

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

During the whole of March, work continued at the **proton synchrotron** on the numerous jobs arranged for the

shut-down period. Of particular importance was the installation of the **fast-ejection system**, which will enable the beam of accelerated protons to be extracted from the machine, and the final setting up of apparatus for the forthcoming experiments with **neutrinos**.

The fast-ejection equipment consists essentially of two special magnets inside the vacuum system, together with beam-transport elements. A kicker magnet (the fast kicker or FK to the specialists), is rapidly brought into position round the beam at the end of the acceleration cycle and pulsed electrically so as to deflect the beam into a second magnet (the fast ejection magnet or FEM) which deflects it further, clear of the ring vacuum tube and main magnetic field of the machine and along a separate evacuated tube to the first of the small pulsed beam-transport magnets (fast magnets, FM, for bending and fast quadruples, FQ, for focusing). Apart from the mechanical installation of much of this equipment, all in careful alignment, considerable progress was made with connecting up the complex electrical units and the hydraulic systems for moving the magnets. Just outside the target area, in the South hall, a prefabricated room formerly used by the cloud-chamber team for processing and inspecting film was rapidly filled with racks of electronic equipment for controlling the pulsed beam-transport magnets and the neutrino horn. The horn, actually a means of providing an enhanced beam of pions, was placed in position in the target area early in the month. After the connexion of power and cooling-water supplies and tests to ensure that everything was working properly, work began on the installation of the shielding surrounding it, to absorb those pions and other secondary particles not directed towards the mouth of the horn.

For the fast-ejection equipment, various foundations, supports, pipework, etc. had already been installed during previous shut-downs, and the success of this policy was shown by the comparative ease with which the new parts were

added. As a result, work was started on the installation of cables and junction boxes for the **slow ejection system**, which will also provide an external proton beam, but of different characteristics. A trial installation was made of the vacuum tank and transport mechanism for the slow ejection magnet (SEM) in the ring. This will considerably reduce the time required for the final installation.

Outside the tunnel, in the South hall, work started on the positioning of the complex array of large, heavy **spark chambers** for detecting neutrino interactions, together with liquid scintillation counters for controlling the triggering system. Also for this part of the neutrino experiments, a pair of large **magnet coils**, brought from Saclay and modified at CERN, were installed and tested. The vast amount of special **shielding**, including some 4600 tons of steel ingots as well as around 5000 tons of more conventional concrete shielding blocks, was nearly finished, and both the spark chambers and the **CERN 1-m heavy-liquid bubble chamber** disappeared from view.

Meanwhile, practically all the existing **beams** were dismantled. The 10-m **electrostatic separator** of the m_2 beam inside the South target area was removed for cleaning and maintenance, and later replaced. The expansion system of the **Saclay/École Polytechnique 81-cm liquid-hydrogen bubble chamber** was dismantled and moved out of the South hall to be overhauled and modified. The **CERN/E.T.H. Wilson cloud chamber** was removed from the North hall and taken for the time being to the new East experimental hall. Part of the new a_4 beam, to replace the a_3 beam that the chamber had been using, was put in place. In the **East hall**, which was put into service at the beginning of the month, the first beam, c_6 , was about two-thirds completed. This beam, of protons scattered out of the accelerator, with energy equal to that of the circulating beam, is for experiments to determine the precise proportions in which different secondary particles are emitted when such a beam strikes

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The cover photograph shows that not only massive shielding but also a large amount of air space is needed for experimenting with neutrinos. In this 'pion decay funnel', pions coming from the magnetic horn (just visible behind the two men at the opening) decay into muons and thus produce neutrinos. The funnel, erected during the recent shut-down of the CERN proton synchrotron, is 22 metres long and specially shaped to produce the maximum number of muon neutrinos (or neutrettos as they are sometimes called). Its cross-section varies from 1 m square at the beginning to 2.9 m x 1.8 m at the end. The walls are of steel plates 6 mm thick, and the funnel is completely surrounded by steel and concrete shielding to absorb all particles other than neutrinos.

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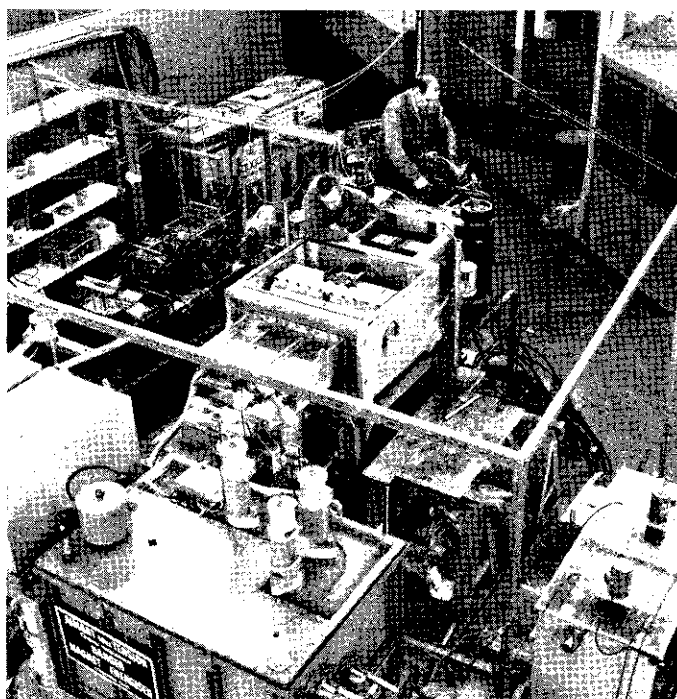
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Both the fast kicker magnet and the fast ejection magnet for extracting the proton beam were extensively tested by members of the NPA Division in the South hall extension before being installed in the synchrotron. Here Claude Scheffre is looking at the fast kicker in its opened vacuum box on the test stand, while Yves Favereau makes some adjustments to the hydraulic actuator. Further to the left is part of the test rig for the fast ejection magnet.

targets of various materials. These studies are vital to the success of the neutrino experiments, where it is more than ever important to know not only how many pions (and hence neutrinos) are being produced under any particular conditions, but also the exact nature of the 'background'.

The **accelerator ring magnets**, were relevelled, as previous measurements had shown that in the East target area the concrete ring on which the machine stands had sunk by some 2 to 3 mm (an amount regarded as considerable for such a machine), no doubt as a result of the extensive civil engineering work that had been carried out in that region. It also appeared that the ring beam had shrunk, reducing the diameter by some 5 mm (1 part in 40 000). As a result, it was decided to realign the whole accelerator, moving all the magnets, together with 'pick-up' stations, etc., back on to the original circle. Good progress was made with this work during the month. In addition, to facilitate the targeting system in the East area, magnet unit 60, in which the C-shaped yoke is towards the outside of the ring, was exchanged with unit 54, which has its yoke on the inside of the ring.

Also among the more noticeable changes being carried out during this shut-down was a rearrangement of the instrument racks in the **main control room**. At the same time, a glass partition was erected in one corner, providing a

relatively quiet place where physicists can gather for discussion during experiments and from where they (and others) can have some idea of what is going on in the control room without actually having to enter it.

In the **Accelerator Research Division**, assembly was completed of the 2-MeV Van de Graaff injector for the electron storage-ring model, and a start was made on the preliminary tests. For the storage-ring itself, installation of control cabling was completed and the radio-frequency system finished. In order to be able to obtain the extremely high vacuum required in this apparatus, special methods of construction have been necessary and special heaters allow the whole ring-shaped vacuum chamber to be raised to a temperature of 300° C during the initial, and necessarily long, pumping period before the lowest pressure is reached. During March, this 'baking' and further vacuum tests were carried out, but the presence of a 'leak', small by normal standards but crucial in this kind of system, prevented pressures of much below 10^{-8} torr from being reached. (For comparison, this is still some 100 times lower than in the proton synchrotron and about one hundred thousand millionth of ordinary atmospheric pressure).

Towards the end of the month, the small mountain resort of St. Cergue, not far from Geneva, was the venue for three consecutive events, organized

under the auspices of the CERN Emulsion Experiments Committee and bringing together **emulsion physicists** from many parts of the world.

Nuclear emulsions consist basically of the same material as that used on an ordinary photographic film, specially adapted to make them sensitive to nuclear particles. A charged particle passing through the emulsion sensitizes the grains of silver halide along its path, so that after development the track shows up as a row of black dots (which may merge into a continuous line). With special care to avoid distortion during development, accurate measurements on the length and direction of each track can be made using a microscope.

The **CERN Emulsion Experiments Committee**, with Prof. C.F. Powell of Bristol University as Chairman and J. Combe of the CERN Emulsion Group as Secretary, is one of the three Experiments Committees through which the experimental programme of CERN is organized, the others being the Track Chambers Committee (chairman: Prof. B.P. Gregory, Paris) and the Electronics Experiments Committee (chairman: Prof. P. Preiswerk, CERN). The recommendations of these three committees are co-ordinated by the Nuclear Physics Research Committee (of which the Director-general is chairman), which is responsible for recommending a detailed programme to the Directorate.

At present the Emulsion Experiments Committee is the most 'international' of the three. In addition to the members of the CERN Emulsion Group it consists of nineteen representatives from eleven Member states, together with six co-opted members from universities or research institutes in Berlin (East), Bombay, Dublin, Moscow, Rehovoth and Warsaw. One of the Committee's chief functions is to disseminate to all interested laboratories up-to-date information on the present and future facilities at CERN for experiments using nuclear emulsions. The other is to consider all proposals for such experiments and to decide on the best ones to submit to the Nuclear Physics Research Committee.

The first of the meetings at St. Cergue the '**CERN Emulsion Experiments Committee Spring Jamboree**', was designed to give first-hand information to the younger research workers who actually carry out most of the experiments, as distinct from the more senior scientists who attend the normal Committee meetings. On 18 and 19 March, about 60 of these physicists, from different European laboratories, met for a programme of

Physics using future accelerators

by **L. VAN HOVE,**

Leader of the Theory Division

The first thing to be said in an article of this kind is that it is not really possible to discuss the kind of physics experiments that may be done with high-energy accelerators in the future, simply because it is impossible to predict what new discoveries are likely to be made. All that can be done is to consider what experiments physicists would like to do with such machines, assuming nothing unexpected happened between now and the date they came into operation.

In a sense it is easier to discuss this now than it was two years ago. This is because so much has been discovered recently and we can now make a longer list of attractive experiments to be carried out with future accelerators.

The two frontiers of physics

However, whether or not we can at this moment make a long list of future experiments, high-energy physics is bound to be important because it is one of the two great frontiers of physics. There is the frontier of small distances and the frontier of large distances. For small distances the frontier is at present around 10^{-14} cm, and for large distances it is about 10^{27} cm. Between these two extremes, the world of physics is fairly well understood. We have good laws, with proper mathematical formulation, and these laws have good predictive power. At the frontiers themselves, however, we understand actually very little, and when we go below 10^{-14} cm or above 10^{27} cm everything is dark. We have no means, either experimental or theoretical, of looking into these regions, but we are most anxious to explore this unknown territory. Unfortunately, however, this exploration is expensive. Towards small distances, very-high-energy accelerators are needed; for large distances one requires very powerful instruments of observation, such as observatories in outer space.

In high-energy physics we are of course concerned with the very small distances, and the value of 10^{-14} cm is associated with the sort of energies produced by accelerators like the CERN proton synchrotron.

The unexpected richness of strong-interaction physics

In recent years the field of strong-interaction physics has proved to be of enormous interest because so many unexpected features have been found. First of all, the last two years have produced evidence for the existence of a great variety of 'particles'. Whether these objects are really particles or not is irrelevant; they are states of matter with a considerable amount of stability and hence of individuality. Therefore, if the laws of physics at small distances are to be understood, these phenomena have to be studied.

At the present time very little is known about even the simplest properties of these particles. It will be a long time before all their quantum numbers are found, and even that knowledge would be far from an understanding of the role the particles play in dynamics, in collisions. Two years ago it was conventional to say that most secondary particles arising from inelastic collisions are pions. Now there are all these new particles. Are they all secondary particles or are some of them the genuine, first-generation secondaries produced in collisions? Only when this is known, will it be possible to study properly the dynamics of inelastic collisions.

The second big surprise produced by the study of strongly interacting particles is the discovery of certain asymptotic energy variations for cross-sections at high energies, above about 5 GeV. This is the phenomenon of the 'shrinking diffraction peak' in proton scattering by protons, which has already given rise to many

Last month at CERN (cont.)

talks that included a comprehensive survey of the facilities provided by the CERN proton synchrotron and details of important emulsion experiments carried out in the past twelve months. G. L. Munday (CERN, PS Division) described all the improvements that have been made to the synchrotron over the last year or so, explained its present capabilities and modes of operation, and gave details of further developments. J. Sacton (Brussels) surveyed the studies on hyperfragments that are being carried out as a result of emulsion exposures in beams of negative kaons, H. Winzeler (Berne) discussed the various scattering experiments made using emulsions, and L. Hoffmann (CERN Emulsion Group) talked

about the pulsed magnet at CERN for producing high magnetic fields. In addition, Prof. G.B. Zhdanov, of the Lebedev Institute in Moscow and one of the co-opted members of the Emulsion Experiments Committee, who attended the Jamboree as well as the Easter school that followed it, gave a survey of emulsion work carried out in Moscow.

The Jamboree was followed, from 20-27 March, by the '1963 CERN Easter school for physicists using the nuclear-emulsion technique in conjunction with the CERN proton synchrotron and synchro-cyclotron' — otherwise known as the Easter school. Nearly 60 students and more senior physicists attended for a course of lectures and discussion on

theoretical and experimental aspects of the work currently of interest in high-energy nuclear physics.

Finally, from 28-30 March, there was an informal conference, the 'International conference on hyperfragments', bringing together physicists from a wider geographical area to discuss a more restricted subject.

Detailed reports on the last two meetings will be given in the May issue of CERN COURIER.

Friday, 29 March was another busy day for the electricians of the SB Division, when all the power transformers on site had to be readjusted to their

At the first meeting of the European Committee on Future Accelerators, held last January at CERN (see CERN COURIER, vol. 3, no. 2, p. 18), Prof. L. Van Hove presented a paper with the rather impressive title of 'The physics that could be done with future high-energy accelerators as it appears in January 1963'. This is a revised version of that talk, in which Prof. Van Hove discusses the present frontiers of high-energy physics and considers how more-powerful accelerators would help to solve outstanding problems. He concludes with a discussion of the 'long-range' view — the question why it is desirable, or even necessary, to investigate these problems even when the means to do so become so expensive.

experimental and theoretical considerations and developments. It is to be presumed that this whole field of asymptotic energy variations is going to be with us for a long time. It will be one of the great sources of information and it may dominate the picture for some time to come — most likely, even when the next generation of accelerators is in operation. For example, it seems to be true that the proton-proton diffraction scattering with its slow shrinking is the 'shadow' of the inelastic collisions. What is done at present is just to see how the shadow changes. But nobody studying optics would investigate the precise shape of shadows without wondering how they were produced. One day the elementary-particle physicist will look not only at shadows but also at the absorption that produces them, and therefore he will again study inelastic collisions, trying to see what it is in the absorption process that gives rise to slow modifications of the shadow scattering. This brings us again to the long list of strongly-interacting particles, because it is only possible to study slow energy variations in inelastic collisions if the true secondaries are known. The growing list of fundamental particles and the energy variation of scattering patterns thus belong to the same general class of problem.

Two years ago it seemed that in the field of high-energy collisions of strongly interacting particles two things were easily explained on the basis of intuitive concepts, and therefore not terribly exciting. These were diffraction and the so-called 'pionization', that is, the production of pions with small transverse momenta. Now, this hope seems to have vanished. Pionization and diffraction are just as much a puzzle as the rest of

former settings as a result of the **restoration of the electricity supply voltage** to its normal level. Although the shortage of electricity, noted in 'Last month at CERN' in the March issue of CERN COURIER, had been expected to last until about Easter, extra heavy rain during the last week of March raised the water levels in the reservoirs supplying the hydro-electric stations to such an extent that precautions like the reduction of the supply voltage were no longer necessary.

The appearance of the landing outside the Auditorium, in the Administration building, has been enlivened by the arrival of an animated **model of the proton synchrotron** and its experimental

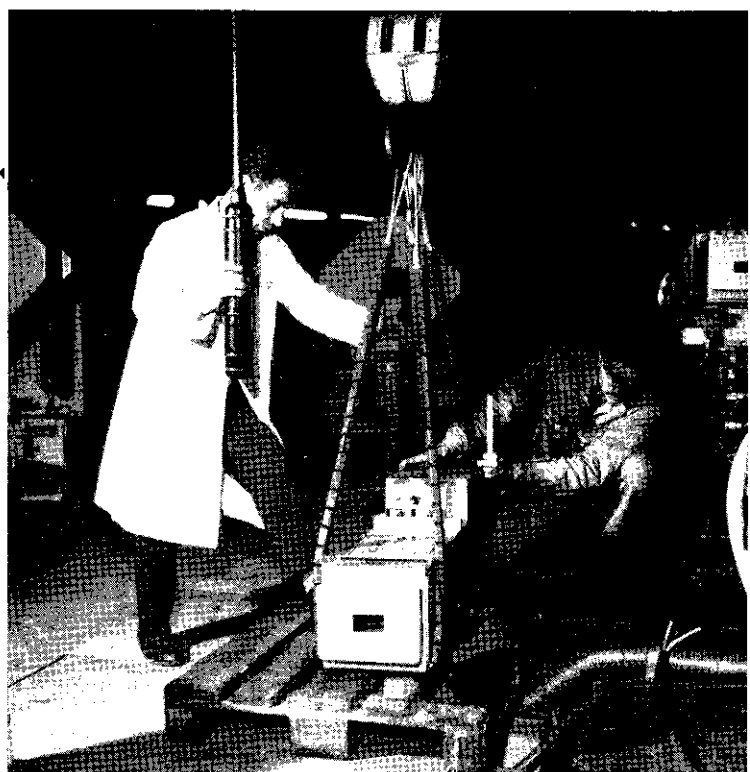
Roger Gerst, NPA Division (left) and Gabriel Crochat, of SB Division, prepare to lift one of the pulsed bending magnets for the ejected proton beam into position on the steel girder just visible to the right of the picture. Another of the magnets can be seen already in place. Their small size (the aperture is 65 mm x 40 mm) can perhaps be judged by comparing them with the normal quadrupole focusing magnets in the background and to the left.

strong-interaction physics. Intuitive concepts have proved insufficient and experimentalists will have to study both problems extensively before the empirical facts can be described and understood properly. The concepts used now are just about good enough to allow a crude description of some of the experimental facts that have been found, but none of them has predictive power at all.

There is much scope for new concepts, new ways of analysing experiments, and new theories. These, however, are only likely to arise through experimental studies. For these studies one needs much higher energies, for exploring collisions which produce many particles and to investigate phenomena that vary slowly with energy. Very good intensities are also needed because the effects of interest are not dramatic and require refined and accurate work. A lot of flexibility in experimentation is also required, in particular the possibility of studying as many types of collision as possible: proton-proton, neutron-proton, pion-proton, kaon-proton, antiproton-proton, and many more if at all possible. Such studies require good, intense beams of high-energy particles.

The physics of leptons

In the field of leptons, that is electrons, muons and neutrinos, as well as their interactions, which are the electromagnetic and the weak interactions, the last two years has not given any unexpected surprises. The discovery of the second neutrino, fundamental as it is, was not really a surprise but the confirmation of a bold theoretical prediction which a number of people had made on the basis of previously known facts. This lack of surprise is an indication that our understanding of this part of physics is much better, so that useful, realistic theoretical discussions are possible before experiments are done.



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The most important task for a future programme of lepton physics is the search for deviations from the presently accepted theories of quantum electro-dynamics and weak interactions. Both kinds of study are in progress now and will continue for quite a while. The extension of this sort of work will carry us necessarily to increasing momentum transfers, especially in electro-dynamics. It will be necessary to do electron collisions (electron-electron, and electron-proton) and muon-proton collisions at increasing energies and angles, in order to explore the higher momentum transfers, which unfortunately have very small cross-sections.

The same general course will probably be followed with neutrino physics. Electron-nucleon scattering will be replaced by neutrino-nucleon collisions, and the main difficulty will be with the small cross-sections. Neutrino physics again has a possible fundamental discovery on the programme: the intermediate boson, which, if it exists, would fit well within the framework of current thinking. This type of work will no doubt be going on next year, the year after, and probably still in 1968 or 1970, although in the meantime unexpected things may come in addition — perhaps related to the strange particles, the weak decays of which are so puzzling.

The search for deviations from accepted theoretical views may possibly lead to the answer to an outstanding question first asked long ago. This is the puzzle of the two electrons, the difference between electron and muon. It is not clear whether higher energy is necessarily needed in this case. Maybe measurement of the mass of the neutretto, the neutrino of the muon, will produce a crucial advance. However, it may also be that, to obtain new information on the electron-muon puzzle, neutrino energies of several hundred GeV would be required, which would be very expensive.

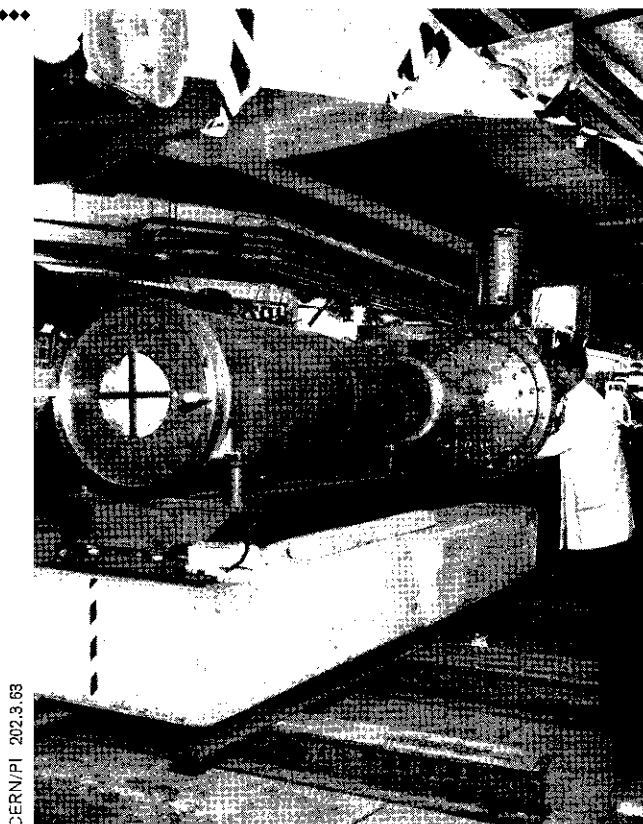
High-precision work in energy regions already explored

Especially in the field of weak interactions, where cross-sections decrease rapidly as the energy is increased, not only higher energy is required but also higher intensities. This raises the more general question of high-intensity accelerators in the energy regions already explored, that is, of highly refined work in the energy regions which have already been studied at a lower level of precision. Are very high intensities at moderate energies going to be as good a source of new knowledge as higher energies at conventional intensities? If a choice has to be made between the two, the answer would appear to be 'no'. On the other hand it is better to regard high intensities at moderate energies as a complementary field of study, and considerable attention should be paid to the necessity of giving it the right emphasis. Undoubtedly, however, the unexplored region of very high energies is the most likely source of important new discoveries.

The long-range view

So far, this discussion has been almost entirely on the problems of high-energy physics and the means needed for their investigation. However, it may well be asked why these problems are of interest at all. What, taking the long-range view, is the general significance of high-energy physics?

In discussing the general significance of physics as a whole it is convenient to distinguish the 'practical' significance and what might be called its 'philosophical' or 'epistemological' significance, that is its significance for human knowledge in general. Consider, for instance, electromagnetism, the phenomena of electricity and magnetism. The practical significance is clear. Understanding of this branch of physics is very closely connected with the understanding and controlling of electricity and of electromagnetic radiation in all forms: radio-waves, light, radar. The practical applications are only so complete and diversified because the basic understanding is so good. As for the epistemological significance of electromagnetism, its main contribution has been the theory of relativity. Maxwell's equations probably did not excite the layman very much, but certainly relativity has been a striking development for philosophy and human knowledge in



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Last month at CERN (cont.)

The magnetic (or neutrino) horn was one of the first pieces of new equipment to be placed in position near the synchrotron during the shut-down. Seen here behind the horn is Roger Gerst, working on the pulsed beam-transport system. This conducts the protons ejected from the accelerator to the target in the throat of the horn, where they produce pions.

areas. Coloured lights on the model, operated by labelled push-buttons, locate the major parts of the accelerator and associated experimental equipment, and coloured-light sequences indicate the acceleration process with the production and deflection of secondary beams. The model is particularly useful for explaining the functions of the accelerator to large groups of people, particularly since most visitors to the laboratory come on Saturdays, when the synchrotron is normally in operation and therefore inaccessible.

general. Yet there could have been no relativity without electromagnetism. Relativity was born from the clash between Maxwell and Newton, and both were necessary for Einstein.

Then there is the example of atomic physics. The practical consequences of understanding atomic and molecular structure through quantum theory are obvious. It has led to the detailed understanding and controlling of all the forces at the atomic level, that is of all the forces that dominate chemistry, solid-state physics, etc. The epistemological consequences arise from quantum theory itself, particularly statistical interpretation and the concept of complementarity, which are striking examples of how important the implications of physics can be in philosophy.

In the field of elementary-particle and high-energy physics, included in the broader one of nuclear physics, the question of general significance is largely for the future to determine. On the practical side, nuclear forces (those forces which are believed to be caused by mesons) have already found very spectacular applications, but these resemble to some extent the practical uses of chemistry before atomic and molecular forces were understood. Chemical forces, the energies of chemical reactions, were used extensively by humanity long before the real structure and the conceptual world of atomic and molecular phenomena were really understood. In a certain sense it is true that nuclear forces are known fairly well. It is known how nuclei stick together, and they are used in all kinds of practical ways. But nobody at present claims to understand nuclear forces. They can only be described by somebody or other's potential, which is not only ugly and complicated but almost completely misunderstood. It has also been learnt that the understanding of these forces will not come from low-energy nuclear physics, but will only be reached by looking deeper into the properties of fundamental particles, towards higher energies in other words.

The Yukawa programme for explaining nuclear forces in terms of particles has still not been carried out, and this is hardly surprising when it is realized that it was tried for 25 years with one meson whereas three others with an equal right to participate have now been found. It seems that in the field of nuclear physics something analogous to the understanding of

chemical forces through atomic physics and quantum theory will arise. New applications of nuclear forces, more refined and better under control, can therefore be expected when the true nature of these forces is understood, in the sense of an accurate, reliable and rational description with full predictive power.

When this time comes there will probably also be fundamental consequences on the epistemological level. At the moment the fundamental discoveries and concepts of high-energy physics appear to be of interest mainly to physicists. Consider the existence of antimatter, the violation of parity, the symmetry between matter and antimatter, the existence of many strongly interacting particles, the existence of fundamental variables outside space and time (like baryon number, lepton number and isospin), the hierarchy of interactions (strong, electromagnetic, weak), and the strangely parallel one of symmetry properties. Although these are overwhelmingly important to the specialist, none of them seem to hold much interest for the layman. The same is probably true for unsolved questions like the place of gravitation in the hierarchy of interactions, or the possibility that this hierarchy might cease to exist at high energies.

However, at the moment, physicists have discovered a forest of particles and interactions. They are looking from a distance very roughly at what it contains and there is little point in trying to predict what will emerge at the basic level of general scientific concepts and human understanding. The very fact that the variety of unexpected findings is so puzzling, and that so much has appeared which fits so poorly into the present framework of thought, is a promise that new fundamental discoveries may very well be in store at the end of a long process of elucidation. Through these discoveries, the nature of the basic forces in this field of physics may eventually be grasped. In so doing, new consequences may arise, which may be as significant as the two mentioned above, relativity and complementarity. It should be remembered that both of these arose at the end of many years of very thorough experimental work, at a detailed level where the layman could find little intellectual excitement. The study of nuclear physics has now reached such a detailed level. A look back to the past produces an extremely strong motivation for the vigorous continuation and extension of this work ●

One of the visitors to CERN in March was Mr. **A. Meller-Conrad**, Plenipotentiary and Permanent Representative of Poland to the European Office of the United Nations Organization. During his visit, on 22 March, he met a number of Polish scientists working in various Divisions at CERN.

Among the new **Fellows of the Royal Society** elected at a meeting on 21 March were Dr. **J.B. Adams** and Prof. **E.H.S. Burhop**. Dr. Adams, formerly head of the PS Division and then Director-general of CERN, and now director of the Culham Laboratory of the United

Kingdom Atomic Energy Authority, was elected as one 'distinguished for his contributions to the design and construction of the 25-GeV proton synchrotron at the European Centre (*sic*) for Nuclear Research'. Prof. Burhop, professor of physics at University College, London, 'distinguished for his contributions to experimental and theoretical atomic and nuclear physics, particularly to the Auger effect and atomic collision processes', is spending this year at CERN with the study group on future accelerators in the Accelerator Research Division. Prof. **P.T. Matthews**, professor of theoretical physics at the Imperial College of

Science and Technology, London, 'distinguished for his contributions to quantum field theory and the theory of elementary particles', who was also elected, is known to many people at CERN and spent some weeks in the Theory Division last summer.

After the Nobel Prize, Fellowship of the Royal Society is regarded as the highest scientific honour a scientist can hope for in the United Kingdom. The Society was formally established in 1660 and at present no more than 25 new Fellows, from all branches of science, may be elected each year ●