutions which will be generally acceptable and in the best interest of the Community as a whole, bearing in mind that we share with you a common underlying interest in the peaceful development of atomic energy. We have admired your achievements in the atomic field and we think that we have something worthwhile to contribute. United we believe that Western Europe, which has led the world in so many other fields of scientific endeavour, will also be in the vanguard in developing the peaceful uses of atomic energy. We look forward to joining with you in this common task."

The negotiations will be resumed in October.

EURATOM NEWS

Petten: agreement on research establishment ratified.

On 24th July 1962, the First House of Representatives of the Netherlands passed the bill approving the convention concluded with Euratom in 1961 concerning the transfer of the HFR high flux reactor in Petten.
The actual transfer will take place shortly and will enable Euratom to create a second general purpose establishment (with Ispra) of its Research Centre. The Community plans to develop the establishment rapidly; $ 27.5 million have been earmarked for this purpose.
Petten's programme includes: maximum utilization of the HFR reactor for various irradiation experiments, technical coordination of several research tasks in the field of advanced gas reactors (Dragon project in Winfrith and pebble-bed reactor in Jülich), and studies in the field of fluidized reactors.

Acceptance of SENA proposal for nuclear plant

On 26th June, the US-Euratom Joint Reactor Board announced the acceptance by the Euratom Commission and the US Atomic Energy Commission of the proposal for the construction of a nuclear power plant submitted by the Franco-Belgian group "Société d'énergie nucléaire franco-belge des Ardennes" (SENA). The reactor is to be of the pressurized water type.
This proposal was a response to the US-Euratom second round invitation, issued on 21st September 1961, calling for the construction of nuclear power plants to be brought into operation by 31st December 1965.
The SENA proposal was the first to be received but others were received before the closing date of 1st August 1962 and are now under consideration.
SENA is a group of French and Belgian utilities, who will share in the cost of constructing as well as operating the plant. The site is to be near Givet, France, just beside the Franco-Belgian border, and the electricity produced is to be distributed to the interconnected French and Belgian networks. The plant will have an initial capacity of 210 MWe but is designed to permit an increase to 242 MWe.

Fast reactors

A new Euratom/CEA association

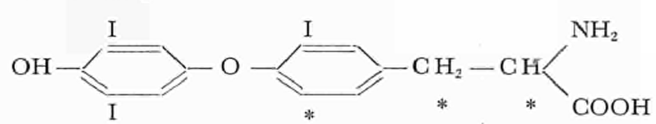
The Euratom Commission and the French Atomic Energy Commission (CEA) have concluded a far-reaching contract of association under the terms of which Euratom will participate in the research and development work on fast neutron reactors which has been carried out by the CEA since 1958 in the Saclay, Fontenay-aux-Roses and subsequently Cadarache plants. Studies on this type of reactor, which the Euratom Commission included in its research programme back in 1959, occupies an important place in the Community's recently drawn up second five-year research programme. Covering a period of five years, the new Euratom/CEA association is aimed at the design, construction and operation of the sodium-cooled fast neutron Rapsodie experimental reactor, and also of a fast neutron critical assembly. Euratom's participation in the project, for which a total of more than 450 million NF have been earmarked, will be in the order of 35%.
The interest in fast reactors is warranted in particular by the possibilities they offer of producing more fissile material than they consume (breeding), thus cutting the cost per kilowatt and making the best use of the plutonium produced for example by natural uranium gas-graphite reactors.

In 1958 the CEA embarked on a theoretical and experimental programme, the preliminary results of which prompted the decision to build the 20,000 kW(th) Rapsodie experimental reactor. This reactor, construction work on which began in July 1961, is scheduled for commissioning in mid-1965. The plant consists also of auxiliary buildings and laboratories.
The purpose of the project is to provide an instrument for physical research, to acquire technological experience which can be applied to subsequent reactors and finally to constitute an irradiation facility for fuels used in the fast reactors of the future.

The Euratom/CEA association will also provide for the construction of a fast neutron critical assembly which will enable studies to be carried out on the physical characteristics of the entire range of fast plutonium reactors planned for the future, from the Rapsodie stage to that of the large 300,000 kW industrial plant reactor. Its volume will be greater than that of comparable installations in the US and the UK. It is due to go into operation in about 1965.

The association, which is to be administered by a joint management committee, provides for a participation on the part of Euratom research workers amounting to a maximum of 50% of the total staff.

The chemical formula shown on page 31 of Euratom Bulletin 1962 No. 2 is to be replaced by the following:



Thermonuclear fusion

Association with Dutch laboratories

On 16 July 1962, Euratom signed a three-year contract of association with the "Stichting voor Fundamenteel Onderzoek der Materie" (FOM). The work covered by the contract relates to plasma physics and will be performed in laboratories located at Jutphaas, Utrecht Amsterdam and Arnhem.
The research will be centred on alternating toroidal pinch based on confinement by a rotating magnetic field, the improvement of plasma containment by means of high-frequency electromagnetic

ORDER FORM
EURATOM BULLETIN

I wish to subscribe to EURATOM Bulletin i

☐ English

☐ German

☐ French

☐ Italian

☐ Dutch

☐ direct from the publisher

☐ through my bookseller ....

....

Name ....

Address ....

....

Date .... Signature ....

Euratom Bulletin annual subscription in the Unit Kingdom 18/—, single copies 6/— each; in t United States: $ 3.50, single copies $ 1.—

ORDER FORM
EURATOM BULLETIN

I wish to subscribe to EURATOM Bulletin i

☐ English

☐ German

☐ French

☐ Italian

☐ Dutch

☐ direct from the publisher

☐ through my bookseller ....

....

Name ....

Address ....

....

Date .... Signature ....

Euratom Bulletin annual subscription in the Unit Kingdom 18/—, single copies 6/— each; in t United States: $ 3.50, single copies $ 1.—

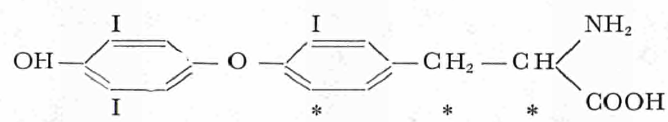
EURATOM BULLETIN
A. W. SYTHOFF
Postbox 26 Leiden
Netherlands

EURATOM BULLETIN
A. W. SYTHOFF
Postbox 26 Leiden
Netherlands

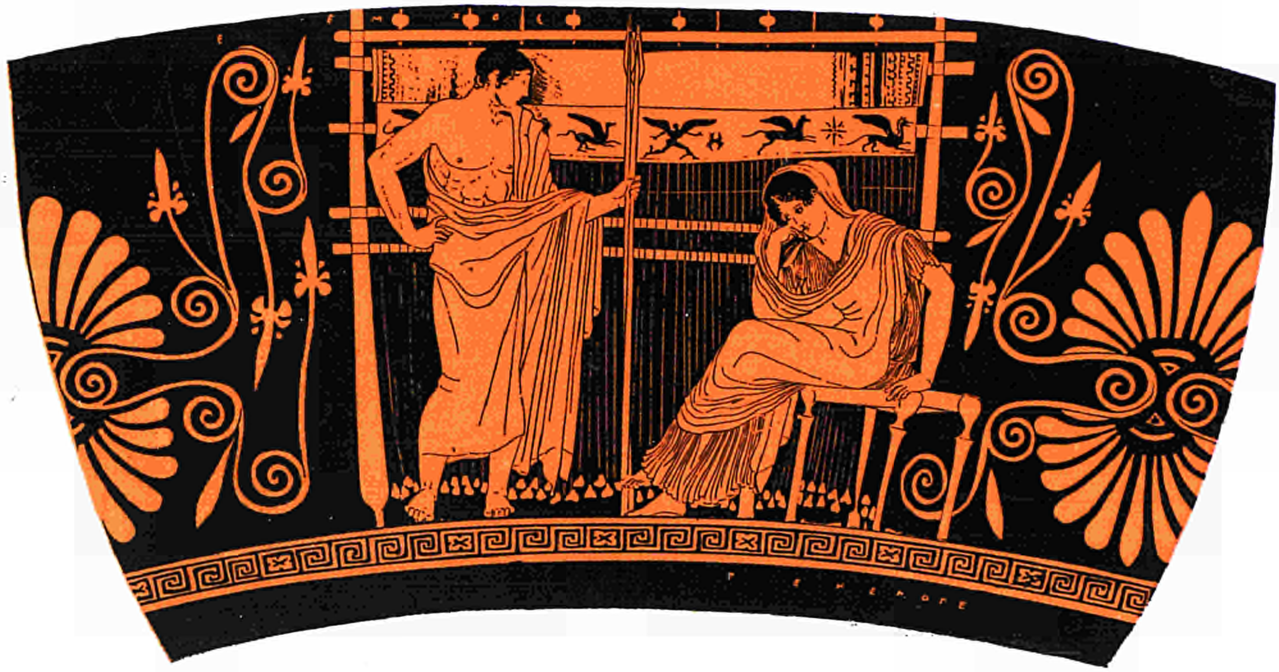
waves, the injection of accelerated ions, a radial plasma "gun", rotating plasmas (known as the "Ixion" experiment) and a heavy-current linear pinch.
This work will be accompanied by basic theoretical and experimental research.
We would point out that this contract comes within the overall scope of Euratom's fusion programme. Thus, the Dutch research teams have now taken their place alongside those of Garching in Germany, Fontenay-aux-Roses in France and Frascati in Italy.

Uranium oxide monocrystals of more than 1 cm diameter produced by CEN

Uranium oxide has a number of advantages over uranium metal as a nuclear fuel. It stands up better to irradiation and to high temperatures, and does not react to any extent with water. This last advantage is an important safety feature in the case of boiling water and pressurized water reactors; hence the considerable research effort being devoted to uranium oxide in this context.
One important aspect of this research is the precise determination of the physical properties of uranium oxide. However, the data obtained with "raw" uranium oxide powder, even after it has been, say, densified into its final form for use as fuel, are scattered because of its heterogeneous crystalline structure. This is why work was started under contract by CEN (Belgian nuclear research Centre) within the framework of the research and development programme of the US-Euratom Agreement, with the aim of producing "monocrystals", i.e. samples of uranium oxide with a near-perfect homogeneous structure.
Monocrystals have been obtained elsewhere before but their dimensions have in most cases been of the order of a few millimetres only. On the other hand, CEN have succeeded in obtaining crystals of more than one centimetre. The process which gave this result is basically a sublimation technique.
Thanks to these relatively large monocrystals, accurate information is at the moment being compiled on the physical properties of uranium oxide (in particular as a semi-conductor) and on the effect of radiation on this material.



The HFR reactor in Petten: a view from inside the reactor building



Some titles from the next issue of Euratom Bulletin:

"Marked Molecules"

by Prof. Lettré, Head of Heidelberg University's Institute for Experimental Cancer Research.

The author explains what is meant by "marked molecules"—so useful to the research scientist, especially for the detection of biological phenomena.

"Fast neutrons and fast reactors"

by Wilhelm Sahl, of Euratom's Directorate-General for Research and Training.

Most nuclear reactors in operation or under construction in the world are based on the use of *moderated* neutrons, i.e. neutrons which are deliberately slowed down. Why not use *fast* neutrons?

"From archaeology to automatic documentation"

by J. C. Gardin, of the French "Centre National de la Recherche Scientifique".

Scientific data processing and archaeology: an odd juxtaposition, you may think. This is what the author wants to disprove: logical processes can be defined without reference to subject matter.

CDAA62003ENC