

Last year at CERN

Owing to the long time since the last appearance of *CERN COURIER*, our usual feature 'Last month at CERN' requires a temporary change of title. Unfortunately it is not possible to cover in detail all the events of the past year, but it is hoped that the following account includes the chief items of interest and gives an idea of what has been happening recently at CERN.

From the beginning of the year, the laboratory was reorganized internally into **twelve divisions**, indicative of its broadened scope and increased emphasis on experimental work, following the full operation of the second particle accelerator. The divisions are: PS Machine, SC Machine, Nuclear Physics, Engineering, Data Handling, Theory, Track Chambers, Nuclear Physics Apparatus, Accelerator Research, Site and Buildings, Finance, and General Administration. Then on 1 August, J. B. Adams left for England, to be replaced as Director-General by Prof. V. F. Weisskopf. The 19th Session of the **Council**, reported briefly elsewhere in this issue, took place at CERN on 2 June, and the 20th on 19 December.

A noticeable change has been brought about in the appearance of the site by the progress on new **building projects**. In April, 1120 m² of floor was laid in the courtyard at the eastern end of the South experimental hall of the proton synchrotron, followed two months later by roofing, thus providing another large area for engineering and auxiliary experimental work. A further wing was added to the adjacent laboratory block. One result of these changes was to enable the **Engineering Division** to release the space it formerly occupied in the South hall. For the new **East experimental area** the large triangular apron has been laid and the new building at the end of it has already started to receive sections of the 1.5 m **British Hydrogen Bubble Chamber**. The neighbouring compressor and generator buildings to serve this and the CERN 2-m hydrogen bubble chamber that will also be installed, are more or less finished, and at the end of the year a 10-m-diameter steel sphere was being completed at one corner of the apron. This is to accept in the form of gas the whole volume of hydrogen from either chamber in case of emergency.

The **NPA building**, for development of nuclear physics apparatus was brought into operation in June, and parts of the new building for the **Accelerator Research Division** in December. On 6 November, new electrical and mechanical stores for the **Site & Buildings Division** were inaugurated.

An important step forward in the use of the proton synchrotron was the bringing into service of the **North experimental hall** in September. Towards the end of the year, the first of the **CERN electrostatic separators** was installed there as part of the system for providing a 1.5 GeV/c negative K-meson beam. The electrostatic field of this separator can be as high as 53 kV/cm over a gap of 8.5 cm. The **32-cm hydrogen bubble chamber** operated by the **Track Chambers Division** was transferred to the North hall initially to help in setting up the beam and then for experiments. The d.c. power supplies in this hall total 3500 kW for beam-transport magnets and 3000 kW for track-chamber magnets.

Full exploitation of the **synchrotron** was hampered to some extent by the civil engineering work on the East junction, and for some time it was possible to run the machine only at week ends. Complete shut-downs totalling 11 weeks were also necessitated by this work, by the installation of new equipment, and for changing beams. More time was lost by the breakdown of parts of the injector system. In spite of these pauses, however, some **1540 hours** were devoted to nuclear physics in the six months from June to November, out of a total running time of 1907 hours, and at the end of the year **93 hours a week** were being given to nuclear experiments. Beam intensity then was 2.5×10^{11} **protons per pulse**. The **permanent PS**

control desk was installed in August, and a platform erected in the North hall to act as a centre for counting and control equipment belonging to the experiments. The accelerator can now produce secondary beams of 120-milliseconds duration, and a 6-headed **target** assembly is also being used with success.

In June, there were altogether 44 standard magnets and lenses available for the guidance of secondary beams from the PS. To supply them with power the new **generator building** houses 30 generators with outputs ranging from 40 to 320 kW together with 4 of 1500 kW each.

In the first ten months of 1961 the **synchro-cyclotron** provided **5361 hours** operating time for nuclear physics, apart from over 1000 hours when 'parasite' experiments were possible. In this time only 195 hours were lost because of machine faults. In addition to the Easter holiday, there was one shut-down of 10 days in mid June and another in October.

The internal beam intensity was raised during the year from **0.3 μ A to 0.8 μ A**, by mixing small amounts of argon in the hydrogen supply to the ion source, and improving the electrostatic focusing near the source. Another way of increasing the usefulness of this accelerator has been the installation of devices designed to increase the duty ratio of internally produced secondary beams. An increase from below 1% to about 25% is achieved. Further studies and experiments are continuing to augment the intensity and improve the duty ratio of the extracted proton beam. Twelve new generators of a total capacity of 680 kW have been installed to supply beam transport equipment.

Among activities in the **Engineering Division**, two prototypes of controlled semi-conductor rectifiers were built, one rated at 500 A, 125 V, the other at 100 A, 25 V. Such rectifiers, used instead of motor-generator sets, will simplify the provision of power for beam-transport magnets. Other applications of semi-conductors, developed by the **Nuclear Physics Division**, are transistorized scalars, fast pulse amplifiers, etc.

Still on the subject of new equipment, the magnet armature for the **CERN 2-m hydrogen bubble chamber** was completed at the manufacturers' works towards the end of the year. Also nearing completion was the transport system: on site, the 4000-W refrigeration system was being erected.

Development of the **microwave particle separator** has continued, the aim being to produce separated beams of antiprotons and positive and negative kaons between 10 and 20 GeV/c. Experimental equipment to permit the accurate study of **spark-chamber** operation was completed.

A major success of the year was the setting up of the separated **antiproton beam** (up to 1 GeV/c momentum) from the PS. This was carried out by the **Nuclear Physics Division** with the assistance of visitors, and was made possible by the use of two electrostatic separators from the **University of Padua**. In addition, a score of lenses and magnets were used to guide the beam, fed by 18 independent generators. The first experiment using the **81-cm hydrogen bubble chamber from Saclay** was carried out with this beam, resulting in 170 000 photographs showing 300 000 antiprotons stopping in the chamber, and another 90 000 photographs showing low-energy antiprotons passing through. A study is being made of the production of pairs of K-mesons by antiprotons at rest. Measurements of total cross-section in hydrogen have also been made. In September, this beam was replaced by its successor, designed for separated antiprotons up to a maximum of 6 GeV/c. With the second of the **CERN electrostatic separators** installed in the South PS hall, 3.6 GeV/c was reached in December.

It is not possible to note all the dozens of experiments that were carried out during the year. We should mention

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that the **Trieste** team returned home at the end of their experiment on charge-exchange scattering of negative pions in hydrogen; after this, in August, came a new visiting team from **Argonne National Laboratory**, U.S.A., led by Prof. A. Roberts. Five thousand tons of shielding had to be placed in position when the **neutrino experiment** attempted to find whether the neutrino emitted in the decay of a pion is the same as that involved in nuclear beta decay. The new **CERN heavy-liquid bubble chamber** was used for this during May-July, together with the **Ecole Polytechnique (Paris) chamber**, using a multiplate cloud chamber and large-area scintillation and Cerenkov counters for background measurements. Unfortunately, the number of neutrinos, which are extremely non-reactive particles, proved to be much lower than originally expected, and insufficient to allow any results to be obtained. Only seven possible events were found among the 150 000 pictures taken, and revised estimates of the number of neutrinos available indicated that only 1 event in 100 days was to be expected. The experiment will be continued, using a '**magnetic horn**' to increase neutrino intensity, and a bigger detector, a **multi-ton spark chamber**.

Another search for something rare, or non-existent, resulted in the establishment of lower limits of between 10^{-35} and 10^{-39} cm² per nucleon for the production cross-section of **magnetic monopoles**.

Many experiments on the PS utilized **proton** or **pion** beams to carry out measurements of a number of different reaction cross-sections for these particles. Important studies were carried out on the quasi-elastic **small-angle scattering** of protons on protons. The absorption cross-section for 10 and 13.5 GeV **photons** was measured for a number of elements. An experiment of interest in connexion with cosmic-ray-induced activities in iron meteorites was the measurement of cross-sections for a number of **spallation**

products from the action of high-energy protons on iron.

Many of the experiments using the synchro-cyclotron concerned **muons**. Further measurements on (g-2), the **anomalous magnetic moment** of the muon, were carried out to reduce the experimental error to $\pm 0.5\%$ and the final result was awaited at the end of the year. In another experiment, about 380 000 bubble-chamber pictures were obtained of muons stopping in highly purified hydrogen. X-rays emitted when muons are captured into '**atomic**' orbits have also been studied for two ranges of nuclear mass, to obtain information on nuclear radii.

Apart from carrying out measurements on tens of thousands of track-chamber photographs already taken, the **Data Handling Division** actively pursued the development of more automatic machines that would be able to handle greater numbers in future. The 'Mark O' version of the **lep Y**, or Hough-Powell flying-spot apparatus, was tested in May by a team composed of personnel from Brookhaven and Berkeley, in the U.S.A., and the Rutherford Laboratory in England, as well as CERN. Further tests were carried out in June, and construction of the 'Mark I' working version was at an advanced stage at the end of the year. Design studies by the **Accelerator Research Division** have continued on the two **proton storage rings**, proposed for the CERN proton synchrotron to give two colliding beams of particles. This would enable, for instance, proton-proton collisions to be investigated in the region of 50 GeV centre-of-mass energy. Construction of the **electron beam-stacking model** has suffered some setbacks because of delayed deliveries, but the RF system is ready and much progress has been made with the all-important ultra-high vacuum.

Some controversy exists over the relative value of colliding beams, and the Division has also made a start on the study of an alternative suggestion of building a **new synchrotron** giving much greater energy. Accelerated protons of over 1000 GeV would be needed, however, to give the same centre-of-mass energy for the proton-proton

working on the construction of a magnet regulator for the synchro-cyclotron and was then responsible for the formation of an electronics maintenance section. This was originally for the SC machine, but it is now concerned with the repair, checking, and calibration of electronics instruments used throughout CERN.

Christoph C. SCHMELZER, one of the earliest CERN staff members, left on 22 March to return to Heidelberg University, where he began studies on the acceleration system of the future European synchrotron as far back as the end of 1952. This followed his work under Prof. Bothe, when he made a study of phase stability in microtrons and played an important part in the redesign of the Heidelberg cyclotron.

After coming to Geneva in 1954, he became responsible for the design, development, construction and final testing of the PS acceleration system, and was also deputy to the Division Director. The results of his work were seen on 24 November, 1959, when the first beam was accelerated to full energy so soon after completion of the machine construction. He then continued with studies of radio-frequency systems both for the PS and

for other accelerators. During his stay at CERN he was also at some time a member of the Leading Board and of the library committee.

At Heidelberg, where he occupies the chair of applied physics at the Max Planck Institute, Prof. Schmelter is still concerned with accelerator development. He is a consultant to CERN, and also chairman of the Wissenschaftlicher Rat (scientific council) which advises on the 6-GeV DESY (Deutsches Elektronen-Synchrotron) accelerator at Hamburg.

Frederick A. R. WEBB returned to England at the end of December after being at CERN since 1 October 1956. Originally released for a period of two years from the Ministry of Works in the United Kingdom, he has stayed to see the putting into operation of the 28-GeV PS accelerator, and the beginning of further expansion on the site. As Site Engineer, and later Deputy Leader of the Site and Buildings Division, he has been responsible for all the civil, mechanical, and electrical engineering installations and maintenance, and for the overall control of transport, security and fire services. As chairman of the organization's Safety Committee he was res-

ponsible for the preparation of the Safety Codes now in use.

Like many British engineers, Mr. Webb received his early training as an apprentice in an industrial works, studying part-time at a Technical College as an external student of London University. Subsequently he became an Associate Member both of the Institution of Civil Engineers and the Institution of Mechanical Engineers, and in the course of a varied career first in industry and then in Government service was one of the original design engineers for the Atomic Energy Research Establishment at Harwell.

On 15 August, Dr. **Toyio YAMAGUCHI** left CERN for his home country, where he has been appointed to the Chair of Physics at the University of Tokyo.

Born on 29 January, 1930, Dr. Yamaguchi received his education in Japan, where he was a student of Prof. Toganaka. He obtained his Doctorate in Physics, with a thesis on the 'Theory of mesons'.

Dr. Yamaguchi had been at CERN since 1957, with a Fellowship from the Ford Foundation. As a member of the Theoretical Physics Division he carried out a number of studies, mainly on the subject of weak interactions.