A brief history of CERN

In June 1955 Felix Bloch, CERN's first Director General, laid the Foundation stone of the Laboratory watched by Max Petitpierre, President of the Swiss Confederation.

(Photo CERN 02.6.55)

Although scientists had been discussing the possibility of a European physics laboratory for some years, the idea was first voiced publicly in a message from the French physicist Louis de Broglie to the European Cultural Conference in Lausanne in December 1949. Scientists were becoming increasingly aware that further progress in physics required resources beyond those of individual European nations, while statesmen were eager to promote worthy projects which symbolized the new spirit of European unity.

With the help of UNESCO, a series of conferences in 1950 and 1951 paved the way for the establishment of an international nuclear physics laboratory. In Geneva in February 1952, eleven governments signed an agreement setting up a provisional 'Conseil Européen pour la Recherche Nucléaire'—hence the acronym CERN, which has been retained ever since. Later in the same year, an offer from Switzerland to provide a site near Geneva for the Laboratory was accepted.

By the beginning of 1955, the Convention establishing the Organization had been ratified by twelve Member States—Belgium, Denmark, the Federal Republic of Germany, France, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and Yugoslavia. Austria joined in 1959 and Spain was temporarily a member from 1961 to 1969 but had to withdraw, as also did Yugoslavia.

John Adams announced the first operation of the proton synchrotron in November 1959. He is holding an empty vodka bottle into which he fed a polaroid photograph of the 24 GeV pulse, to be sent to the Soviet Union. The vodka had been supplied by Dubna to be drunk when the world record energy of their 10 GeV synchro-phasotron was surpassed.

(Photo CERN 1881E)
The chamber of the 3.7 m European bubble chamber being prepared for installation in 1971.

(Photo CERN 216.12.71)

in 1962, for financial reasons. Yugoslavia, Poland and Turkey have the status of observer.

The first accelerators — the SC and PS

At an early stage, it was decided that CERN should build an ambitious proton synchrotron using the very latest developments in accelerator technology. At the same time, construction of a smaller, less powerful machine was launched to allow a research programme to get under way as soon as possible and to provide some experience of accelerator building by a European collaboration.

Excavations began on the Geneva site in May 1954, with a view to accommodating a 600 MeV synchro-cyclotron and a 25 GeV proton synchrotron with all their experimental and administrative support facilities. The synchro-cyclotron came into operation on 1 August 1957.

With construction of the proton synchrotron well under way in 1958, attention turned to the provision of adequate experimental facilities to complement the power of the big machine. Work began on the new experimental technique of bubble chambers and the first in a long line of increasingly powerful computers appeared on the CERN site.

On 24 November 1959, the proton synchrotron reached an energy of 24 GeV. This was a proud day for European science. It was the first proton machine of its type (using the strong focusing principle) to operate and was for a time the most powerful particle accelerator in the world.

In 1961 the first attempts at experiments using neutrino beams began; this field of research eventually became a speciality of the physics programme at CERN. To monitor the interactions of these elusive particles required special detectors; large arrays of spark chambers and heavy liquid bubble chambers were developed, and the first ever bubble chamber pictures of neutrino interactions were taken at CERN in 1963. The neutrino physics benefitted greatly from fast ejection of protons from the synchrotron, also achieved for the first time ever in 1963.

While the performance of the accelerators was being steadily improved and the physics programme was yielding many good results, the detection techniques used to study the behaviour of the particles and the computer power needed to analyse the collected information were advancing considerably. Several bubble chambers were in use at the proton synchrotron, and to meet its computing needs CERN had to
In January 1971, Kjell Johnsen announced in the control room of the Intersecting Storage Rings that proton-proton interactions in colliding beams had been seen for the first time.

(B.CERN 248.1.71)

develop one of the largest computer centres in the world.

Bubble chamber techniques were being thoroughly mastered. In 1965 an agreement was signed between CERN and the French Atomic Energy Authority to build a very large heavy liquid bubble chamber, which became known as Gargamelle. In 1967 another agreement, this time between CERN, France and the Federal Republic of Germany, covered construction of a very large hydrogen bubble chamber, which became known as BEBC — Big European Bubble Chamber. Both these detectors were initially destined for operation at the proton synchrotron.

There were also many advances in the domain of electronic detectors and the most important involving the properties of multiwire proportional chambers and drift chambers. They are able to give information about particles which traverse them with a precision and at a rate never obtainable in a single device before. Detectors of this type are now in use in high energy physics Laboratories throughout the world and are also finding extensive application in medicine, biology, solid state physics, etc.

The 600 MeV synchro-cyclotron and the 28 GeV proton synchrotron, on which the early research at CERN was based, are still in very productive use today. The synchro-cyclotron was largely rebuilt in the early 1970s to produce higher proton beam intensities so that it could remain competitive for physics experiments with other modern machines in its energy range. It is the scene of many experiments in the field of nuclear physics and, since 1967, has had one of the world’s finest facilities for the study of very short-lived nuclei — the Isotope Separator On-Line (ISOLDE).

In 1978 the research was further extended when helium ions were accelerated in the machine, and the use of carbon ions is planned.

The proton synchrotron has seen many modifications and additions. A four-ring 800 MeV Booster was completed in 1972 to increase the injection energy and a new 50 MeV linac started operation in 1978. The machine has exceeded its design intensity by more than a factor of a thousand. Its reliability in operation, for such a complex accelerator system, is exceptionally good. It has provided particles to hundreds of experiments in its own range of energies and it is now the source of all the protons used in the higher energy machines at CERN — the Intersecting Storage Rings and the Super Proton Synchrotron. It is also a vital component of the new project to collide proton and anti-proton beams at high energies.

The ISR and SPS

It became evident, following the operation of the proton synchrotron, that the information gained about the nature of matter in the newly accessible energy range posed further questions which called for still higher energies to attempt to answer them. To obtain a consensus in the European community as to the best way to develop CERN’s research facilities, a ‘European Committee for Future Accelerators’ was set up. In 1963 ECFA recommended the construction of a 300 GeV proton synchrotron and of Intersecting Storage Rings (ISR).

In 1965 CERN Council authorized a supplementary programme for the construction of the ISR to enable two 25 GeV proton beams to be brought into collision. That same year the French government agreed to make available to the Organiza-
Inauguration ceremony for the 400 GeV proton synchrotron, the SPS, in May 1977 which was held a huge experimental hall on the North Area.

The accelerator, which became known as the Super Proton Synchrotron or SPS, began operation in June 1976 at an energy of 400 GeV. As with the ISR, the building of the machine was completed ahead of schedule and within the authorized budget. The accelerator performance improved rapidly so that design intensity has been exceeded and at the end of 1978 the peak energy was taken to 500 GeV. The SPS thus joined the machine at the Fermi National Accelerator Laboratory as the highest energy proton synchrotron in the world.

Planning for experiments at the SPS started under the auspices of ECFA in 1972 and sophisticated detection systems were ready to receive particles very soon after the machine came into operation. Careful design of the beamlines from the machine has resulted in beams of the highest energy, intensity and quality ever achieved.

Experiments at the SPS are now by far the largest part of the CERN research programme. Three large experimental halls are being supplied with beams and another is under construction to receive very intense beams, while four detection systems, including the large bubble chamber BEBC, are lined up in series to receive neutrino beams. There is every hope for a continued rich crop of results from these experiments in the coming years.

International collaboration

International collaboration is the life-blood of CERN. The success and development of the Organization and its Laboratories over the past 25 years reflects both the need for and the usefulness of international partnership in high energy physics, where experiments require considerable resources in equipment and

The Intersecting Storage Rings came into operation in 1971 with remarkable smoothness, in advance of the schedule and within the authorized budget. The machine was a daring one when it was conceived but so thoroughly was the construction executed that the ISR is widely regarded as the most perfect example to date of the accelerator builder's art.

Though the study of particles in the ISR was for a long time limited to the interaction between two protons, it has the great advantage of observing head-on collisions where the energy available to produce phenomena of interest is equivalent to that at a conventional synchrotron of 2000 GeV.

Performance of the Intersecting Storage Rings has far exceeded the design parameters. The machine is so perfect and reliable that usable proton beams can circulate for many days without need for refilling. In the future it is intended to store antiprotons in one of the rings so as to resurvey the ISR energy region, this time with proton-antiproton collisions.

Authorization to build a 300 GeV proton synchrotron took a long time to obtain, mainly because of difficulties in site selection and in cost. Finally a decision was taken in February 1971 to construct the new Laboratory alongside the existing one. Although at first administratively separate, the two Laboratories were united in January 1976.
manpower, and where a continual exchange of ideas provides valuable stimulus for further investigations.

From a relatively small level in the early years, the use of the CERN experimental facilities has now grown to involve some 1500 experimental physicists drawn from over 100 European universities and research institutes. It is this level of activity which makes Europe one of the main world areas for high energy physics research.

In addition to this ever-growing collaboration of European physicists, CERN, as a Laboratory of world class, attracts visitors from further afield.

In 1956, when the proton synchrotron was still on paper, the Ford Foundation initiated a funding programme which for the subsequent ten years enabled scientists and technologists from non-Member States, notably the US, to participate in the CERN programme. This provided valuable additional experience in those early years, and the programme has been continued and expanded with direct funding by CERN.

Also in the early years, scientific exchanges began with the Joint Institute for Nuclear Research at Dubna, near Moscow. A further important landmark was in 1967 when an agreement was signed between CERN and the USSR covering technical contributions by CERN to extracted beam facilities at the 76 GeV proton synchrotron at Serpukhov. This enabled physicists from CERN Member States to carry out experiments at this accelerator, at that time the highest energy machine in the world. This agreement was extended in 1975, enabling Soviet physicists to collaborate in experiments at the big new CERN machines. Although as yet still in its infancy, two-way contact between CERN and the People’s Republic of China has been under way since 1973.

The future

In 1977, trials began to test ‘stochastic cooling’ — a new method invented at CERN for concentrating particle beams. These trials were quickly successful and showed the feasibility of storing new kinds of particle beams, notably antiprotons. In the following year, antiproton beams were successfully stored for the first time ever.

As a result, ambitious plans were prepared for the SPS to take on a new role as proton-antiproton colliding beam machine, and the necessary construction work initiated. In the SPS, these colliding beams will open up a new domain of high energy physics, with collision energies equivalent to that of a 155 000 GeV conventional accelerator. Further uses of the cooled antiproton beams are foreseen at the ISR and for low energy studies at the PS.

With the full capabilities of the SPS yet to be exploited and the proton-antiproton project due to receive its first colliding beams in 1981, it is still necessary to look further ahead to the longer-term requirements for high energy physics in Europe. In 1977, these studies crystallized as an ECFA recommendation for a large electron-positron colliding beam machine. This ‘LEP’ project is now under detailed study for the long-range future of CERN. With such a vigorous development programme and with its tradition of international collaboration, Europe is well placed to maintain the position it has established in the forefront of high energy physics research.