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EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

The European Organization for Nuclear Research (CERN) came into being in 1954 as a co-operative enterprise among European governments in order to regain a first-rank position in nuclear science. At present it is supported by 13 Member States, with contributions according to their national revenues: Austria (1.92 %), Belgium (3.78), Denmark (2.05), Federal Republic of Germany (22.47), France (18.34), Greece (0.60), Italy (10.65), Netherlands (3.87), Norway (1.46), Spain (3.36), Sweden (4.18), Switzerland (3.15), United Kingdom (24.17).
Contributions for 1963 total 92.5 million Swiss francs.

The character and aims of the Organization are defined in its Convention as follows

'The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto. The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available.'

Last month at CERN

The most exciting news during June was that after years of preparation and the last few months of intense activity to instal the equipment for the most complex experiment ever to be attempted at CERN, the **'neutrino pre-run'** was a complete success. The proton synchrotron, the fast ejected-beam system, the CERN heavy-liquid bubble chamber and the massive spark-chamber array all worked smoothly, and everything pointed to the fact that CERN now possesses a new and outstanding tool for scientific research.

Beginning on Thursday, 13 June, at 8 a.m., initially with alignment of the beam and measurements of the ejection efficiency, the run continued more or less without pause until 6 a.m. on the morning of Sunday, 16 June. The first 'neutrino events' were observed around 7 p.m. on the first day. Most of the time the protons in the ejected beam had a momentum of 23.8 GeV/c, but for 10 ½ hours on the Saturday this was changed to 21.1 GeV/c. The pulse repetition rate was one every three seconds.

After removing the restrictions on the intensity of the proton beam, previously imposed to limit induced radioactivity near the ejection magnets, new high values were obtained; the average for the whole run was nearly 7×10^{11} protons per pulse. The operating voltage of the kicker magnet was chosen so as to eject 18 of the 20 bunches in each pulse, giving an average intensity at the target of about 6×10^{11} protons per pulse, focused into a spot 2 mm in diameter (as shown in the photograph in last month's *CERN COURIER*). The magnetic horn was operated at its maximum current of 300 000 A, and arranged to focus positive pions, resulting in an intense beam of muon neutrinos directed towards the detection apparatus.

This apparatus was in two complementary parts. Immediately behind the steel wall, 23 metres thick, designed to absorb all particles except neutrinos, was the heavy-liquid bubble chamber, operated by the Nuclear Physics Apparatus Division. Beyond this was the spark-chamber assembly, operated by members of the Nuclear Physics Division, consisting of three consecutive sections: a 20-ton array, 2 m wide and 1.6 m high, known as the production region, designed to show interactions of the neutrinos; a large magnet for momentum measurements on the particles produced; and a 55-ton 'range-chamber', essentially for observing whether the particles emerging from the production region interacted or just stopped. This latter was not yet in operation for the pre-run.

Since neutrino reactions are so rare, the bubble-chamber cameras were adjusted to take two exposures on each frame of film, and the 27 000 photographs obtained thus represent 54 000 expansions of the chamber. Considerably fewer photographs were taken by the spark chamber, since various scintillation counters were arranged to ensure that the chamber was only triggered by events that might possibly have been from neutrinos. Even so, most of these triggers were due to muons or neutrons which had managed to get around the shielding.

Nothing much can be said about the results yet, since this was only a preliminary experiment. The main runs will be spread over several weeks or more, and careful measurements and analysis will be necessary on all the photographs thought to be of neutrino reactions before definite conclusions can be drawn. This may take some months. However, the kind of particle tracks so far obtained, both in the bubble chamber and in the spark chamber, are quite consistent with last year's Brookhaven result that muon neutrinos and electron neutrinos are two different kinds of particle.

The CERN experiments are designed to investigate in more detail the nature of the interactions both of neutrinos and antineutrinos (the latter coming from the decay of negative pions), and to search for the existence of a boson 'particle', thought by many to be involved in weak interactions in the same way as pions and kaons are involved in strong interactions.

The collaboration of many people in many Divisions of CERN, not to mention the good-natured indulgence of others whose activities had sometimes to be interfered with, has produced a neutrino beam and detection apparatus with many unique features particularly suited for

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The cover photograph shows one of the lighter aspects of the neutrino experiment. This notice, in many colours which we unfortunately cannot show, marks the entrance to the zig-zag passage, through concrete shielding in the South hall of the proton synchrotron, leading to the enclosure which contains the CERN heavy-liquid bubble chamber. Together with the massive spark-chamber assembly, situated in a similar heavily shielded enclosure, the bubble chamber is now being used to give, for the first time ever, detailed information on the extremely rare interactions caused by neutrinos. At this stage the programme is exploratory and also includes an experimental study of the postulate of the 'intermediate boson', a very short-lived particle, which many theoreticians believe may have a role in weak interactions.

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Roger Anthoine

Editor:
Alec G. Hester

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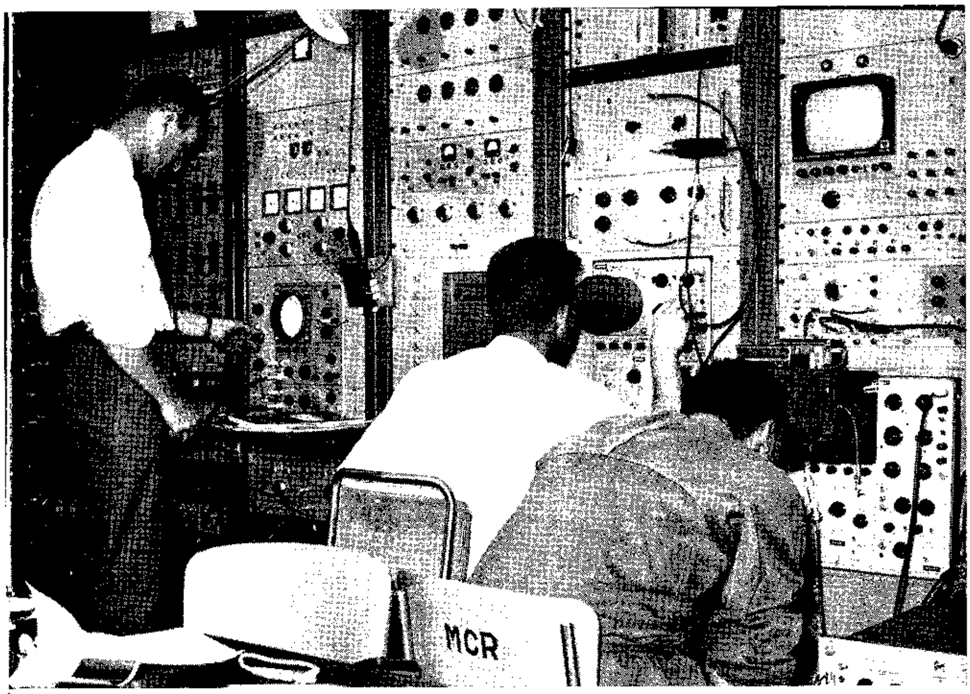


Activity at the control panels for the beam-ejection system, in the main control room of the proton synchrotron, during the setting up of the beam for one of the neutrino runs. On the left, Berend Kuiper adjusts the oscilloscope that shows the operation of the hydraulic system for the kicker and ejection magnets. In the centre, Hendrick Dijkhuizen checks the kicker-magnet pulse on an oscilloscope measuring time in thousandths of a millionth of a second (as mentioned in last month's article on the ejection system). Next to him, Georges Paillard views a similar oscilloscope, equipped with a camera, showing the number of proton bunches in the ejected beam. The television screen for viewing the ejected beam at various points of its trajectory is higher up on the same panel.

such investigations. The very high intensity of the synchrotron, the large fraction of the accelerated beam that is ejected and its short pulse length, and the focusing action of the horn, combine to give a neutrino flux which is about a hundred times higher than anything achieved previously. Neutrinos or anti-neutrinos can be selected at will. For the first time, it appears that neutrino reactions have been observed in a bubble chamber. The diversification of the spark-chamber array makes it well suited for the analysis of rare events, and the magnetic field incorporated is especially useful in this respect as it will provide a distinction between positive and negative particles which pass through it.

Apart from the run with the neutrino beam, the main experiments at the **proton synchrotron** during the month continued to be those using counters for particle detection. In addition, the **Saclay/École Polytechnique 81-cm bubble chamber,** filled with liquid deuterium (heavy hydrogen), carried out a long run in the m_3 beam, lasting most of the month, during which 204 000 photographs were taken. This was primarily to study the reactions of medium-energy positive pions with neutrons. A target consisting only of neutrons is impossible to obtain, but liquid deuterium is very near to it, since each deuterium nucleus consists of one neutron and one proton, comparatively loosely bound together. Reactions between the pions and the protons can be allowed for on the basis of previous work with liquid hydrogen as the filling for the bubble chamber, when only protons were present.

Although early in the run one of the **10-m electrostatic separators** in the m_3 beam gave some trouble with its vacuum system, both operated particularly well from the point of view of stability of the high-voltage field between the plates inside each tank. For one separator, situated in the entry part of the beam, inside the ring tunnel, the rate of sparking across the gap was only one spark per day, at a field of 50 kV/cm (700 kV across a gap of 14 cm); for the other, in the South hall, the rate was about six per hour, but this is still considered low for this field strength.

As mentioned in the report of the neutrino pre-run, the synchrotron **beam intensity** was increased considerably during the month. Visitors to the main control room or the experimental areas could see values of over 8×10^{11} protons per pulse often appearing on the digital display panels that announce the intensity pulse by pulse, and for one shift of 8 hours the average reached 7.82×10^{11} protons per pulse.

A report on the preliminary results from the neutrino experiments, by H. Faissner (NP Division) and R. Voss (NPA Division), formed an unexpected ending to the **Track Chamber Jamboree,** held at CERN on 27 June.

This was the yearly meeting held under the auspices of the CERN **Track Chambers Committee** to report on progress over the past year and to review future plans. This Committee, of which Prof. B. P. Gregory (École Polytechnique, Paris) is chairman, and R. Budde (CERN) secretary, is one of the three Experiments Committees that guide CERN's experimental programme. Any proposal for an experiment involving a bubble chamber at CERN, by a group in CERN, from one of the Member states or sometimes from outside the Organization, has first to be submitted to the Committee, which circulates it among the members. Once a month, there is a meeting to consider each new proposal from the points of view of its usefulness to physics and the possibility of fitting it into the general experimental programme. More detailed discussions

PROF. V. F. WEISSKOPF TO STAY ANOTHER YEAR

At the Council meeting held at CERN on 20 June it was announced that Prof. V.F. Weisskopf had agreed to continue as Director-general of the Organization for a further year, until August 1964.

Other staff changes

It was also announced that **S.A.ff. Dakin,** Directorate Member for Administration, is returning to the United Kingdom at the end of September and will be replaced by **G.H. Hampton,** who is at present Assistant Director for Personnel and Administration at the headquarters of the U.K. Atomic Energy Authority's Production Group, Risley.

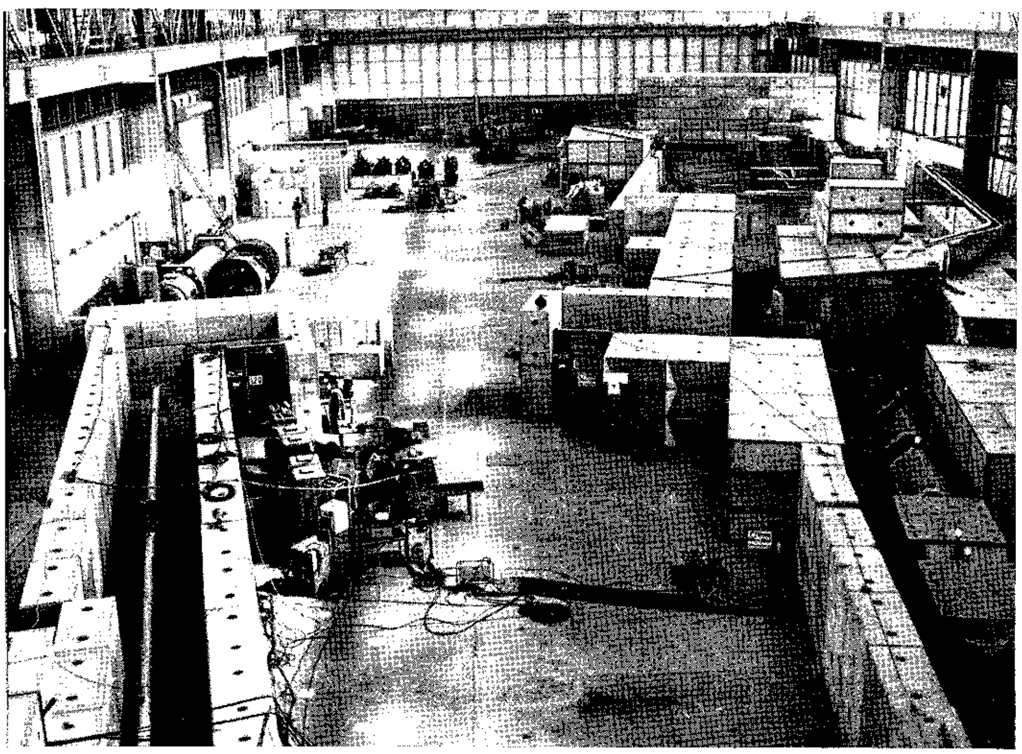
L. Kowarski, Leader of CERN's Data Handling Division, is going to Purdue University for a year, beginning in September, as visiting professor of nuclear engineering. **G. Macleod** has been appointed Deputy Division Leader and will be in charge of the Division during Dr. Kowarski's absence. He will also be a member of the Data Handling Policy Group, which has been set up by the Director-general to co-ordinate policy and actions in this field. **Y. Goldschmidt-Clermont,** previously Deputy Leader of this Division has transferred temporarily to the Track Chambers Division, as from 1 June, together with a number of his former group, including the operating staff of the IEPs (instruments for the evaluation of photographs).

on carrying out the experiment (which chamber to use, scheduling, etc.) also take place in the Committee. The recommended programme is then submitted to the Nuclear Physics Research Committee for incorporation into the overall programme, which of course includes experiments using other techniques.

The Committee contains representatives from CERN and outside laboratories responsible for operating the various bubble chambers, representatives from CERN concerned with particle beams and accelerator operation, and representatives of the different experimental groups, chosen on a regional basis.

The **Jamboree** is held once a year and as many people as possible are invited from all laboratories that participate in the track-chamber work. Anyone else who is interested may also attend. This year, the Jamboree was organized by M. Derrick, of Oxford University, and some 150 people attended from about 30 laboratories. The morning session was devoted to reports on the various experiments that had been done in the past year, beginning with an introductory talk by Prof. Gregory in which he gave a résumé of the various beams that had been used. He also gave figures for the number of photographs taken during the previous twelve months — 500 000 with the École Polytechnique heavy-liquid chamber and 1 100 000 with the Saclay/École Polytechnique 81-cm liquid-hydrogen chamber. In the afternoon, reports were given on the British national chamber, expected to come into use this autumn, the separated beam, o_2, planned for the East area, and possible experiments for the coming year.

Two new technical novelties were also discussed, both designed to observe gamma rays produced as a result of nuclear interactions with protons. In a liquid-hydrogen bubble chamber, the gamma rays which come mostly from the decay of neutral pions, can only rarely be detected, so the group under Prof. A. Lagarrigue, of the École Polytechnique, Paris, is now converting its heavy-liquid chamber to incorporate a liquid-hydrogen target in the beam-entry side. Reactions will thus take place in the hydrogen and the products, including electron showers formed by any gamma rays, will form tracks in the heavy liquid, which will be photographed and examined in the normal way. Another approach has been put forward by a combination of groups in Warsaw, Cracow, and Prague. Their proposal is to bring a spark chamber to CERN and place it behind the British national bubble chamber, where it would detect gamma rays arising from interactions inside the latter. The spark-chamber photographs would then have to be correlated with those from the bubble chamber in order to get full information on each event.



CERN/PI 136.5.63

The East experimental hall is now partly in use, as can be seen in this photograph, taken during May, looking towards the East bubble-chamber building. To the left is part of the equipment for the proton-proton interaction experiment using the proton beam c_7; to the right is the proton beam c_6, used for precise investigations on the secondary particles produced by proton interactions in various targets.

Among a number of fundamental research experiments at the **synchro-cyclotron** carried out recently, there was one last May which provides a good indication of how even the 'purest' research can lead to more practical developments. This experiment, carried out by P. Fowler of Bristol University, was designed to investigate in more detail the behaviour of negative pions stopped in water, with a view to the possible use of this kind of elementary particle in the radiological treatment of deep cancer tumours. Such a use depends on the fact that charged particles, unlike x-rays or gamma rays, lose most of their energy towards the end of their range, and negative pions in particular are captured by nuclei after they have been slowed down. Moreover, one of the chief reactions is with oxygen nuclei contained in water, and this produces heavily ionizing alpha particles. It thus appears possible to direct a narrow, intense beam of pions at a tumour with the assurance that the major destructive effect will be in the tumour itself, the surrounding healthy tissue being little affected.

The experiment at the synchro-cyclotron was made with nuclear emulsions, some in their normal state and some soaked in water, so that, by comparison, the reactions of the negative pions captured in water could be determined. The results will give a good approximation to the behaviour of pions in cancer tissue, since this is very largely water.

At the moment, it is not possible to produce beams of pions of sufficient intensity to make their use in radiology practicable, but the growing development of 'meson factories' for fundamental research makes it likely that suitable accelerators could also be produced for medical work if the usefulness of pions was proved. Pions, it will be recalled, are 'particles' with a mass of 140 MeV predicted on theoretical grounds nearly thirty years ago (in 1935), discovered in cosmic rays in 1947 and first produced artificially in 1948.

The **vacuum tank for the CERN 2-metre liquid-hydrogen bubble chamber** arrived on the site on 3 June. Manufactured in Lille (France) according to CERN specifications, from special stainless steel supplied by a company in Firminy (France), the vessel is made up of 5 main elements, of welded construction, bolted together. The central

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Tribute to Niels Bohr

by the Director-general

on the occasion of the unveiling of a bust of Bohr in the Administration building of CERN on 19 June, 1963

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Ladies and Gentlemen,

Science is the search for the absolute, for fundamental laws, for basic truth in nature. We try to express it in mathematical forms, in ways that are independent of the personal character of the individual scientist, in absolute terms beyond the frame of mind of the particular men who created it. This is the aim of science and we are proud of it. But this is also why we, physicists, are often not sufficiently aware of the role and influence of personalities in our life and in our activities. In all human enterprises, there are great personalities who give sense, direction and purpose to the work. If there is any personality who has given these essential ingredients to our institution here at CERN, it is Niels Bohr. It is therefore most fitting and natural for us to have Bohr's likeness here, at the very centre of this institution. All the things we are doing here — the ideas in CERN, the ideal of CERN — are expressions of his heritage.

What is Niels Bohr's heritage ? It can be expressed in two complementary ways. We can speak of his scientific heritage : to-day's knowledge of the structure of matter ; this knowledge, perhaps the greatest cultural achievement of our time, is an intellectual edifice that we owe to him. Bohr provided the foundations of this edifice in his theory of the atom. He designed the structure of this edifice when he formulated the concepts of quantum mechanics. He supervised its construction as the founder of the famous School of Theoretical Physics in Copenhagen, with its circle of students and pupils that spread all over the world. Here in CERN, we are so to speak on the top of this edifice. Our work tries to continue, in his spirit, to build to greater heights, to move towards deeper knowledge of matter.

We can also express Niels Bohr's heritage in terms of human relations ; it is a complementary form of the same ideal. In the last centuries we witnessed a tremendous expansion of knowledge and power : knowledge of nature and power over nature. This great expansion, of which Niels Bohr's work is part, is a source of many conflicts of to-day. It uprooted established ways of living and thinking, and therefore created great problems for our life and for our world and future. Many people are overwhelmed by these dangers, they are discouraged and fear the worst for the world. But never Niels Bohr. For him, every difficulty, every conflict contains its solution. The greater the difficulty, the greater the step to surmount it, the greater is the reward which ensues. When simple solutions failed, in human and in scientific struggles alike, he saw the great advantage of being forced to attack a larger problem. In his mind, science not only created problems, it also showed the way to overcome them. Science is, in his mind, a form of human collaboration, the most developed form. It therefore must lead the way to better human relations. And it is here that Niels Bohr's vision and CERN's purpose come together. In CERN the two complementary forms of Bohr's heritage are both essential :

1. CERN stands and works at the frontier of science, and
2. CERN shows a new way of human collaboration as a supernational and superpolitical enterprise.

I think this is why Bohr worked so hard to bring CERN into existence, why he spent so much of his efforts in the latter years of his life to get this idea going. We know very well that without Bohr's drive, without his energy, without his active work, there would have been no CERN. There is a word that I can only find in Danish : without Bohr's ' indsats ', CERN would not exist.

How he would have appreciated it if he were here to-day, if he had seen that we, for the first time, were able to switch on our strong neutrino beam ! How he would have appreciated the fact that the groups working on this great experiment, of which we are very proud these days, that these groups are made up of men of nineteen different nations, not only from our Member states but also from Russia, Japan, the United States, from India, from all over the world, all engaged together in the search for new fundamental knowledge. This is a symbol of what he wanted to do here !

When we look out and see the world outside this laboratory, we realize that the world is far behind us in this respect, even behind our imperfect attempts that we are trying out here in our scientific world. We are bound to lose heart, but there is no reason for it. We can and we must try to fulfil these ideals here ; when we succeed here at CERN, when this great experiment for international work succeeds, then its influence will and must spread over the rest of human activities. How we would need his leadership in this task ! We now must bear the load of his heritage alone, we can no longer count on him. Men like him come only once in a century. But let his image remind us of the right way. With him we have worked in the past, great was his influence and much of his spirit lives here still in our generation among us. Much of him, I hope, is still here, at CERN and will carry on his work in the days to come. May his likeness be a symbol of his spirit, not as a memory of the past but, as he would have wished, as a beacon that points the way to the future●

CERN Past, Present and Future

24th Session of CERN Council

On 20 June, the delegates of the 13 Member states of CERN met at Meyrin for the 24th session of Council, under the presidency of Mr. J. Willems.

PROGRESS AND FUTURE PROSPECTS

An early item on the agenda was the presentation by the Director-general Prof. V.F. Weisskopf, of the report on the Organization's activities for the six months ending May 1963. Under the heading of **machine building,** he spoke of the major improvements in the 28-GeV proton synchrotron, notably the successful ejection of the primary proton beam and the increase in intensity of the linac current (both reported in the May issue of *CERN COURIER*). The linac current of 60 mA is three times the value of a year ago; it is also about four times that produced by the linac of the Brookhaven AGS, the slightly larger accelerator in the U.S.A. with which CERN works in friendly rivalry.

Prof. Weisskopf was also able to tell the meeting of the increase in the synchrotron's accelerated beam intensity to over 7×10^{11} protons per pulse, and the successful operation of the new high-intensity neutrino beam (see 'Last month at CERN' in this issue).

Among the **experimental results** specially mentioned were those proving that the sigma and the lambda hyperon have the same parity (reported in last month's *CERN COURIER*). New measurements had confirmed that in proton-proton scattering the diffraction peak shrinks at high energies whilst in pion-proton scattering it does not. The muon beam of the synchro-cyclotron has been used for an experiment on the capture of muons by calcium-40, leading to the first reasonably accurate value for the strength of the 'pseudoscaler' coupling. New measurements with improved accuracy have been made on the beta decay of the positive pion ($\pi^+ \rightarrow \pi^0$), discovered at CERN in 1961.

In the field of **data evaluation,** Prof. Weisskopf had to report retarded development, as a result of budget restrictions in previous years. Strong efforts will now be made to catch up, however, and as a first step the operating hours of the 709 computer will be increased. In September this computer will be replaced by a 7090, with about four times the capacity.

REPORT OF THE EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS

The conclusions of a European committee for future accelerators, in the form of the Report drawn up by its Working party under Prof. E. Amaldi, were noted by Council, for transmission to the governments of the Member states.

In its studies during the first half of this year, the Working party has examined the whole field of high-energy physics in Europe, relating it to corresponding work in other parts of the world and to research in general. It has considered not only the desirability of particular lines of progress, but also the practicability of carrying them out, in the light of their financial and manpower implications. As a result, it has recommended that high priority should be given to the construction in Europe of :

(a) a pair of storage rings for operation in association with the existing CERN proton synchrotron;
(b) a new proton accelerator of a very high energy (probably about 300 GeV).

To supplement this new step forward, and to ensure a balanced programme of research in high-energy physics, the committee recommends that at least one of each of the following types of machine should be built as national or regional projects;

(a) a low-energy (500 to 750 MeV) high-current proton accelerator (a so-called 'pion factory');
(b) a high-current proton accelerator of about 10 GeV, to provide intense beams of K mesons, antiprotons and neutrinos (a 'kaon factory');
(c) a high-energy electron accelerator of energy greater than 10 GeV.

If European governments decided by the end of 1964 to build PS storage rings, it is estimated that they could be completed by 1970. A proton accelerator of 300 GeV could be in operation between 1973 and 1975 if governments had accepted the proposal by the end of 1965.

The Working party's report laid great emphasis on the continued participation of universities in the overall plan and pointed out that full consideration should be given to ensuring an easy interchange of staff between the universities and the various national, regional, and European accelerators.

The committee's recommendations were fully endorsed by the Scientific Policy Committee of CERN which, among other things, reasoned that elementary particle physics would continue, at least for several decades, to provide one of the most fruitful and significant fields of investigation, with results penetrating every branch of scientific culture. If Europe were to play a significant part in this field, rather than a purely secondary role, it would be essential that in about ten years' time it should have available a new accelerator capable of solving the more advanced problems now being formulated on the basis of present discoveries. Meanwhile, for a limited but important range of experiments, storage rings at the PS would be equivalent to an accelerator of 1300 GeV, providing an essential 'window' through which the future course of high-energy physics could be viewed. They would also provide continuity by ensuring an active future for the laboratory at Meyrin.

Naturally no decisions on the recommendations of the report were taken at this meeting of Council, but some discussion was held on how studies could be intensified during 1964. CERN has requested a supplementary budget for 1964 of 3.8 million Swiss francs, primarily to enable the preparation of more precise specifications, and hence of cost estimates. It is expected that this will be considered further by Council in October, and a decision taken in December.

BENEFIT OF CERN TO ITS MEMBER STATES

Although CERN was founded with the purpose of enabling scientists from all its Member states to participate in the co-operative work with its two large accelerators, it has been found in practice that the larger Member states benefit more from CERN's work than do the smaller nations. This is largely because the bigger states possess centres or universities of their own, equipped with accelerators, of a sufficient size to enable young experimental physicists to acquire the right kind of experience before working at CERN for a few years, and to provide them with interest and a future on their return.

The smaller states, on the other hand, have reached various stages in the development of local high-energy physics groups, which co-operate with CERN by sending visitors and fellows and by studying, for instance, bubble-chamber pictures and emulsions exposed at CERN. Depending on the stage of their development they can therefore play a useful part in the work of CERN, but the advantage they draw from membership is relatively less than that of the larger states.

Earlier this year the problem was investigated and a meeting held at CERN on 26 April of representatives of the nine Member states whose individual financial contribution to the Organization is below 5 %. The results of this meeting were presented to the Council and there was some discussion on their implications.

One of the most striking things to emerge from the report presented was that whereas each of the four larger Member states (Federal Republic of Germany, France, Italy and the United Kingdom) spends 2½ to 4 times its CERN contribution on additional high-energy physics within its own boundaries, none of the smaller states spends more than one third extra. This seems to underline the contention that, to get the most out of the co-operative CERN research, a strong national effort is required.

Among ideas put forward on how CERN itself can help to ease the problem is the suggestion that more lecture courses should be given in Member states by senior CERN physicists, with perhaps even the loan of staff on sabbatical leave for 6 - 12 months. The number of fellows and research associates at CERN could be increased, and perhaps arrangements could be made with universities for doctoral theses to be prepared on work done at CERN. 'Corresponding fellowships', involving a stay at CERN of, say, three months a year for several years, might be particularly useful. More facilities could be provided for visiting scientists (individuals or teams), who usually ought to stay for a year or more. CERN's practice of taking undergraduate students during vacations is already proving useful, and there is probably more scope for short training courses like those organized by the Emulsion Group at St. Cergue.

For those states needing to set up high-energy physics units for the first time, CERN could advise on equipment and organization and might provide technical training for the staff, or even lend some of its own for short periods. Exposed nuclear emulsions, bubble-chamber film or spark-chamber film would of course be supplied to such a unit once it was formed. Collaboration on the development of electronic and other techniques is possible, and in principle time could be provided on the CERN computers for calculations desired by national groups.

The report emphasizes however, that most of these activities and services would be in competition with CERN's main tasks of equipping and operating the accelerators and running the experimental programme; the rate at which they can be realized will thus depend on the rate at which CERN as a whole is enabled to develop.

POLAND ADMITTED AS AN OBSERVER

For the purpose of improving scientific co-operation with European countries who are not members of the Organization, CERN Council is empowered to invite observers from these countries to its meetings. In this way, representatives of Turkey have attended since June 1961 and those of Yugoslavia since that country relinquished its membership last year.

At this meeting of Council it was agreed to extend these facilities to Poland. Welcoming the Polish representative, Mr. A. Meller-Conrad, Mr. J. Willems, the president of the Council, said : 'We are pleased to recognize in this way the excellent relations which have existed between the physicists of Poland and of CERN for a long time. I am sure that both will work still better towards their scientific ideal'.

A number of Polish physicists have taken part in the research at CERN over the past few years, either as fellows or as visiting scientists, and have contributed to some important scientific results. Some weeks ago, a meeting of the 'European K^- collaboration', which includes a Polish laboratory as well as those in CERN Member states, was held in Warsaw.

CERN SITE EXTENSIONS

After the Council had heard a report on the progress of the administrative and diplomatic negotiations with France over the land promised to CERN at the previous meeting, Mr. André Chavanne, one of the Swiss delegates, announced that the State of Geneva had acquired some 4 acres of land in the Commune of Satigny, adjoining the site of the proton synchrotron, and was making available immediately nearly ⅓ of it to assist in CERN's plans for expansion. The rest of the land would be held in reserve for the Organization's future use.

Mr. Willems stated in reply that ' the Council has pleasure in re-expressing its gratitude to the Geneva authorities for this new gesture towards our Organization' ●

24th session of Council

PARTICIPANTS

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Prof. C.F.Powell

Observers
Mr. H. Fahir Alaçám **(Turkey)**
Mr. A. Meller-Conrad **(Poland)**
Mr. S. Soc **(Yugoslavia)**

Guests
Prof. P. Auger, Director-general, ESRO
Prof. A. Bohr, Institute of Theoretical Physics, Copenhagen
Mr. W. Baumann, Deputy Director, 'Contrôle fédéral des finances', Switzerland

* Adviser ** Alternate

Last month at CERN (cont.)

frame measures approximately 4 m x 4 m x 70 cm, to this are bolted the side covers with their snouts (each about 4 m x 4 m x 2 m), and the snouts are closed by covers fitted with windows to allow flash illumination on one side and photography on the other.

When the bubble-chamber assembly is completed, this tank will contain the chamber proper, and the space between them will be pumped down to a vacuum of better than 10^{-5} torr (like a gigantic vacuum flask) to prevent heat transfer from the outside atmosphere to the liquid hydrogen in the chamber at a temperature of −250° C. The tank in turn will be enclosed by the electromagnet, which provides a uniform magnetic field of 17 000 gauss.

In the main, 60-mm plate was used for construction of the tank, to eliminate the need for webbing, which would have increased the overall dimensions and thus demanded a larger overall size for the magnet. The completed tank occupies a volume of some 4 m x 4 m x 5 m and weighs 50 tons.

During the last stages of its manufacture, a team of CERN technicians was present at the works, to check on the quality of the finished parts and the assembly, and to perform the acceptance tests. The assembled tank was then brought by road to CERN, a journey taking 5 days, with a police escort all the way because of its large dimensions.

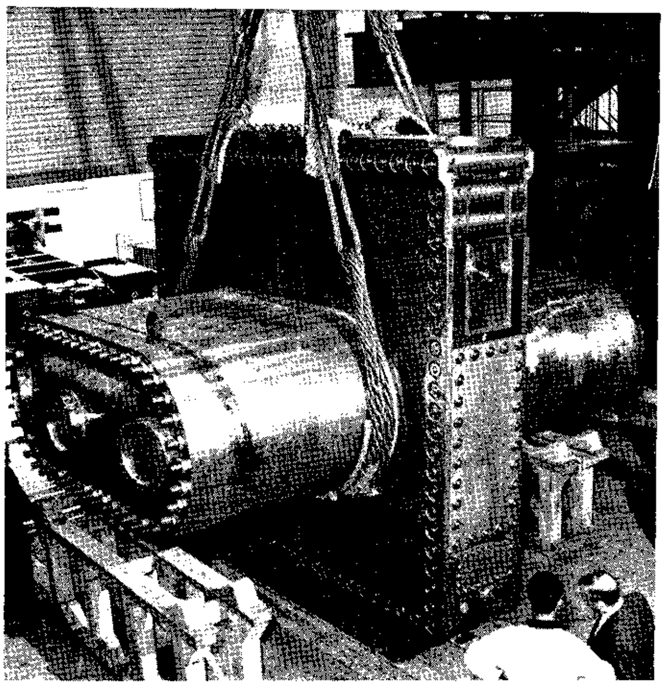
The tank is now suspended from its bridge in the East bubble-chamber building, and is undergoing a series of tests to ensure its fitness for final operation.

In the early evening of 19 June, a short **ceremony to the memory of Niels Bohr** was held in the upper foyer of the CERN Administration building. The occasion was the unveiling by the President of the CERN Council, Mr. J. Willems, of a bust of Prof Bohr, the work of the sculptor H. Isenstein. Present at the ceremony were the Danish physicist's widow, Mrs. Margrethe Bohr, and his son, Prof. Aage Bohr, as well as many members of CERN. The address given by the Director-general on this occasion is published on p. 89.

On 27 June, CERN was visited by **Mr. Louis Armand,** accompanied by members of the 'Conseil d'administration' of the 'Houillères de Lorraine', of which he is chairman, and by Mr. Brasillac, Director-general of 'Charbonnages de France'. Mr. Armand, who has recently been elected to the 'Académie française', is a member of the French Atomic Energy Commission, and a member of the Supreme Council for Scientific Research and Technological Progress. From 1957 to 1959, he was President of the Euratom Commission. The visitors had lunch with CERN's Director-general, Prof V. F. Weisskopf, when they were joined by Profs. L. Leprince-Ringuet and B. P. Gregory, of the École Polytechnique, and some of the CERN staff.

The **Staff Association Committee** for the year 1963/64 met for the first time on 25 June, under the new chairman, **Guy Vanderhaeghe.** At the meeting thanks were expressed to the 12 retiring members (out of 24) of last year's committee, and particularly to the former chairmain, **Mike Pentz,** for the enormous amount of work he accomplished during his two years in office. Guy Vanderhaeghe is a physicist who was until recently in the Emulsion Group of the Nuclear Physics Division. He is now head of CERN's Training and Education Section●

CERN/PI 37.6.63



The construction of the vacuum tank for the CERN 2-m bubble chamber can be seen from this photograph, taken during its unloading into the East bubble-chamber building. The three ports in the snout cover on the left will eventually house high-intensity flash light sources for illuminating the bubble chamber inside the tank.

BOOKS

The series of **'Nuclear Engineering' Monographs** published by Temple Press Ltd. (London), publishers of the well-known monthly journal of that name, is intended for university and technical-college students, research assistants and qualified technicians who require a broad understanding of those topics of nuclear engineering outside their own field of study. Realizing that the depth of treatment in the specialist works is too great and the cost too high, the publishers have aimed at meeting the requirement of low cost and, at the same time, providing a broad treatment ranging from elementary principles to up-to-date summaries of more advanced theories.

Elementary nuclear physics, by W. K. Mansfield (2nd impression, 1959; 15s.) covers the basic physics of reactor design in an elementary manner. It starts with a résumé of the relevant parts of atomic physics and then develops the idea of the nucleus, with its structure, its various forms of energy, and its reactions with bombarding particles. A chapter on radioactivity follows, with the inclusion of the basic phenomena of fission, leading to a discussion of the interaction of neutrons with matter and the conditions required to produce a nuclear chain reaction. The last two chapters deal respectively with the effects and the detection of nuclear radiations.

The treatment of the subject matter is highly concentrated, the reader being led from one concept to another with little interruption for detailed explanation or even justification of the facts presented. Thus chapter 2 ,on the nucleus, begins with a section on nuclear theory, dealing successively with meson theory, the nuclear shell model and the liquid-drop model, and then explains with examples the equivalence of mass and energy. This leads to the concept of the nuclear binding energy and definitions of the processes of fusion and fission. Nuclear reactions in general are then discussed, followed by the special case where the residual nucleus is left in an excited state. After this, beta emission and alpha emission are dealt with briefly (the following chapter deals more specifically with radioactivity), and the chapter ends with a few words on spontaneous fission. All this occurs in less than nine pages of readable type, complete with explanatory diagrams. Approached in this way, a large number of specialized terms are defined and explained, in accordance with the author's aim of giving the terminology and essential principles of nuclear physics, to enable other engineers and physicists to understand the language and the arguments of the specialist. It is perhaps worth pointing out that the subject is indeed *nuclear* physics, with a strong bias towards practical applications, and the reader who wants to know about *high-energy* physics will not be helped a great deal. All the same, he will find information here on a number of the ideas and modes of expression, such as elastic and inelastic scattering, cross-sections, particles and waves, that have now been carried over from the study of nuclear matter to the study of mesonic matter.

As a book for quick reference, aided by an adequate index, this seems very good. Its usefulness as an introduction to the subject could probably be improved, however, by the inclusion of a bibliography of the most useful books giving fuller treatment.

This last criticism cannot be levelled against another book in this series, **Nuclear reactor instrumentation,** by M. W. Jervis (1961, 15s.). In some 70 pages, an effective summary is given of over 100 technical papers and books on this subject, all of which are listed at the end, grouped by chapters. Adding his own knowledge as a senior engineer with one of the British nuclear-power consortia, the author has divided his account into eight chapters, beginning with an introduction outlining the requirements in the light of the basic kinetics of a reactor. The remaining chapters cover temperature instrumentation, power measurements, safety systems, measurement of neutron flux, 'burst cartridge detection', telemetering and gas-analysis instrumentation, and health-physics instrumentation.

The treatment is necessarily brief, but sufficient to give a good idea of the special requirements and the difficulties as well as the various ways in which these have been met and overcome. Indications are also given of the directions of future development. This is obviously not a specialist's book, but seems basically well suited to the purpose of this series of monographs. As an instructional book, however, its value is diminished by the type of slipshod writing that is all too common among specialists over-familiar with their own subject. Critics of the present standard of English technical composition will find many examples here to support their views, though it is probably sadly true that most of the book's readers will not notice them. Even they, however, may wonder at a sentence such as: 'However, this indication would be masked by the background activity of activities in the coolant due to particulate matter and to the induced activity of the coolant'!

Fast reactors, another volume in the series, by R. G. Palmer and A. Platt (1961, 15s.) is much better from this point of view. True, the English reader is put off by the use of the word 'fissionable' on the first two pages, but happily this gives way to 'fissile' for the rest of the book, and the omission of the hyphens that would clarify (and draw attention to!) the long strings of words used as adjectives is regrettable but not uncommon.

In content, this volume seems more specialized, though this is no doubt mainly a reflection of the greater artistry of the subject matter, and the treatment is more mathematical. Successive chapters, covering some 90 pages in all, give first a general introduction to the subject and then details on the choice of materials, sodium technology, fast reactor statics, fast reactor dynamics, and heat transfer in liquid metals.

Fast reactors have the double attraction of being able to consume plutonium produced by the present type of nuclear power station and of being able to 'breed' new fissile material. These properties, and their limitations, are clearly explained in the introduction, and anyone who still thinks that this type of reactor is some kind of perpetual-motion device for producing something out of nothing should surely read this chapter (it has hardly any mathematics). As a matter of interest, the authors remind us that the Experimental Breeder Reactor I (EBR I), in the U.S.A., was the first nuclear reactor in the world, of any type, to produce electricity, now rather more than ten years ago.

It can be clearly seen that these reactors have little in common with the 'conventional' type of power reactor in which the neutrons arising from fission of the uranium are slowed down as quickly as possible by a moderator. Not only is the technology very different, arising primarily from the need for very high heat output from a relatively small volume and from the use of liquid metal as a primary coolant, but a different way of thought would appear to be necessary. Certainly little of the data acquired in the study of thermal reactors is of direct use to designers of fast ones, and much experimental work with 'zero-energy' assemblies and experimental reactors is necessary before even a prototype power reactor can be operated.

The accent in this book is on theory, but much of the necessary data, particularly accurate values for the cross-sections as a function of neutron energy for all the materials of interest in a reactor, including impurities, are not known; even if they were, the equations would very often still not be soluble with present-day computers. The approximations, aided by experiments as necessary, that are described here give an interesting confirmation of Prof. Van Hove's recent assertion, that although we can successfully use nuclear forces we do not really understand them. The authors state, for instance, that for the important determination of the distribution in energy of neutrons after inelastic scattering, 'frequent recourse has to be made to theory based on nuclear models', but of course these models are at present far from exact.

However, much progress has clearly already been made in this field, and references are made throughout the book to the various fast reactors and experimental assemblies already constructed. It is unfortunate that, since the text dates from around 1960, much new information is missing (particularly on the successful operating experience with the Dounreay Fast Reactor) but the clear way in which the subject is presented should make it relatively easy for anyone sufficiently interested to bring himself up to date. A slightly intimidating page and a half of 'notation' immediately after the preface proves to be quite helpful, and there is a useful bibliography for each chapter.

A. G. H.

Introduction to structural problems in nuclear reactor engineering, edited by J. R. Rydzewski (London, Pergamon Press Ltd., 1962; 84s.) is volume 2 in Division VII of the **'International series of monographs on nuclear energy'** under the general editorship of J. V. Dunworth. It includes contributions by J. M. Alexander, R. W. Bailey, G. H. Broomfield, A. H. Chilver, P. B. Morice, N. W. Murray, R. W. Page, J. F. Poynor, J. Przemieniecki, E. A. Richards, D. F. T. Roberts, J. R. Rydzewski, and H. Tottenham.

Covering the basic aspects of structural engineering for nuclear reactors, the book starts with a short review of the main nuclear reactions and the most common types of reactor, and continues with a discussion of the constructional materials used and the influence of nuclear radiation on the physical properties of the materials.

After an exposition of the construction of pressure vessels in mild steel, with some details on the various welding techniques, there are several chapters which deal with the mathematical analysis of structural problems,

namely: the elastic analysis of statically indeterminate structures by means of matrix methods with the aid of digital computers, the elastic behaviour of steel and plates, a theory on thermal stresses, the plasticity and creep of metals, the design of special grillages, the evaluation of stresses in reactor pressure containers, the flexibility of gas ducts.

In the last chapter the essential principles of experimental stress analysis by means of models, strain gauges and photoelasticity are treated; an appendix gives some ideas on the application of concrete for the construction of large pressure vessels.

The book concentrates on fundamentals; specific problems are quoted, or outlined, but for their practical solution readers are referred to the more specialized publications cited in the ample bibliography at the end of each section. Owing to the change of author from one chapter to another, there is a certain amount of repetition, particularly in those chapters dealing with the use of computers in the analysis of structures.

Although in principle written for people embarking on the design of nuclear reactors, the book could also be of real interest to any structural engineer, since a number of the theories and ideas included are immediately adaptable to applications in many other fields of mechanical design.

R. V. Perin

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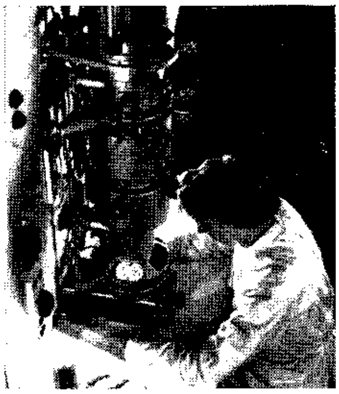

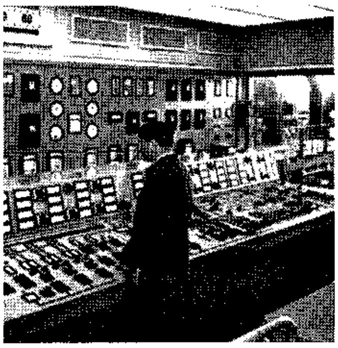

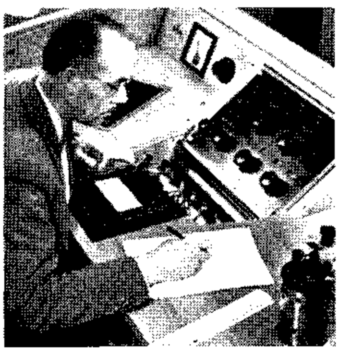

Measurement and control in thermal and processing techniques

Electrical metrology

Electronic microscopy

Non-destructive testing of materials

Measurement of mechanical quantities

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