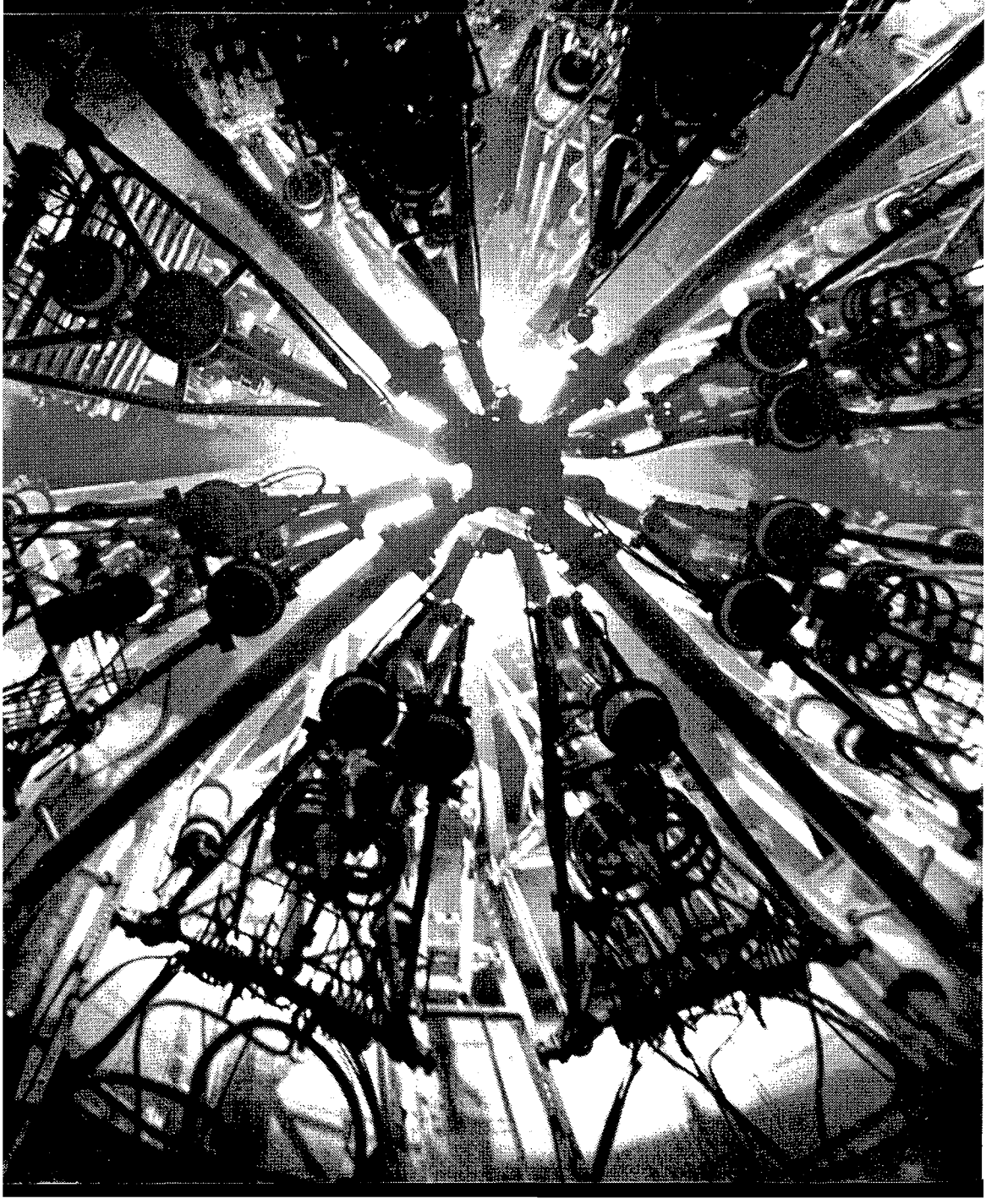
FRANCE



NUCLEAR PROSPECTS IN FRANCE

from the Commissariat à l'énergie atomique (CEA)

The thirtieth anniversary of the first chain reaction, produced at the Metallurgy Laboratory of the University of Chicago on 2 December 1942, deserves much more than the few words of commemoration that are customary on such occasions.

Thirty years have now passed since that event, a distance of time that allows us not only to measure the progress that has been made since, but also, and this is the main point, to take stock of the far-reaching transformation that has come about in nuclear science, affecting the use of nuclear energy in its most fundamental aspects.

In fact, the first phase of what is sometimes called the "atomic age" has just come to a close, and for some years we have been witnessing premonitory signs, harbingers of the second phase into which we shall have penetrated deeply within five or ten years.

For about 25 years we have all been living in the epoch of the scientific and military atom. The explanation for this is simple; the exploration and use of atomic energy were in their infancy, and the task of the pioneers was to clear the way, principally by testing the various lines of reactor development that would make it possible to generate electricity at a competitive price. At the same time, atomic energy had become, since the end of the Second World War, a synonym for nuclear weapons, and nations with a large enough research potential and a large enough budget made every effort to acquire them, regardless of profitability criteria.

In neither case, therefore, could there be any question of short-term economic considerations, for fundamental research took first place and the elements that would have made it possible to plan on the basis of economic data were not yet available. Nevertheless, each new step in the nuclear field constituted in its own way a building brick for economic appraisal, so that by about 1965 the specialists in nuclear economics became convinced that nuclear power could become competitive with conventionally generated power.

At the present time, then, we are on the threshold of the second phase of nuclear development, in the course of which nuclear activities will play a more telling role in the economic cycle. We must therefore consider the development of nuclear energy during its first two decades in the light of the above conclusions and in the realization that for some time to come we shall find ourselves in a delicate transitional stage, during which various influences from the period behind us and the period ahead will make themselves felt.

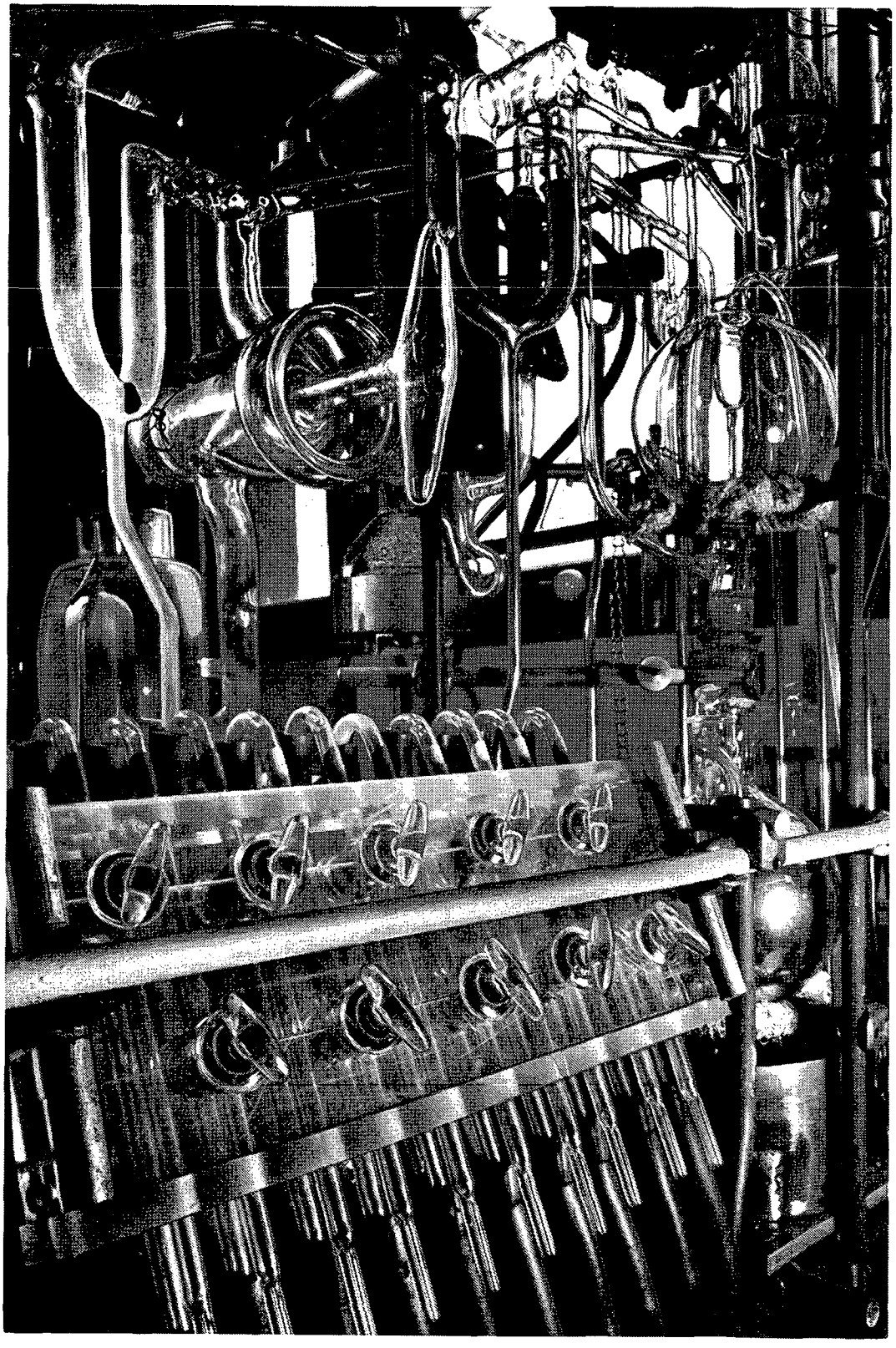
This train of events is not restricted to France, where in 1970 the CEA undertook a complete restructuring of its departments. It is also taking place in other countries, where the various atomic energy commissions are feeling the need to reorganize in order to fit themselves for essential changes.

We must therefore be prepared to act in the most effective way possible during this nuclear industrial period. To this end we must establish structures and adopt ways of thinking that are in keeping with the objectives of the period, which will be accompanied by a large growth of investment in the peaceful uses of nuclear energy. Success will depend to a large extent on timely joint efforts in the public and private sectors.

Taken together, these requirements imply that we must follow a long-term policy covering at least the next 20 years.

As our remarks are to concern the peaceful applications of nuclear energy in France, leaving aside questions of fundamental research and military applications, we shall concentrate on the fuel cycle and the production of nuclear power, enlarging the subject at each step to encompas the necessary and increasing international co-operation.

Eight loops round the core of the reactor "Pegase" in Cadarache.



Laboratory equipment used to extract gases from metals at the Saclay Atomic Energy Centre.

The first stage of the fuel cycle i.e. the production of natural uranium, is of importance, particularly to the CEA, which has the task of ensuring the availability and reliability of supplies of nuclear material at minimum cost, essential as it is for both peaceful and military activities. But the problem to be resolved today is not one of acquiring a rare mineral, but of managing at the lowest cost a surplus of uranium production capacity.

We do not believe that we shall be short of uranium in the future. We hold the view that improvement in prospecting and fabrication methods will allow cost prices to be maintained at near their present level. However, it is certain that once the stocks which at present govern the state of the world market have been absorbed, there will be an exponential increase in requirements from 1980 to 2000. It is on the basis of this hypothesis that we are attempting to develop a policy for financing the accumulated stocks and for continuing the prospecting efforts already undertaken. We are pursuing our prospecting policy in order to secure inexpensive foreign resources on a long-term basis, while keeping a careful watch on the reliability of supply, which is still being ensured by a tradiational combination of diversification of sources (including home sources) and optimum storage. It is known that France has been active abroad for some time, notably in Africa and particularly in Gabon and the Niger, represented by the CEA either acting alone or in collaboration with private French and sometimes foreign companies.

But, with the present organizational structures, the links that CEA embodies between the various French companies would be no match in five years or so for powerful foreign groups. It is up to us, therefore, to consolidate our links at the right time and to adapt our organizational structures so that we can face international competition with some chance of success.

With respect to the reprocessing of irradiated fuels, as in the case of uranium production, the problem is one of an over-capacity of equipment. The success of the negotiations undertaken and concluded last year with our British and German partners, concerning the creation of a joint company that would permit the rational use of existing plant and planning of future plants, illustrates the value of a European policy for investments particularly sensitive to the effects of scale.

It would appear, however, that an attitude as realistic as this is more difficult to adopt where the most critical step in the fuel cycle – isotopic enrichment of uranium – is concerned. The reason for this, no doubt, is that we have passed the stage of "scientific and military uranium" and all that it entails without yet having fully entered the "economic uranium" phase for the development of power stations, with its concomitant cost-price and financing constraints.

Everything there is to say about the short-term saturation of American plants and the need for client countries to seek new sources of supply has already been said. Forecasts indicate that we should launch a new plant at the end of 1973 or the beginning of 1974. Consequently, on 11 May 1971, at Pierrelatte, we offered possible partners the opportunity of constructing a plant jointly on the basis of our gas diffusion technique.

Our proposal quickly met with favourable reactions in Europe, and on 25 February 1972 a joint enterprise, later named "Eurodif", was born. The participants are the CEA (France), Sybesi (Belgium), Studiengesellschaft für Uranisotopentrennverfahren (Gelsenberg, Hoechst, Nuken and Steag, Federal Republic of Germany), CNEN (Italy), Agip Nucleare (Italy), Ultra Centrifuge Nederland (Netherlands) and BNFL (United Kingdom). Its work will last two years, but an intermediate feasibility report together with a technical and economic review of the prospects of the project is to be ready at the beginning of 1973. The interest aroused by this joint enterprise is such that on 10 October last the Spanish Empresa Nacional del Uranio S.A. and A.B. Atomenergi of Sweden joined it.

Moreover, we are not restricting our investigations to Europe, for we have concluded two agreements, one with Australia and the other with Japan, to examine the possibility of

constructing uranium isotopic enrichment plants based on the French technique. This question is all the more important as world demand for enriched uranium has surged ahead now that almost all orders for nuclear power stations call for enriched-uranium light-water reactors.

Above all, the problem must be seen in the light of the major peaceful use of nuclear fuel, i.e. the production of electricity by means of the fission reaction. We know that we are going to see such a spectuacular surge forward in nuclear power generation that it is still difficult for us to imagine it today.

Thus, in fifteen years' time an order will be placed in France every month for a nuclear power station of a size equivalent to that of the plant being constructed at the present time at Fessenheim. That will of course require a much more solid and more thoroughly rationalized industrial infrastructure than the one we know today. The enterprises required for such projects will have to be of a truly European size, and financing policies will have to be adapted to the expansion of production.

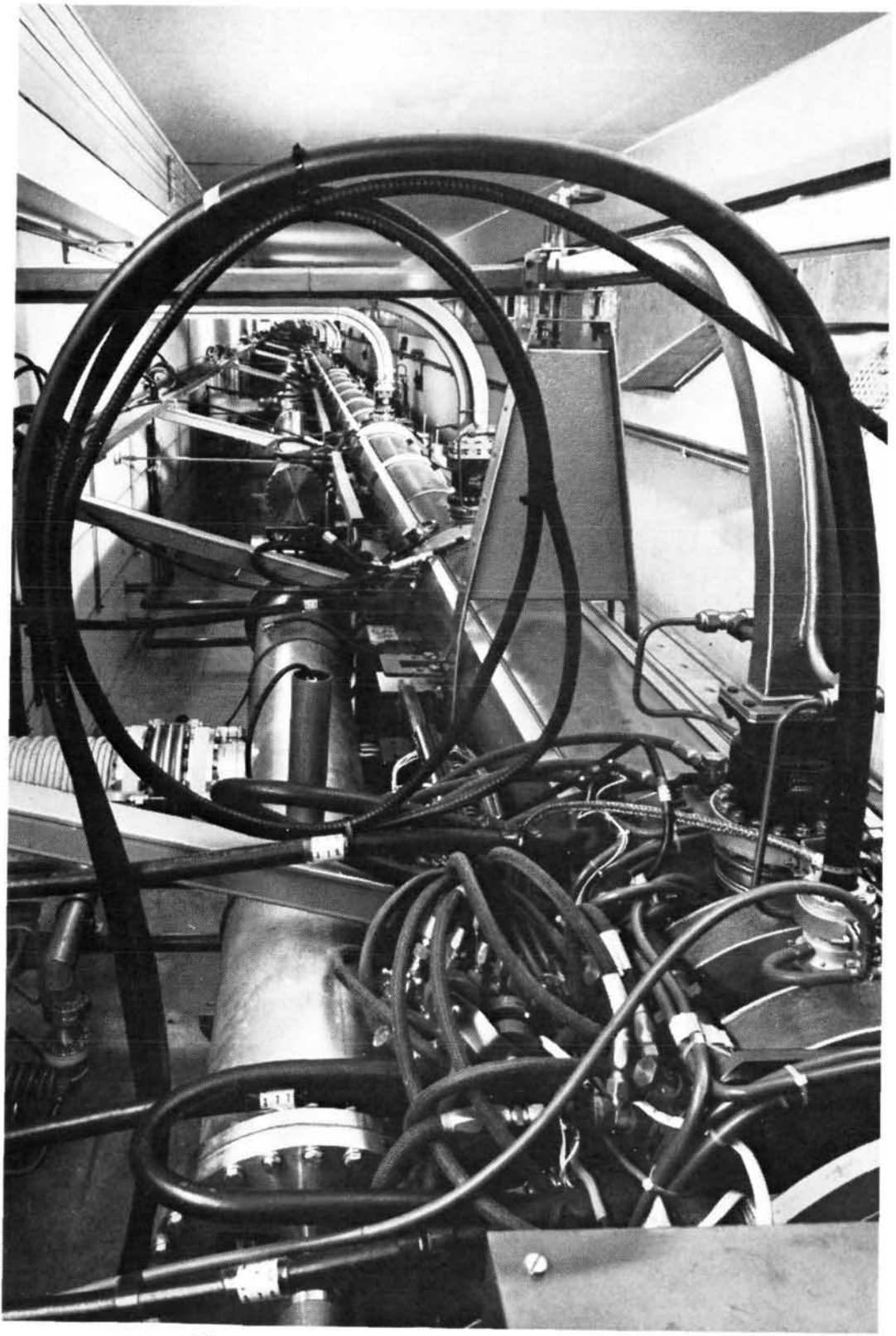
In keeping with the growth of nuclear power, the CEA will have two distinct roles to play in addition to providing fuel in the natural or enriched form. First, it will have to test various types of power station, and then it will have to promote the use of nuclear power by creating stepping stones towards fully fledged production units.

It is in fact the task of the CEA to develop the types of power station likely to interest possible buyers, first and foremost Electricité de France. Our efforts in this field will therefore be directed towards types belonging to the future, primarily fast reactors. The excellent results obtained with Rapsodie augure well for the experiments on Phénix, which is to become critical in the course of next year.

Our technologists appear to be capable moreover of introducing several major innovations in light-water models, which cover almost the whole of the market. These modifications would allow us, by eliminating start-up difficulties in power stations and by resolving reliability and safety problems, to avoid an excessive dependence on foreign licences. This approach, which we have termed the "Champlain" approach, would allow us to proceed to the second generation of light-water reactors within a period not exceeding five to ten years. It is obvious that this project will only have a chance of success if we co-ordinate our efforts with industrialists and electricity producers, which we are attempting to do on a regular basis.

A third option deserves further examination, namely high-temperature reactors. As we stressed at the outset, the industrial age of the atom requires that energy sources be profitable, and therefore an attitude which excludes smugness or national self-sufficiency. An economic activity can come to full fruition only when the market is sufficiently large, on both the production and the consumption sides, to reduce costs; international collaboration thus becomes imperative. It is in this belief that we have decided to collaborate with the American Gulf Energy and Environmental System Company, which in the last 18 months has won a certain number of orders in the United States. Under the agreements concluded, the CEA, in exchange for a dovetailed programme of research and development, has access to all the present and future information on the Gulf HTR system. In addition, any studies made by the CEA on this subject outside the planned programme will be taken into account in the overall economic balance of the agreement. The information will then be passed on to an association of industrialists (H.G.T.R.) which can subsequently submit offers to various electricity supply companies. These agreements thus allow us to make use of our experience with materials and gas cooling by availing ourselves of Gulf technology which, as is evidenced by the orders already received by Gulf, has reached the commercial stage. The set of agreements covering this operation is of a truly exemplary type in that it represents precisely the philosophy that should be the keynote of our actions in this second phase of the evolution of nuclear energy.

On another plane, the CEA will attempt to transfer its techniques to industry under the best possible conditions. In the past we have witnessed the difficulties that can arise if no advance



A linear accelerator, part of the Saclay programme, seen through its tunnel.
In the right foreground is the "head" of the accelerator.

arrangements are made for co-ordination between the departments that develop a technique and those responsible for applying it.

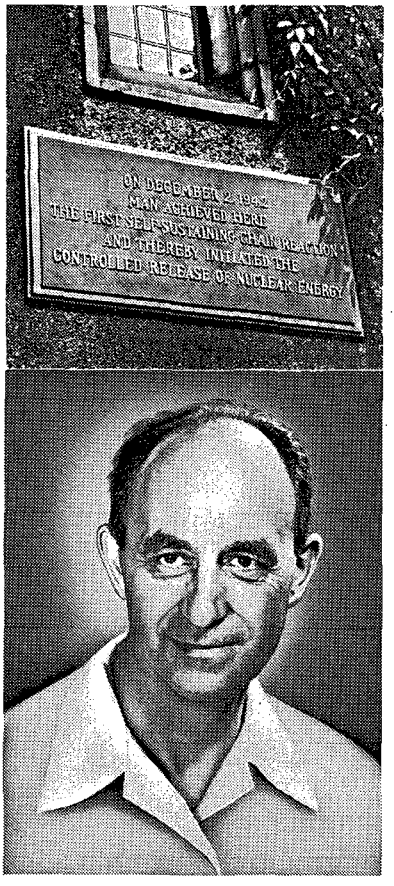
It is in order to remove these disadvantages that we have decided to introduce a series of stepping stones to facilitate the transfer of knowledge. Thus, the CEA will play a critical role in the installation of the first commercial breeder-reactor power station because the whole scientific and technological package for the process will be derived from experiments on Rapsodie and Phénix. Technicatome, a company created for the purpose, will provide liaison between the CEA experts in nuclear power technology and the industrial firms which must assimilate it. The company's first task will be the engineering of this first power station, which is to have a capacity of 1200 MW(e) and is to be constructed jointly by Electricité de France, ENEL (Italy) and RWE.

In many other fields nuclear establishments must adapt themselves to the requirements that industrial applications will entail. The many technical problems which will arise in the next 20 years must therefore be resolved by close co-operation between research workers, technologists, industrialists and also consumers. Every action must be governed by the quest for a rational approach, economic viability and international co-operation.

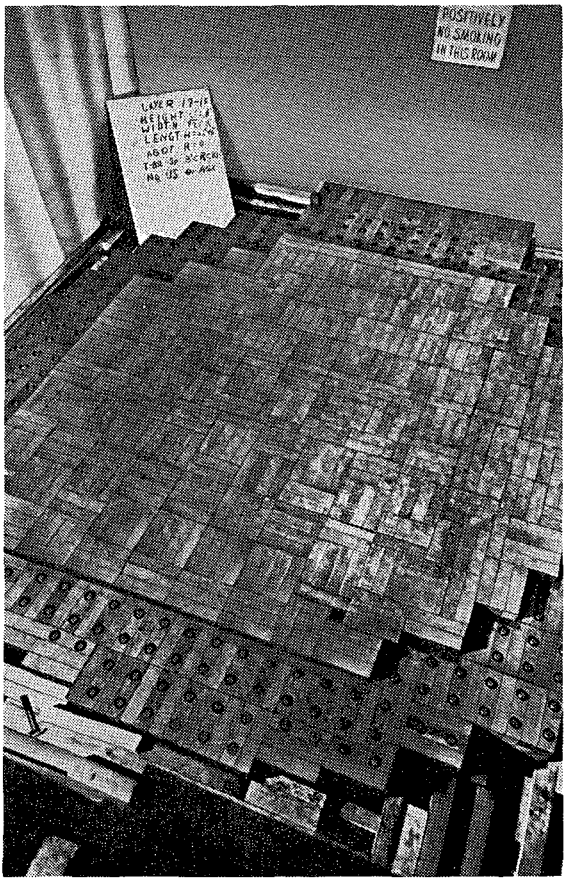
For example, the important problem of radioactive waste disposal can be finally resolved only through international co-operation, and must for the next 20 years be treated as a problem of prime importance. The increase in the volume of radioactive waste will necessitate international agreements both on general legislation and for the solution of specific problems. Thus, at the international level an answer must be found to the question of what is to be done with disused nuclear plants. Once they have been completely decontaminated, could some of them be freed for other users, or should they be turned into non-recoverable "radioactive cemeteries"? International recommendations on this question, as on many others, would make it possible to harmonize the policies of the countries concerned.

The few examples mentioned above will serve to illustrate the corner that we now have to turn in the nuclear field. The turning of the corner towards an expansion of nuclear energy must be the main objective of the nuclear energy commissions in every country, and also of their industrialists and producers; and all must advance in step.

The following pages from our photographic archives illustrate some of the early stages in the history of nuclear development.



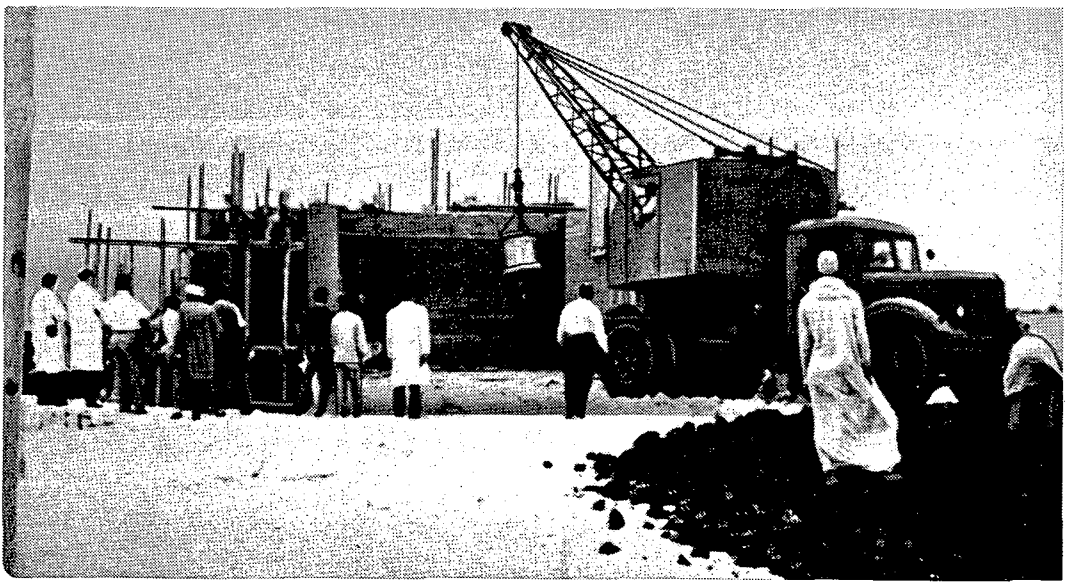
Professor Enrice Fermi, who achieved the first self-sustaining chain reaction on December 2, 1942, and the bronze plaque on the wall of the West Stands, Stagg Field, Chicago, to commemmorate the event... Los Alamos, Argonne National Laboratory

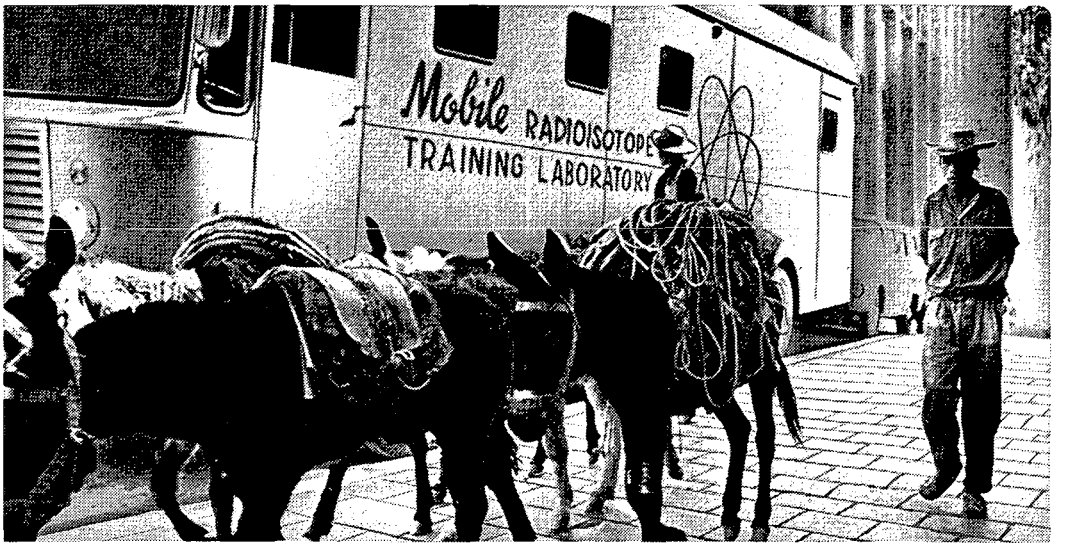


The only photograph of the world's first reactor during its construction at the University of Chicago. Taken in November 1942, it shows the basic design of the pile, with alternate layers of graphite containing uranium metal and uranium oxide, and spaced with layers of "dead" graphite... Argonne National Laboratory

As part of its technical assistance programme, the IAEA provided the United Arab Republic with help in the agricultural applications of radioisotopes. Above: Camels transporting material to construct the building which will house the cobalt-60 unit for the irradiation field at Inshas.

Below: Construction in the field... IAEA





The Mobile Radioisotope Laboratory outside the University of Guanajuato, Mexico, in February 1960... Unations

Left: Ambassador Kurt Waldheim (Austria) addressing the opening session of the IAEA Conference on Civil Liability for Nuclear Damage at Vienna's Hofburg in April 1963... IAEA

Right: April 1959, Members of the Board of Governors inspecting the site of the IAEA laboratory at Seibersdorf near Vienna. In the background, the reactors and laboratories of the Austrian Studiengesellschaft für Atomenergie under construction... IAEA

NEWS IN BRIEF

From Headquarters:

The highlight of activity for the IAEA was a move of headquarters – from Vienna to Mexico – for the 16th annual General Conference from September 26 - October 3. The meeting was attended by representatives from 75 Member States. H.E. Horacio Flores de la Peña, the Minister of Natural Resources of Mexico, was elected president during the proceedings which were held in the imposingly modern Foreign Affairs building in Mexico City. This is the second time that the conference has been held away from Vienna. In 1965 Japan had invited the Agency to hold its general conference in Tokyo.

H.E. Ambassador N.F.H. Berlis of Canada was elected chairman of the Board of Governors of the IAEA from 1972-73. The members of the Board are: Argentina, Australia, Belgium, Brazil, Canada, China, Colombia, Egypt, Finland, France, Fed. Rep. of Germany, Greece, India, Indonesia, Japan, Mexico, Poland, Romania, Saudi Arabia, South Africa, Sri Lanka, USSR, United Kingdom, USA and Zaire. The Vice-Chairmen are the representatives from Japan and Romania.

- The Director General presented the Agency's Report to the United Nations General Assembly in New York on October 31.
- An official call on President Suharto of Indonesia was made by the Director General during the President's State Visit to Austria on November 18.
- The official ceremony to mark the opening of the Karachi Nuclear Power Plant (KANUPP) was held on November 27. Mr. Chernilin represented the Agency.

Items of Interest:

During 1972 more than 700 people visited the IAEA headquarters to attend lectures and film showings on the Agency's work. Most of the visiting groups came from universities and high schools, but also included diplomats, businessmen and tourists from the following countries: Austria, Brazil, Ecuador, Arab Republic of Egypt, Federal Republic of Germany, Switzerland and the United States.

On November 18 President Suharto of Indonesia met in Vienna with the Director General.

The Bank of America and eight large European banks have formed a multi-national company whose specific purpose will be to finance worldwide expansion of the nuclear energy industry. Although still subject to appropriate approvals, the new company will have authorized capital of $4.5 million, with participation shared equally by the nine shareholder banks. To be called the International Nuclear Credit Corporation, the company's aim will be to place financing facilities at the disposal of nuclear plant builders, fuel manufacturers and energy producers around the globe.

European banks which have agreed to participate in the formation of INCC are: Banque Nationale de Paris, Algemene Bank Nederland, Banca Commerciale Italiana, Banca Nazionale del Lavoro, Banque de Bruxelles, Banque de l'union Européenne, Barclays Bank and Dresdner Bank. This announcement was made recently by the Bank of America's Multi-national Division in San Francisco.