

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

On 11 October the **25th Session of Council** was held at CERN. This was a special meeting, held between the normal ones in June and December, primarily to allow further consideration of two matters of vital importance to the Organization's future outlook.

The first of these concerns a so-called 'supplementary programme' for CERN

in 1964. In its report earlier this year, the European Committee on Future Accelerators recommended that further thought should be given to the design of storage rings for the CERN proton synchrotron and of a synchrotron with an energy of the order of 300 GeV. Proposals for continuing the study of these projects next year have been set out in the form of a supplementary programme which would be financially independent of CERN's normal activities. At the October Council Session a resolution was adopted approving this programme in principle, in the sense that it is compatible with the purpose of CERN, as laid down in the Convention, and would not interfere with CERN's basic programme. The supplementary programme was, at the same time, submitted to Member states for consideration and for appropriate decisions at the December Session of Council by those states that agree to contribute financially.

The second item for discussion was the CERN **budget** itself over the next three years. By its adoption of the 'Bannier Report' in October 1962, Council accepted the fact that it was necessary for CERN to continue to expand over the next few years, and consequently that the Governments of the Member states would need to provide increasing amounts of money each year to finance this growth. However, the budget agreed for 1964 was only 11 % more than that for 1963, instead of 13 % which the report recommended. For 1965, the figure proposed was only 10 % more than for 1964.

At the October meeting a number of Council Members, as well as members of the Scientific Policy Committee and the CERN Directorate, spoke in support of a greater increase. Among the points stressed was the fact that the major difficulty now is to satisfy the growing demand by physicists in Member states to use these facilities. Because of new ideas and new techniques, the amount of money required per physicist tended to increase each year

rather than remain constant (as assumed by the Bannier committee), and on the present forecasts it is likely that the number of physicists employed must remain constant for the next few years. Any increase in the already much greater number of 'visitors' in the same circumstances could only lead to a decline in the support made available to them in the laboratory.

No decision was called for at this Session, but the overall sum for the 1965 budget will be voted at the next Session in December.

Among other business dealt with by the Council was the appointment of the United Kingdom Government's Exchequer and Audit Department to audit the CERN accounts for the next three to five years, in place of the 'Contrôle fédéral des Finances' of the Swiss Confederation, which is no longer able to undertake this work.

At the **proton synchrotron** the first week of October was devoted to phases of the same **counter** and **spark-chamber experiments** that were mentioned in last month's account, namely investigations of the production of electron pairs in antiproton annihilation, the electron decay of the lambda particle, 'peripheral' production of gamma rays, and the operation of spark-chambers in a strong magnetic field.

The rest of the month was oriented more towards bubble-chamber exposures. In the m_3 beam in the South hall, which incorporates two 10-m electrostatic separators, the **81-cm Saclay/École Polytechnique liquid-hydrogen bubble-chamber** provided 135 000 photographs of interactions by antiprotons with a momentum of 5.7 GeV/c, 135 000 of 3.5-GeV/c positive kaons, 110 000 of 3.5-GeV/c negative kaons and 45 000 of 3.0-GeV/c negative kaons. Antiprotons

Continued on p. 146

Contents

Last month at CERN	140
The NP electronics group	141
Dubna — 1963	143
Books	146

The cover photograph shows just one of the many kinds of electronic instruments used at CERN. This piece, constructed from transistors and modern miniature components and using a circuit printed photographically on the rear of the card, produces a standard output pulse when triggered by a suitable input signal. It is one item in a comprehensive range of fast 'nucleonic' devices produced by the electronics group of the Nuclear Physics Division. An article on the group begins on the opposite page.

CERN COURIER

is published monthly in English and in French. It is distributed free of charge to CERN employees, and others interested in the construction and use of particle accelerators or in the progress of nuclear physics in general.

The text of any article may be reprinted if credit is given to CERN COURIER. Copies of most illustrations are available to editors, without charge.

Advertisements are published on the sole responsibility of the advertisers.

Published by the
European Organization for
Nuclear Research (CERN)

PUBLIC INFORMATION

Roger Anthoine

Editor:

Alec G. Hester

CERN, Geneva 23, Switzerland
Tel. 34 20 50

Printed in Switzerland

BOOKS

Weak interactions, and topics in dispersion physics, edited by Christian Fronsdal (New York, W. A. Benjamin, Inc., 1963; cloth \$ 8.80, paper \$ 5.45), is the report of the second Bergen International School of Physics, held in 1962. The publication of such a report is always a good thing from the point of view of the organizers; it is of most value to students when it provides a systematic exposition and review of a field not recently covered in such a way elsewhere. Sometimes, however, the material included in the report is simply that which has given least trouble to the available lecturers, who have reluctantly written, in a minimum number of words, a sketch of what they have said.

The present volume, unfortunately, to some extent gives this latter impression. However, it does have a main theme, namely weak interactions, and most theoretical aspects of that subject (which stands now much where it did in mid-1962) are touched on. The authors of this part of the volume are Bernardini, Telegdi, Treiman, Behrends, Sirlin, di Lella, Primakoff, and Fujii. The most lengthy and systematic article is that of Treiman on 'The structure of weak interactions'. This invites comparison with his similar work at Les Houches in 1960 ('Relations de dispersion et particules élémentaires'; Paris, Hermann, 1960) — a comparison which shows the Les Houches article to be the more complete and better documented. Of the other articles, that of Behrends and Sirlin on the isobaric structure of weak interactions is especially notable. Their development includes as a special case the 'six-boson' scheme, afterwards proposed by T. D. Lee, and (in a footnote) the crucial observation on this theory made later by Bell, Meyer, and Prentki.

The remaining 40 per cent of the book is given to a miscellany of topics in field theory. Fubini gives a nice introduction to the small amount of dispersion theory needed for weak-interaction form factors. The other articles are individually very worthy, but it is a pity that the time and space were not devoted to amplifying and deepening the weak-interaction side. The excellent article by Mandelstam, 'Dispersion relations in strong-coupling physics', is reprinted from *Reports on Progress in Physics*, vol. 25 (1962).

J. S. B.

Nuclear and nucleon structure, edited by Robert Hofstadter (New York, W. A. Benjamin Inc., 1963; cloth \$ 11.00, paper \$ 7.65), provides an excellent collection of

reprints on various subjects connected with the study and interpretation of nucleon and nuclear structure through the medium of electromagnetic interactions. Guided by the editor's comments on every article, the reader is taken on a fascinating tour through this field, in historical order, starting with Dirac's classical 1928 paper on the quantum theory of the electron. Among the 82 selected papers one notices the early probing of the neutron structure in the scattering of slow neutrons on electrons, followed by a series of later papers on the probing of protons and neutrons by high-energy electrons at high momentum transfer. The description of these experiments by 'form factors' as well as their theoretical interpretation in terms of resonances and dispersion relations are well represented. The experimental papers explicitly demonstrating the existence of the ρ , ω and η mesons are included.

Also in the collection are a number of experimental and theoretical papers on the determination of nuclear size and shape by muon x-rays and elastic electron scattering. Inelastic scattering of electrons on nuclei is, however, surprisingly little represented (with the last paper from 1956), in view of the importance that this field has acquired in the last few years.

Any collection of this kind is easily criticized on some ground. In this case, the editor has been too eager at the end of the book to include the very latest developments. Thus, the last two 'papers', dealing with nuclear structure effects on muon x-rays are, in the one case, an American Physical Society abstract and, in the other case, a private communication. While both would merit inclusion in their final form, the wisdom of presenting them as they stand may be doubted. Among the more recent papers (1960-1962) the level of selection is also not always as high as earlier in the volume. The inclusion of several important survey and review articles is, however, of great value.

As a whole, this reprint collection should be a very useful reference source for most physicists, and in addition it is an excellent place in which to become acquainted with this field. The price, however, is regrettably high for a book consisting basically of photographic reproductions of existing papers.

T. E.

Proceedings of the Eastern Theoretical Physics Conference, University of Virginia, 1962, edited by M. E. Rose (New York, Gordon and Breach, 1963; \$ 5.00).

Nowadays it is becoming more the rule rather than the exception that to review a conference report is an arduous

Last month at CERN (cont.)

with a momentum of more than 5 GeV/c and negative kaons of more than 3.5 GeV/c carry enough energy to create a possible new particle, known as the omega particle, predicted by the theory of unitary symmetry. Attempts to find this particle have so far proved unsuccessful, but a new search for it will be made among the photographs obtained in these latest runs. Evidence for the particle will also be sought in the **1.5-m British national hydrogen bubble chamber**, using the long separated-particle beam, o_2 , in the East hall.

The second electrostatic separator of this beam was put into operation during October, and assembly of the chamber was also virtually completed. Operation of the chamber was, however, confined to test runs. The synchrotron was programmed so that 90% of the beam in each pulse hit the target for the m_3 beam and the remaining 10% the target for the o_2 beam.

During the second operating fortnight, every tenth pulse was directed on to the target for the a_5 beam in the North hall. This is a beam of negative pions, of momentum 1.05 GeV/c, specially designed for high intensity (the

original version, a_2 was described in *CERN COURIER* in July 1962). The beam was being used for an experiment intended to give a value for the magnetic moment of the lambda particle, by allowing lambdas, produced by the interaction of pions in a polyethylene target, to decay inside **nuclear emulsions** placed within a very high (pulsed) magnetic field. Measurements on the tracks left by the decay products of the lambda in such an arrangement show the effect of the magnetic field on the lambda as it travelled the 10-cm gap between the target and the emulsion. The effect in turn depends on the magnetic moment

if not quite a thankless task. Often a great deal of partly baked material is presented and the poor reviewer has to wade through a mass of unconnected papers very carefully, searching for a nail on which to hang his notes. Fortunately this particular conference proved to be the exception: the avowed aim was to spread the subject matter over as wide a spectrum of topics as possible so that people working in one field would have the opportunity to learn of recent progress in other areas. Obviously the entire span of theoretical physics could not be covered in the course of two days, and so the discussions were loosely restricted to nuclear and particle physics and to topics in general relativity. That this limitation in no way detracted from the scope of the conference, a glance at the table of contents will show. For example, the subject matter ranged from vibrations and single-particle excitations in nuclei (G. E. Brown) to a detailed review of analyticity in particle physics (S. B. Treiman), from a reformulation of the theory of pairing correlations (M. Baranger) by way of the pion resonances (J. Steinberger) to remarks on weak interactions (C. N. Yang), the quantization of geometry (B. DeWitt) and gravitation from a field-theoretical viewpoint (R. Arnowitt).

It would be invidious to discuss certain contributions to the exclusion of others and the papers mentioned above should be regarded as being representative of topics rather than as the selection of particularly interesting talks. However, it would be a grave omission indeed not to mention Wheeler's after-dinner talk, which in a sense epitomizes this conference. He poses a very simple question: what makes a physicist, in particular a theoretical physicist, tick? To give here a summary of his ideas would be a travesty and quite out of place, but we would suggest that those who wish to understand more deeply the philosophy underlying his question, and those who wish to forge further links in the charismatic chain, should spare a little time and give some thought to his words.

A remark concerning the discussions which follow each paper may be in order. Editors of future proceedings of conferences should take a look at the excellent example set by this book: some editing of the participants' remarks would certainly have been necessary, yet the discussions have remained extremely lively, almost personal, one could say. None of these clinical, grammatically impeccable pronouncements one usually associates more with government spokesmen than with a live debate on a very controversial subject. Full marks to the organizing committee for allowing sufficient time between talks for these verbal engagements to develop.

St. L.

of the particle. Another emulsion experiment during the month involved the exposure of six emulsion stacks to about 1.4 million negative kaons, of 3 GeV/c, in the m_3 beam.

With no experiment scheduled to use the fast ejected beam from the synchrotron, more extensive tests were possible on the **slow ejection system**. The external beam path was extended in vacuum nearly to the wall of the South target area, the final viewing screen being near the neutrino horn. Straightforward checks of the beam position at various points along its path were carried out

with the aid of plastic scintillator screens and television cameras, supplemented by the use of 'polaroid' film, ordinary photographic paper and x-ray film. In more detail, the average cross-section of the beam was measured, using nuclear emulsions of various kinds, arrays of small solid-state-diode radiation detectors, and aluminium foils on which the distribution of the induced radioactivity was afterwards determined. Measurements of the time structure of the beam gave promising results. These measurements were carried out with scintillation counters, solid-state diodes, and photographic paper or film on a rapidly rotating wheel perpendicular to

the beam. The latter showed clearly that the beam was focused into a spot less than 1 mm wide but that it oscillated from side to side by about the same amount, in time with the slight ripple remaining on the current in the septum magnet that ejects the beam.

The ejection efficiency was measured with the aid of a secondary - emission chamber, borrowed from the MSC Division, and irradiated aluminium foils measured, like the others, by the NP Division's nuclear chemistry group. These gave values of from 30% to 60%, according to the limitations placed on the quality of the beam ●

Nuclear power engineering, by M. M. El-Wakil (New York, McGraw Hill, Inc., 1962) and **Nuclear reactor engineering**, by Samuel Glasstone and Alexander Sesonske (Princeton, D. Van Nostrand, Inc., 1963).

There is a subtle difference between these two titles, which reflects the opposition of two dissimilar views presented by the authors, concerning essentially the same subject matter but seen from two different standpoints and responding to two different sets of requirements.

Dr Glasstone, Consultant to the U.S. Atomic Energy Commission, this time in collaboration with Prof. Sesonske, Professor of Nuclear Engineering at the Purdue University, presents a successor to his well-known text, *Principles of nuclear reactor engineering*, published in 1955. The new book, of 830 pages, about equal in size to its predecessor, had to cover a field in which practical knowledge and new applications had expanded enormously during the intervening eight years. But the main purpose declared in the preface is still to 'describe the fundamental, scientific and engineering principles of reactor systems'. The emphasis is on what happens in a nuclear reactor, and how the engineers contrive to put the necessary material system together and to keep it running. Various uses (production of electric power, research, space activities) then find their logical place as additional conditions imposed on the definition of the material system. About one-third of the total length of the text is devoted to fundamentals (Introduction, Nuclear reactions and radiations, Diffusion and slowing down of neutrons, Reactor theory in the steady state, Reactor kinetics, Temperature and poisoning effects). Then various practical aspects are considered: Control, Energy removal, Structural and moderator materials, Fuels, Radiation protection, Shielding, Mechanical and Structural components, Preliminary design. In the remaining hundred pages various existing reactor systems are reviewed from the points of view of uses, comparative efficiency and cost.

The declared objective of Prof. El-Wakil, Professor of Mechanical Engineering at the University of Wisconsin, was 'to cover the engineering aspects of converting nuclear fission energy to useful work', and he sees a nuclear reactor as 'a heat source from which useful power can be produced'. The first part of his book of 556 pages covers the fundamentals: Atomic and molecular structure, Atomic and nuclear reactions, Neutron flux distribution in cores, Time variables in reactor behaviour, and occupies nearly as large a fraction of the total length as the corresponding section of Glasstone and Sesonske's book. However, since the overall