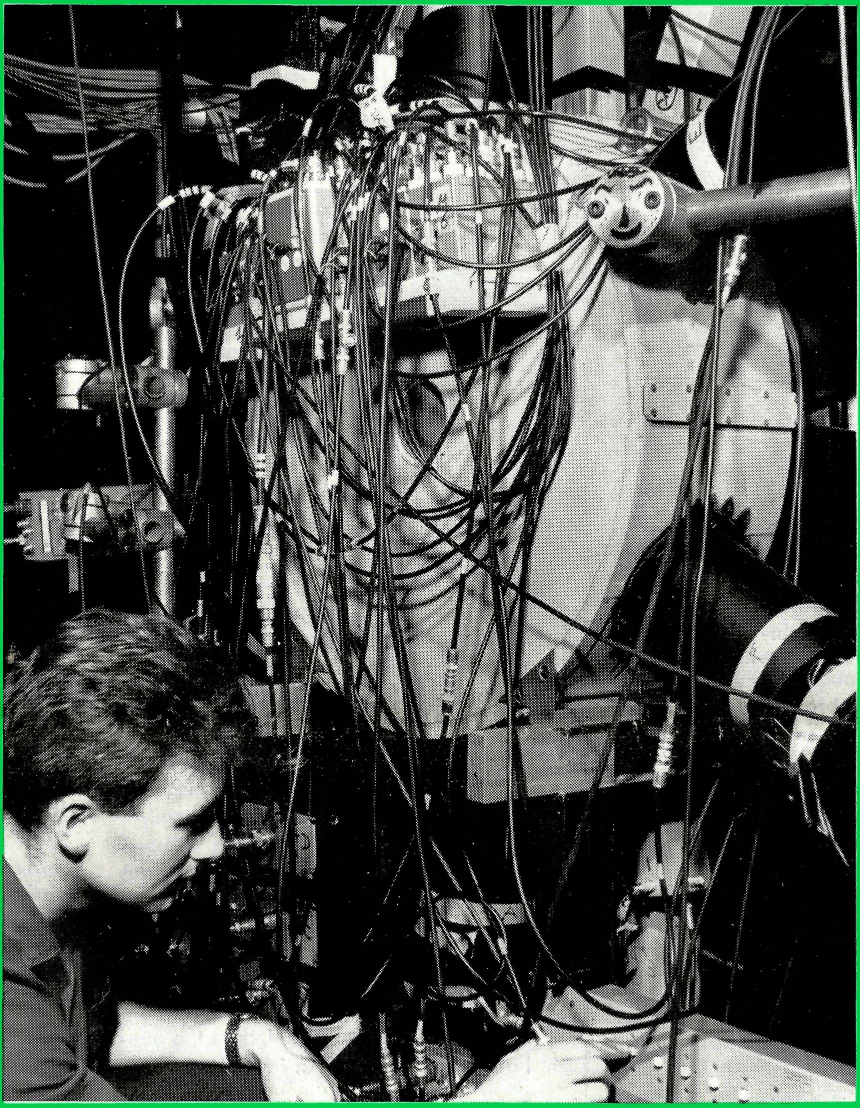
CERN COURIER



CERN/PI 88.9.63

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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

September saw the final machine runs for the first part of the **neutrino experiment** and the presentation of some of the early data derived from a study of the photographs obtained.

As reported in our July issue (p. 86), the experiment used the fast extracted beam of the proton synchrotron directed towards a target to produce large numbers of pions, which were then concentrated in the forward direction by the so-called 'magnetic horn'. The pions disintegrated into muons and muon neutrinos during their flight and the neutrinos alone penetrated some 23 metres of steel shielding to traverse first the CERN 1150 mm heavy-liquid bubble chamber and then the special spark-chamber array.

Contents

The cover photograph was taken at the heart of one of the electronic-counter experiments in progress at the proton synchrotron during September. In this experiment, to study the beta decay of the lambda particle, lambdas are first produced in association with kaons, and here one of the physicists of the team, Ian Blair, is seen making adjustments to the controls of the large cylindrical water Cherenkov counter that forms part of the counter system for detecting the kaons.

CERN COURIER

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From 27 June the experiment ran, for five or six days at a time, every other week until 17 September. Out of many hundred thousands of photographs, about 260 have been found showing neutrino interactions in the bubble chamber, and some 2500 showing events occurring in the spark chamber. It is in these photographs that the answers will have to be found to the various questions that the experiment was designed to elucidate.

Although it is easy to think of an 'experiment' as the exposure of some more or less complex equipment to a particle beam from an accelerator, there is much more involved in reality. There is first the preparation of the equipment, then the machine run itself, then the analysis of the results. An important subsidiary to the latter is the calibration of the equipment, which can become of vital importance when rare events are being sought against a more numerous 'background' of processes which might look very similar. The results of the neutrino experiment presented in September at the Brookhaven 'Conference on fundamental aspects of weak interactions', as well as the later ones given during the Sienna 'International Conference on elementary particles', were all of a preliminary nature and therefore subject to revision.

Even so, the results were impressive. First of all (as was apparent even from the first run in June) the discovery last year at Brookhaven of the existence of two types of neutrino (one associated with a muon and one with an electron) has been completely confirmed. In addition, the CERN experiment shows that similar neutrinos are produced in the decay of kaons — a muon neutrino when the kaon decays to a muon and an electron neutrino when (more rarely) it decays to an electron.

Another conclusion is that the results confirm the general theoretical belief that the number of particles classified as 'leptons' in the universe is constant, that is, either they are produced or destroyed as pairs of particle and antiparticle, or when one disappears another takes its place. Thus, when positive pions were focused by the neutrino horn, their decay produced each time a positive muon (antiparticle) and a neutrino (particle). Disappearance of the latter then produced a negative muon (particle), recognized by its curvature in the magnetic field and lack of interaction. Previously the law had only been verified for electrons and electron neutrinos.

In the CERN experiment, too, it has been possible for the first time to use the neutrino as a probe to investigate the structure of nucleons (neutrons and protons). Although lacking considerably the refinement of other measurements using electrons, the results are similar. (This is not as trivial as it might at first seem — for example, even in everyday experience, objects can look different when viewed in different coloured lights.)

The neutrino reactions observed have been separated for convenience into two classes : 'elastic', when only a muon and a recoil nucleon are produced from the neutrino, and 'inelastic', when other particles (pions, etc.) are produced. It has been found that the cross-section (chance of happening) of the elastic events at different neutrino energies is in excellent agreement with theory, but at the higher neutrino energies the number of inelastic events seems to be much greater than expected. This has not only led the theorists to look again at their equations but it has also given the experimentalists many more photographs of complicated events than they had planned for. It is an interesting discovery, which has also made the final analysis of all the results more difficult and time consuming.

This applies particularly to the question of the existence of a new, really fundamental 'particle', known as the intermediate boson, or W particle. Such a particle has been postulated on theoretical grounds as being associated with the weak interaction in the same kind of way as the pion is associated with strong interactions and the photon with electromagnetic interactions. Because an elastic neutrino interaction is purely weak, investigation of such reactions was thought to give the best chance of finding the W particle. According to the theory, this weak interaction between a neutrino and a nucleon is made up of two successive 'not-so-weak' interactions : between the neutrino and the intermediate boson and between the boson and the nucleon. Since only one such 'semi-weak' interaction is required to produce the boson, it should be formed abundantly from neutrinos of energy sufficiently high to create its rest mass (the higher the mass, the higher the neutrino energy required). The particle would then disintegrate very quickly after formation, two of its important modes of decay being into a muon and a neutrino or into an electron and a neutrino. Bubble-chamber or spark-chamber photographs showing two muons, or an electron and a muon, proceeding from the same spot, with no other tracks, would thus indicate the existence of the particle.

About 80 'candidates' for such an event were found among the spark-chamber photographs and one rather dubious one among the bubble-chamber photographs. Such a low number shows that if the W particle does exist it has a relatively high mass, more than 1.4 times the mass of the proton. A major difficulty, however, exists in proving beyond doubt that the two tracks seen are really those of leptons and not of other particles — no easy task in a spark-chamber, which gives no direct identification of tracks. Many of the eighty photographs undoubtedly show pions behaving by chance like muons. It remains to decide the most probable interpretation of these photographs, by such means as further calibration, investigation of the different sorts of behaviour of particles of a given kind, and calculations of a statistical nature. At the moment there is no proof that the W particle exists ; only indications, which have to be investigated further.

On Friday 6 September, members of the Administration Division gathered in the coffee lounge to say goodbye to their Division leader and Directorate Member for Administration, S. A. ff. Dakin, who was returning to the United Kingdom. The photograph shows him (right) **receiving some farewell gifts, presented on behalf of the Division by B.W. Gamble, head of the General Services section. Mr. Dakin's services to the Organization during the preceding five years (as well as a previous year as interim Director) were acknowledged in speeches by Prof. V. F. Weisskopf, Director-general, and G. Vanderhaeghe, President of the Staff Association.**

CERN/PI 23.9.63

Early in September the a_4 beam in the PS North hall was used to obtain new sets of spark-chamber photographs of muons and of pions, as part of the calibration check to help in the vital distinction between these two particles. Shortly afterwards, work began on dismantling parts of the main experimental set-up, which will be modified before further runs are carried out in a few months time.

Apart from the neutrino experiment, a number of electronic-counter and spark-chamber experiments by various groups of the **Nuclear Physics Division** were in progress at the synchrotron during the month. One of these, in the beam m_3, was the so-called 'Papep' experiment, designed to detect and investigate the production of **electron-positron pairs from the annihilation of antiprotons** (as mentioned in last month's *CERN COURIER*, p. 117). At the Sienna conference it was revealed that, out of fourteen hundred million antiprotons annihilated in the target, seven had been seen to produce the required lepton pair. If the proton were 'point-like' with no structure, 40 such events would have been seen. In another experiment the **beta decay of the lambda particle** was being studied, in order to establish a number of important relations in the theory of weak interactions. For this experiment, still in progress, polarized lambda particles (with their spins aligned in a known direction) are produced by pions in the beam g_1 and the directions of the electrons produced in the beta decays are found from observations on spark-chamber photographs. Scintillation and Cherenkov counters give a basic rejection of events (600 times more common) in which the lambda particle decays to a proton and a pion. In the d_{15} pion beam (10 GeV/c), a group was carrying out preliminary runs with equipment to study the **production of gamma rays in the 'peripheral' interaction of a pion with a proton,** while further along this beam, at the far end of the South hall, spark-chambers were being tested in the former magnet of the Wilson cloud chamber, for a proposed check on negative **kaon interactions** with protons.

After the neutrino tests, the North hall was occupied with preparations for later experiments, involving the change of the a_4 beam into one known as a_5. In the East hall, the o_2 beam was fully tested ready for the British bubble chamber. The length of this beam, nearly 150 metres, has posed some novel problems, because over such a distance even the curvature of the earth and the earth's magnetic field have to be taken into account during the alignment of the various magnets along the beam path ⊛

New Computer Installed

An IBM 7090 computer is now installed at CERN and has been working on a regular basis since 30 September. The presence of this machine should enable CERN to process work at about three times the rate possible with the previous IBM 709 computer and it will undoubtedly be a valuable asset to the organization.

The computer left the factory at Poughkeepsie, U.S.A., on 19 August, and was flown to Cointrin Airport, Geneva, in a specially chartered DC-7, arriving on Saturday 24 August at 2 p.m. The CERN transport section unloaded the 26 cases, of total weight 14 800 kg, and moved them to a temporary storage location inside CERN. Until the final shut-down of the 709, the new computer remained in store, except for some of the tape units which were moved into the computer barrack for checking.

At 6 p.m. on Friday 13 September, the 709 was finally switched off and its removal started immediately. With the wonderful co-operation of CERN's transport section, the old computer was completely removed from the barrack by midnight on the same day, and on 14 September the new machine was moved in. The satellite computer (IBM 1401) used with the 709 was moved into an adjacent office and the manufacturer's engineers began to modify it. During the whole of the week-end the barrack was constantly vacuum cleaned to reduce dust, while the flooring panels were modified to provide access for the new units and cables. New doors into the computer room were made and the electrical power supply modified.

On Sunday 15 September, power was turned on and testing could begin on both the 7090 and the 1401. The latter machine was functioning during the afternoon and work was processed on it on the following day. The team of nine IBM engineers, coming from Switzerland, England and Germany, worked 24 hours a day to get the 7090 into operation, and testing went on continually throughout the week. Finally, on Friday 20 September, it was completed, and on the same day the 1401 was removed from its temporary position and re-installed in the computer room. During the week-end that followed the room was thoroughly cleaned and polished, after the 7090 had been switched off for the first time.

More testing was done on the Monday, and then finally on Tuesday morning 23 September, the first CERN work was processed.

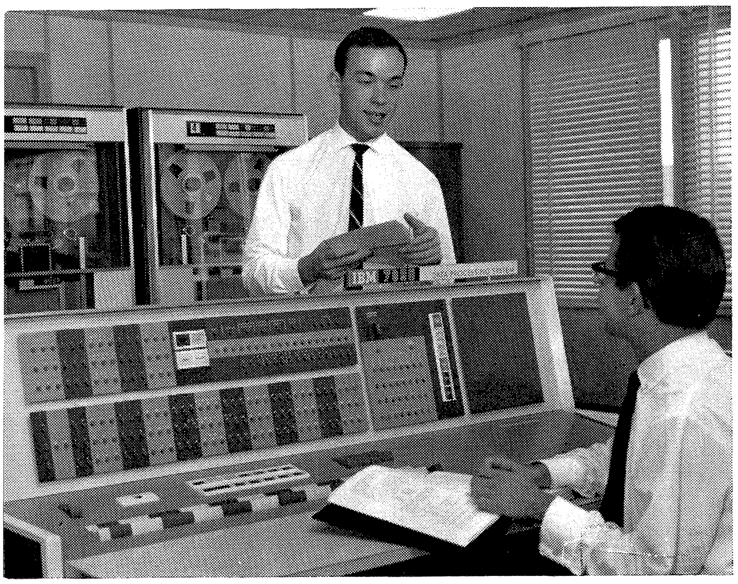
As the programming of the machine is almost identical to that required for the 709, no modifications were necessary to the many programmes already in use at CERN. The monitor system, however, required some minor modifications to enable it to use some of the additional features of the 7090, and these were immediately put in hand. Some former programmes were run to check the agreement with the previous results and urgent work for the Sienna Conference was also executed.

The core store of the machine is identical in size with that of the 709, being of 32 768 ' words ', but the cycle time of 2.18 microseconds is about five times as fast. Twelve new magnetic-tape units have been installed, providing CERN for the first time with the facility for reading from and writing on magnetic-tape in the ' high-density ' mode. This more compressed form of information storage permits a higher maximum rate of data transfer than previously (41 700 characters per second against 15 000). At present nearly all the CERN magnetic tapes are written in the ' low-density ' mode and a gradual change-over is being arranged so that the more efficient mode can be used wherever possible. Three data channels are provided : two for data transfer to and from the magnetic-tape units, on-line printer and card reader, and the third for data transfer from the various flying-spot digitizers being installed nearby for automatic measurements on bubble-chamber films.

In order to utilize the speed of the computer to greater advantage, the 7090 at CERN is supported by the 1401, the principal use of the latter machine being to prepare input magnetic tapes and to process output tapes. Four of the twelve magnetic-tape units on the 7090 can be switched, two at any one time, to the 1401, and a large amount of manual tape handling is thereby eliminated. In addition to the tape units, this auxiliary computer is equipped with a processor and 4000 positions of store, a 600-lines/minute printer, an 800-cards/minute reader, and a 250-cards/minute punch. Even if the printer could be occupied continuously at its maximum speed it is unlikely that it would keep ahead of the output from the 7090, and so a second satellite computer is now on order.

The new computer, in contrast to the one which it replaces, uses transistors instead of vacuum tubes. The consequent saving in space and a general improvement in design has resulted in a more compact machine and a consequent better general appearance ●

N. S.

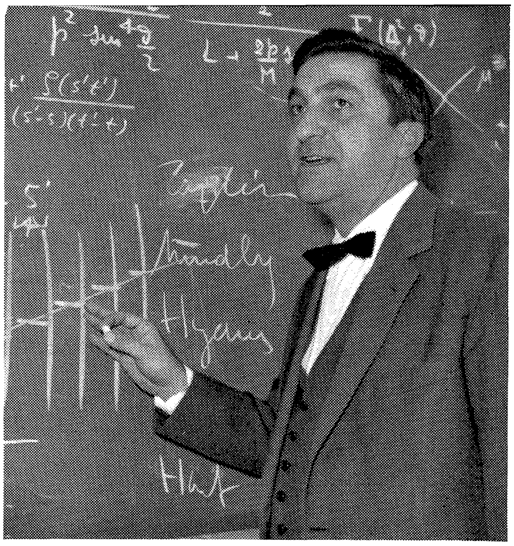


CERN/PI 86.10.63

This photograph shows one of the computer operators, E. Swoboda, seated at the operating console of the IBM 7090. The computer is controlled from here and monitor lamps indicate that it is functioning correctly. Looking over the console is H. Klein, the senior operator ; behind him can be seen two of the magnetic tape units (IBM 729 Mark 2).

WHO'S WHO IN CERN

Gianpietro PUPPI


CERN/PI 6533

Directorate Member for Research

Gianpietro Puppi was born in November 1917 in Bologna, Italy. On leaving school he entered the University of Padua to study physics, his teachers including Prof. Bruno Rossi, one of the leaders in cosmic-ray research of that era, and Prof. Giancarlo Wick. He graduated in 1939, just before war broke out, and physics was impossible for the next four years. His return to academic life began in 1944, and over the next few years he worked successively in the Universities of Bari, Rome and Padua. In 1950 he was appointed to a chair of physics in the University of Naples. Afterwards he moved to the University of Bologna, then back to Padua, and then again to Bologna, where in 1952 he was appointed Professor of Advanced Physics and head of the physics department. This post he still holds, but since September 1962 he has been on leave of absence at CERN.

In the early days of his career he was a theoretical physicist, starting with problems of molecular structure but very soon becoming interested in cosmic-rays. His work included studies on cosmic-ray propagation in the atmosphere, the energy balance in the various interactions that take place, and the mechanism of the production of secondary particles in such interactions.

The discovery that there were two kinds of 'meson' in the cosmic-rays, instead of the one hitherto known, opened the way to new theoretical advances. The new meson (now called the pion) reacted strongly with nuclei, the old one (now the muon) only weakly. It became evident that the pion was the manifestation of the nuclear field of force, but this only left the muon a bigger mystery than ever. However, its decay into an electron invited comparison with the radioactive electron emission from nuclei (beta decay) and, in a paper published in *Nuovo Cimento* early in 1949, Puppi showed that if the three processes, beta decay, muon decay, and muon capture in nuclei, were each considered as an interaction between two pairs of Fermions (particles with a spin of $^1/_2$), the strength of the interaction was roughly the same in each case. In this way, previously unrelated processes came to be thought of as examples of a universal 'weak interaction', which took its place beside the gravitational, electromagnetic, and nuclear (from then on 'strong') interactions already known. The diagrammatic representation of this universality of the weak interaction is known as 'Puppi's triangle'. It is timely to recall that in this original scheme the muon was considered as a heavy electron which transformed into a neutral particle, called a 'neutretto', with the emission of an electron-neutrino pair. Afterwards this neutral particle also became identified with a neutrino, and only in recent years has the idea of two distinct kinds of neutrino been revived and proved to be true. In Italian, 'neutretto' means a neutral particle with a mass somewhere between those of the neutron and neutrino. Whether the muon neutrino finally regains the name of neutretto thus probably depends on future experiments to determine its mass.

From about 1953, Prof. Puppi became gradually more interested in experimental physics and began to build up a fruitful collaboration among scientists in various Italian and American laboratories. Their earlier experiments were carried out with the aid of nuclear photographic emulsions, exposed to beams of high-energy particles at the Universities of Columbia and Chicago and then examined in Italy. His group was one of the first to study pion interactions with hydrogen in photographic plates, in 1955.

Later, he began the practice of large bubble-chamber collaborations. There were still no large accelerators on this side of the Atlantic, so that again the exposures had to be carried out in American laboratories while the analysis was done in Italy. One of these collaborations, involving groups in Columbia, Brookhaven, Michigan, Bologna and Pisa, discovered the violation of the parity conservation rule in the decay of the lambda particle, showing that such violation was not a particular property of the neutrino. Another collaboration, between Duke, North Western, Johns Hopkins and Syracuse Universities (U.S.A.), as well as Bologna, used a helium bubble chamber, exposed to kaons at Berkeley, to investigate various aspects of negative - kaon interactions in helium. A more recent project united groups from Bologna, Bari and the French laboratories at Saclay and Orsay in a determination of the spin of the rho meson and a proof of its resonant character. The exposures this time were carried out at the 'Saturne' accelerator in Saclay, with later ones, following the same line of research, at CERN.

As Directorate Member for Research at CERN, Prof. Puppi is formally responsible for the Organization's research programme. Aiming somewhere between the extremes of dictatorial direction and grandfatherly advice, he sees his task as being primarily one of picking out and giving particular encouragement to the more outstanding physicists. He believes that the biggest scientific advances are made by those who have a better 'feeling' for the right paths to follow, over and above their scientific experience and knowledge, and that CERN has need of many such people if it is to produce results of high quality and timely importance and not lag behind others working in the same field.

At the end of this year, Prof. Puppi returns to Bologna. His interest in CERN, though, and his belief in the Organization as the leader and coordinator of high-energy physics in Europe, will ensure unbroken contact with his colleagues of this year at Meyrin ●

Present layout of the CERN site

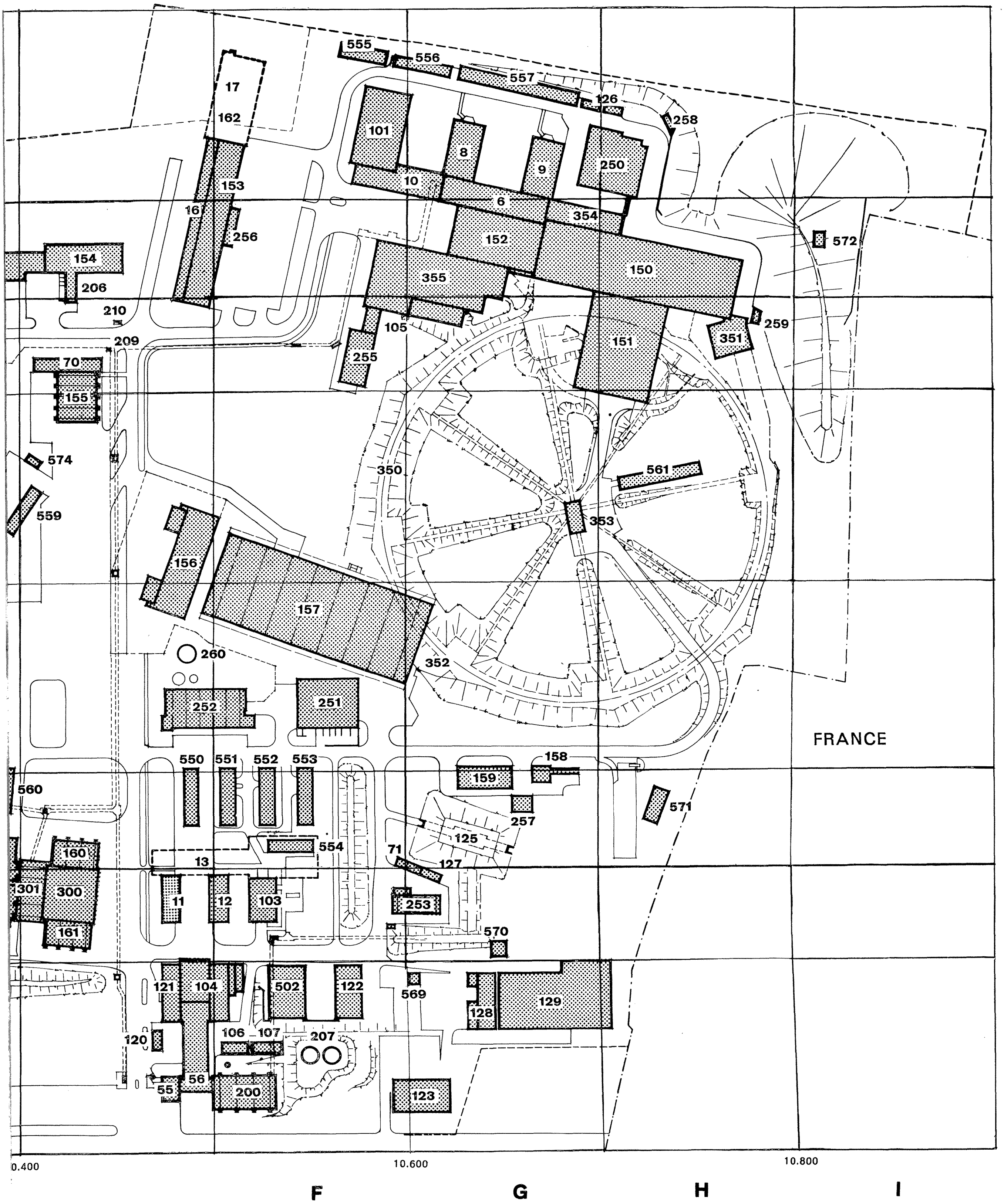
Each issue of *CERN COURIER* invariably contains a number of references to particular buildings or areas of the site at Meyrin, and although these are of interest to those who know the buildings concerned they no doubt have little meaning for a great many readers. Photos published from time to time have shown most of the buildings, but it is practically impossible to give a complete key in such cases, particularly for aerial views.

As an aid to the solution of this problem we are publishing here a plan of the complete site, drawn at the end of 1962 but still up-to-date, showing all the existing buildings as well as those now under construction. The buildings are classified and numbered according to a scheme introduced this year by the Site and Buildings Division, and the key below gives these numbers as well as the more familiar name or the function of each building.

Group	Blocks	Type of building
A	1-99	Laboratories and offices
B	100-199	Workshops, stores, equipment assembly halls, experimental halls
C	200-299	General services and special equipment
D	300-499	Accelerators and their annexes
E, F	500-599	Miscellaneous and temporary buildings

Block number	Name or purpose
1	Laboratory wing 1
2	Laboratory wing 2
3	Laboratory wing 3
4	Laboratory wing 4
6	Laboratory wing 6
8	Laboratory wing 8
9	Laboratory wing 9
10	Laboratory wing 10
11	Laboratory wing 11
12	Laboratory wing 12
13	Laboratory wing 13 *(under construction)*
15	Laboratories of AR building
16	Laboratories of NPA building
17	Extension to 16 *(under construction)*
50	Bridge
51	Offices (3B)
52	Library wing
53	Theory wing
55	Offices of SB Division
56	SB office extension
60	Administration building
61	Council-chamber wing
62	South wing of Administration building
63	North wing of Administration building
70	Offices of ' Adams Hall '
71	Offices for hydrogen liquefier
100	Main workshop (SB Division)
101	West workshop (SB Division)
102	Surface-treatment shop *(under construction)*
103	Workshop of TC Division
104	Maintenance workshop of SB Division
105	PS workshop of SB Division
106	Annexe to 104
107	Annexe to 104
120	Goods reception
121	Electrical and sanitary stores
122	Wood stores
123	Metal stores
124	Central chemical stores
125	Store for radioactive materials
126	PS chemical stores
127	Store for hydrogen cylinders
128	Intermediate store (entrepôt)
129	Storage hall
150	PS South experimental hall
151	PS North experimental hall
152	PS South hall extension
153	Equipment hall of NPA building
154	Equipment hall of AR building
155	Experimental hall (' Adams Hall ', AR Division)
156	East bubble-chamber building
157	PS East experimental hall
158	Building no. 1 for testing hydrogen targets
159	Building no. 2 for testing hydrogen targets
160	SC neutron room (experimental hall)
161	SC proton room (experimental hall)
162	Extension to 153 *(under construction)*
200	Power house
203	Main electricity sub-station, 130/18kV *(under construction)*
204	Pumping station and reservoir
205	Sewage purification plant
206	South-east electricity sub-station
207	Oil tanks
208	Valve room and reserve supply at entrance to cooling-water circuit
209	Intermediate valve room for cooling-water circuit
210	Meter room for town-water supply
250	South generator building
251	East generator building
252	Compressor building
253	Hydrogen liquefier building
254	Propane distillation building
255	Cooling towers
256	Generator room for NPA building
257	Shelter for liquid-hydrogen containers
258	Shelter for liquid-hydrogen containers
259	Shelter for liquid-hydrogen containers
260	Safety sphere for hydrogen from bubble chambers
300	Synchro-cyclotron building
301	SC equipment room
302	Auxiliary generator building (SC)
303	Radiofrequency-equipment building (SC)
304	Control and counting rooms
350	Proton-synchrotron ring
351	Linac building
352	East junction with PS ring
353	PS central building
354	Main control room and counting rooms (PS)
355	Main generator building and annexes (PS)
500	Auditorium, and entrance hall of Administration building
501	Restaurant and bar
502	Site security and cleaners building
510	7090 computer building
511	Health physics building
550-561	Barracks 1-12 (barrack 5, no. 554, now removed)
562	Canteen, for contractors
563	Barrack E (security service)
564-567	Dormitories D to A
568	Heating plant and showers for dormitories
569	Temporary offices in storage yard
570	Hut for reclaimed materials
571	Contractors' hut
572	Temporary experimental hut
573	Hut used for testing constructional materials
574	Temporary store

AR = accelerator research
NPA = nuclear physics apparatus
PS = proton synchrotron
SB = site and buildings
SC = synchro-cyclotron
TC = track chambers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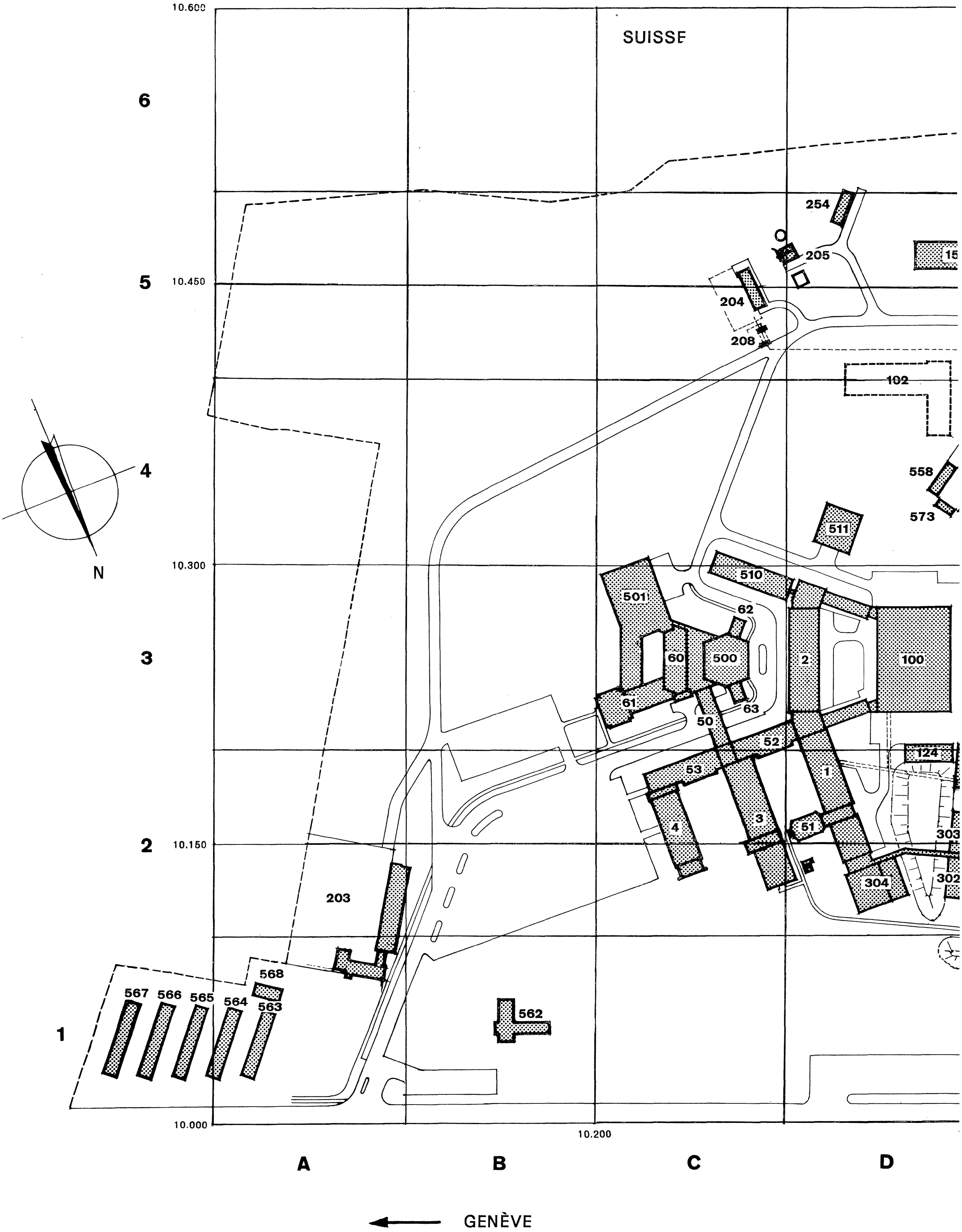
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CERN/PI 126.8.63

CERN has no less than 50 000 m² of glass of all kinds, from large bays measuring several square metres in area to reinforced glass cubes. All this is kept clean by a team of six and most of them can be seen in this photograph, which shows an unusual but nevertheless very useful aspect of work at CERN.

The window-cleaning section also becomes involved with the accelerators, when it is called upon to help the team cleaning the large electromagnets.

In the photograph, Robert Pelloux (at the bottom), Bernard Charvet, Pierre Boggio, Emile Brochu and Roger Paris are seen on the 12-metre-high tubular scaffolding, in position next to the facade of the Administration Building.

International Conference on the

Interactions of High-Energy Particles with Complex Nuclei

Leysin, 9-13 September, 1963

Report by G. RUDSTAM, Nuclear Physics Division

This conference was the direct successor, under a more general title, to the conference on 'Fission and spallation phenomena and their application to cosmic rays', which was held at CERN in September 1961 (see *CERN COURIER*, vol. 2, no. 2, February 1962). This time the conference was held at Leysin, a resort in the Bernese Alps some 100 km from Geneva, where all 80 participants from 15 different countries were accommodated in the same hotel. Following a pattern similar to that of other recent conferences of this kind, morning sessions were arranged for longer talks by invited speakers and evening sessions for shorter contributions. The afternoons were kept free to allow for private discussion among the participants. Further freedom was provided by a determined attempt to keep the conference informal, and participants were urged to present their newest results and discoveries even when these were only preliminary. Because of this, no proceedings of the conference will be published.

Among the topics treated were high-energy fission and spallation, fragmentation, and meson-induced reactions. The last day of the conference was devoted to problems connected with the study of cosmic rays.

Prof. A.C. Pappas (University of Oslo) gave a review of our present knowledge of **high-energy fission.** An interesting contribution in this field, presented by Prof. T.T. Sugihara (Clark University, Worcester, U.S.A.), was the demonstration of fission in silver and indium bombarded by 150-MeV protons. A contribution from CERN on isotopic fission-yield distributions (the relative yields of the different isotopes of a given element produced in fission) indicated that the fine structure found at energies of 1 to 6 GeV does not appear at 19 GeV ; that is, the variation of yield from isotope to isotope is much less pronounced at the higher energy. Dr. C. Stéphan (Radium Institute, Orsay, France) reported on fission studies using solid-state radiation detectors.

Among the reactions that may occur when a high-energy particle strikes the nucleus of a heavier atom are :

fission — the splitting of the nucleus into two parts of comparable size,

spallation — the 'boiling off' of smaller particles leaving a relatively large residual nucleus,

fragmentation — the breaking up of the nucleus into a number of reasonably large pieces.

Fission of certain nuclei (such as uranium 235) also occurs under bombardment by low-energy neutrons, but this process, basic to the various applications of nuclear energy, is rather special and is not studied as such at CERN.

In the field of **spallation,** Prof. J.M. Miller (Columbia University, New York, U.S.A.) discussed a new computer programme now being applied for 'Monte Carlo' calculations on cascades of nucleons inside a nucleus. The principal difference from the programme previously used is that in these calculations the nucleus is assumed to have a diffuse surface, and the effects of diffraction and reflexion of the nucleons have been included.

A large proportion of the contributions to the conference dealt with **fragmentation.** A review given by Prof. M. Lefort (Radium Institute, Orsay) was followed by a series of papers which presented results obtained with various techniques, such as chemistry, mass spectrometry, nuclear emulsions, and bubble chambers. Many experimental features are now quite well known, among them the cross-sections for the formation of the different nuclear fragments and the distributions in emission angle and in energy. It is still not clear, however, whether a new mechanism has to be postulated for the emission of the fragments or whether the experimental results can be explained using the present reaction model, including a nucleonic cascade followed by particle evaporation and fission. Prof. A. Turkevich (University of Chicago, U.S.A.; National Science Foundation Visiting Scientist at CERN in 1962/63) gave a stimulating talk suggesting new experiments which might lead to a better understanding of the mechanism involved in certain reactions.

The present status of **cosmic-ray research** was reviewed by Dr. O.A. Schaeffer (Brookhaven National Laboratory, U.S.A.), one of his conclusions being that measurements of the radioactivity induced by cosmic rays indicate that the intensity of the rays is broadly independent of space and time. Among contributions in this field might be mentioned a report by Dr. J.T. Wasson (Massachusetts Institute of Technology, U.S.A.) on the activities induced in artificial satellites and one by Dr. J.P. Shedlovsky (Carnegie Institute of Technology, Pittsburgh, U.S.A.) on the measurement of spallation products from simulated meteorites irradiated with protons.

The form that the conference took turned out to be quite successful and it has therefore been decided to repeat this kind of meeting about every two years●

BOOKS

It can be said at once that **Science Survey, 3** (London, Vista Books, Ltd., 1962 ; 30 s.) is an excellent example of its kind. Edited by A. W. Haslett and John St. John, and planned in co-operation with the British Association for the Advancement of Science, its main aim is to provide the enquiring layman and the top classes of schools with an authoritative record of scientific progress.

To cover the whole field nowadays would be a formidable task and result in a prohibitively expensive book. Instead, emphasis has been given to the 'growing points', with contributions by a number of experts grouped under various main headings. Thus, of the twenty-two articles contained in this volume, four come under the heading 'Radiation and matter' and there are two on 'High-energy particles', four on 'The solar system', two on 'Cells and viruses', two on 'The human body', four on 'Animal behaviour' and three on 'Science for industry'.

As can be seen, the field is very wide. Moreover, this is the third volume in a series, which, as indicated by the contents lists of the previous two volumes, is being planned as a whole. In fact, the final article, by A. W. Haslett, is in the form of a 'postscript' to the first two volumes, giving notes on any important further advances since earlier articles were written.

The standard of writing is, almost without exception, very high throughout. The articles are reasonably short and the specialist vocabulary is kept to a minimum. Prof. Frisch's opening article on 'Radiation and matter', for instance, is a model of clarity. At the same time, the authors' interest and enthusiasm is strikingly clear, and there is as much emphasis on the problems remaining to be solved as on what has already being discovered. This is particularly noticeable in J.O. Laws account of 'The origin of cancer', while Patricia Lindop's article on the 'ageing' of living matter is almost solely concerned with the immense field here waiting to be explored.

Too much space would be needed to refer to all the topics dealt with in such an interesting way, but two articles closely concerned with the work done at CERN should be mentioned. T. G. Pickavance (Director of the Rutherford High-Energy Laboratory, in England) describes the various types of accelerator that have been developed to provide particles, from a few million up to thirty thousand million electronvolts, for experiments on the structure of matter. H. R. Allan deals with particles of even higher energy, and shows how their study is now beginning to provide information on interstellar space. In doing so, he provides an interesting example of the essential unity of science : the same natural phenomenon that gave so much information about the smallest parts of the universe now helps to increase our knowledge of the biggest. Reading 'Science Survey', one can sense this unity, though there is no deliberate attempt to expound it. The editing, however, has been well done, and there are a fair number of cross references from one article to another, in contrast to many other collections of this kind. Most of the articles are illustrated by clear line diagrams, and there are many excellent photographs, notably a series of particularly clear photomicrographs of cell biological structure at magnifications up to 150 000.

News from abroad

ZGS IN OPERATION

During the accelerator conference at Dubna in August it became known that the first beam had been accelerated in the 'Zero gradient synchrotron' at the Argonne National Laboratory, near Chicago, U.S.A. Less than a month later came the news that on 18 September protons were accelerated to 12.7 GeV, a little above the design energy of 12.5 GeV.

The zero-gradient synchrotron is a ring-shaped proton accelerator approximately 61 metres in diameter, with the unusual feature of having a uniform magnetic field rather than one whose strength varies with radius, as in the CERN proton synchrotron (PS). The circular magnet of the Argonne machine, which is divided into eight sections, has a 'picture-frame' cross-section and weighs a total of some 4000 tons. Focusing of the proton beam circulating in the vacuum tank inside this magnet is achieved by the special shape of the ends of each of the magnet octants, the chief advantage of this kind of design being that 'multiturn injection' can be used. Thus, if the pulse of protons injected from the auxiliary linac is thought of as a continuous ribbon, in the case of the PS it cannot be longer than the circumference of the ring whereas in the Argonne machine it can be perhaps as long as 100 turns round the ring. In this way, the ZGS is expected to produce very intense beams of particles, up to 10^{13} protons/pulse. The repetition rate is 15 pulses per minute.

The accelerator and its auxiliary buildings occupy an area of 47 acres (19 ha) and the total cost was some $ 50 million (215 milions Swiss francs). Apart from its use by scientists at the Argonne laboratory, which is operated for the U.S. Atomic Energy Commission by the University of Chicago, the accelerator will be available to the 'Argonne Accelerator Users Group' which unites physicists from more than 50 universities and research laboratories in the 'middle West' of the United States ●

A short review cannot possibly do justice to this excellent book. It should really be read. As mentioned at the beginning, it is addressed primarily to the interested layman, but, to quote from Sir John Cockcroft's foreward, it can also be commended 'for the scientist taking a busman's holiday or for the student who may wish to postpone too narrow specialization.

A.G.H.

Electronics for scientists, by H. V. Malmstadt, C. G. Enke and E. C. Toren, Jr. (New York, W. A. Benjamin, Inc., 2nd printing 1963 ; $ 12.65).

The title of this book is somewhat misleading, since on examination it turns out to be essentially a handbook intended for use with a series of specific laboratory experiments. Each chapter deals first with a number of related subjects on an elementary level, giving a few references to more detailed publications and a number of problems for calculation, and then goes step by step through the relevant experiments. The references are often to U.S. Government publications, not always easily available to the general reader on this side of the Atlantic ; the experiments are to be carried out with particular equipment designed for the 3-week course and manufactured by a well-known U.S. firm. A supplement of some 60 pages describes this equipment in detail, complete with photographs for identification and part numbers for easy ordering !

Successive chapters cover simple measurements, power supplies, amplification and amplifiers, oscillators, comparison procedures, servo systems, and digital circuitry. Vacuum tubes (radio valves), transistors, tunnel diodes, are all mentioned, but the later chapters of the course refer mainly to vacuum-tube devices. Little attempt seems to have been made to point out important laws or circuits, though the book is uneven in this respect (Ohm's law is mentioned in an aside in an early chapter, but the reader is referred — incorrectly as it happens — to a supplement for details). Where a law or formula does appear, it is often only a statement, with little or no explanation, although two supplements, on d.c. circuits and on electrical signals and reactive circuits, are a little better in this respect.

The illustrations are good. As a laboratory handbook accompanying the experimental equipment, the book may be of some use to those ' engineers, chemists, physicists, medical researchers, and other students and research workers... who need to gain a working knowledge of electronic devices and circuits ', for whom it is said to have been expressly written. Otherwise there appears to be no great merit in publishing by itself a book which has such a specific and limited application.

'Pel'

In any undertaking involving hazard to man or his environment, it has now become fundamental to consider seriously the risks involved, and then to work for their reduction until an acceptable standard of ' calculated risk ' is achieved. For the economic exploitation of nuclear energy, the problem of radiation is outstanding in this respect.

Control of hazards in nuclear reactors, by T.C. Sinclair (London, Temple Press Books, Ltd., 1963 ; 15 s.), another in the series of **'Nuclear Engineering' Monographs,** discusses the problem as applied to nuclear reactors. It presents in a short, precise manner the basic information required for judging the risk to man of the radiations produced by reactors and how these risks arise. One section is concerned with the safe operation of reactors and includes basic information on the effects of radiation on reactor components. Valuable information concerning these effects is also summarized for reactor fuel elements and their cans, pressure circuits, and cooling systems. The book concludes with a chapter on the safety aspects of reactor siting.

Even though it is quite short (71 pages), this book contains in a concentrated, precise, and easily understandable manner the basic knowledge and the questions to be considered with regard to reactor safety. It is, in my opinion, a very valuable introduction to the subject ●

J. B.

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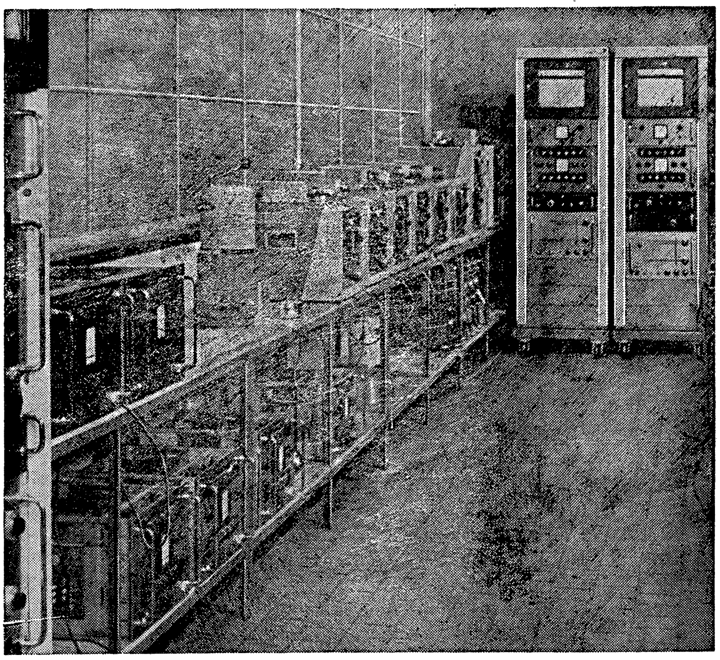

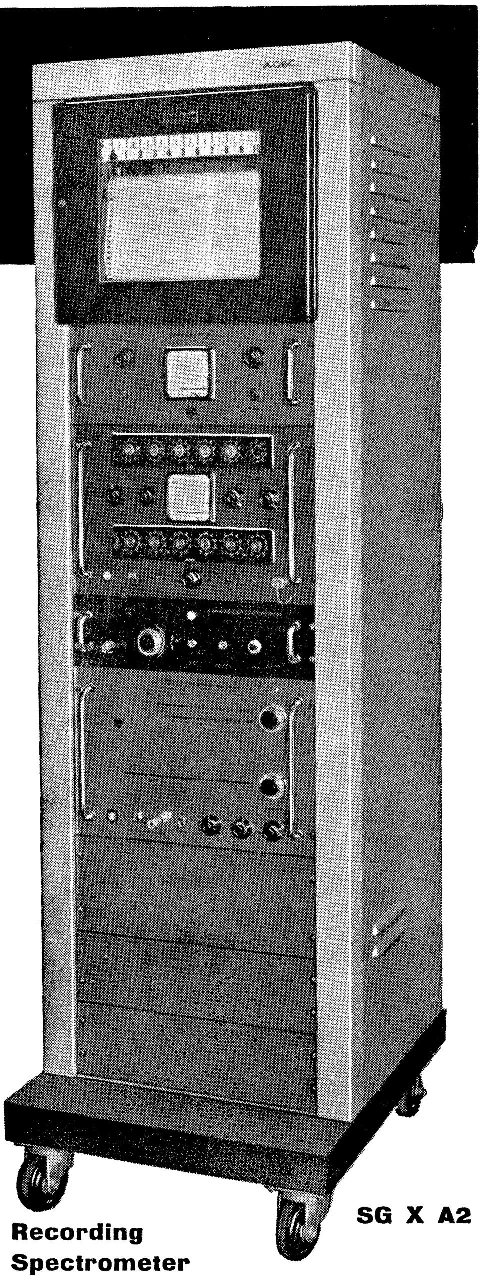

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