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CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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PROGRESS REPORTS

OF THE DIRECTOR-GENERAL AND DIVISIONAL DIRECTORS

4993/E/p

PROGRESS REPORT OF THE DIRECTOR-GENERAL
AND DIVISIONAL DIRECTORS

INTRODUCTION

by the Director-General

CERN is continuing to run smoothly and there is an excellent spirit of co-operation between all staff members.

The synchro-cyclotron which came into operation last year is working very well and construction work on the proton synchrotron (Eurotron) is progressing according to schedule. These achievements are encouraging.

Experimental physics groups are now using the synchro-cyclotron for fundamental research. Some visiting teams from our Member States have already arrived to carry out their experiments in accordance with the policy laid down by the Council. Visiting teams will be encouraged to use the synchro-cyclotron as much as possible, so that physicists from our Member States can profit from the unique research possibilities CERN offers in Europe.

The Advisory Committee to the Director-General appointed by the Council on the recommendation of the Scientific Policy Committee discussed the research programme for the synchro-cyclotron. This Committee is serving a very useful purpose, since it helps the Director-General to establish a priority list from the many experiments that are proposed by visiting teams.

Studies have been very actively pursued recently with a view to designing the experimental apparatus that will have to be constructed for the Eurotron. In this connection mention should be made of a comprehensive study on a big hydrogen bubble chamber and its facilities. This was a successful example of co-operation between physicists from the PS, STS and SC Divisions. As a result a very carefully prepared document was drafted on the subject and was presented to the Scientific Policy Committee, which held a special meeting on 23 May, 1958 to formulate its recommendations to the Council on the question.

Much thought has been given during the period under review to a possible organizational structure of CERN, that might replace the present one when both accelerators are in operation. Discussions took place with the Scientific Policy Committee and with the Senior Staff of CERN. It seems too early yet to make a definite proposal to the Council and preferable to continue for the time being with the present structure. This implies that the SC Division not only is responsible for the operation of the synchro-cyclotron but also that all those activities in CERN which are mainly in the sphere of nuclear physics are concentrated in this Division. The PS Division, which is responsible for the construction of the proton synchrotron and which also has a small group working on new ideas for accelerators, will be entrusted with those activities that are chiefly connected with applied physics. The Theoretical Division, the Scientific and Technical Services Division, the Site and Buildings Division and the Administration will also continue as at present.

The 1958 Annual Conference on High Energy Physics at CERN will start just a week after this Council meeting. A novel scheme has been adopted for the organization of this conference. Several expert scientists will serve as rapporteurs on specific subjects in the field of high energy physics, thus avoiding the large amount of small contributions which often make it somewhat tedious to attend such conferences. It will be interesting to see the result of this experiment. Some 300 leading scientists from all over the world have accepted CERN's invitation to take part in the Conference.

The High Energy Commission recently established, under the chairmanship of the Director-General of CERN, by the International Union for Pure and Applied Physics will hold a meeting on the occasion of the Conference. Amongst other items this Committee will discuss places and dates of future annual conferences on high energy physics and on high energy accelerators.

Finally it may be mentioned that a meeting took place of the Senior Staff with the Divisional Directors and the Director-General for an exchange of views on CERN matters. This meeting was appreciated on all sides; it proved to be useful and similar meetings will be held from time to time.

It was reported recently that the Swiss Federal Council is asking the Swiss legislature for an authorization to grant CERN a special contribution of 1.65 million Swiss francs for the completion of its Administration Building. CERN's appreciation should be expressed here to the Swiss Federal Council for this generous proposal, which is another sign of Switzerland's appreciation of being CERN's host country and of its faith in CERN's aims.

PUBLIC INFORMATION OFFICE

1. Press, radio, television

During the period under review the Public Information Office gave facilities to the press and to broadcasting and television corporations for spot and feature coverage of CERN activities.

Among the more important events were a programme by the foreign service of the British Broadcasting Corporation, including interviews with leading CERN personalities in English, French, German and Italian; an interview and feature programme by the United Nations radio service; a feature film for general distribution in German-speaking countries by the United States Information Service and programmes by the Swiss television.

No press releases were issued on the occasion of the Ninth Session of the CERN Council, and one was issued announcing the conference on High Energy Physics.

The number of newspapers using copy on CERN rose to 492, an increase of 50 during the period.

2. Exhibitions

A CERN stand was set up in the International Science Hall at the Brussels Exhibition.

At the opening ceremonies CERN was represented by the Director-General.

3. Visits

The service arranged 128 visits with a total of 2562 participants, representing 23 countries and territories.

Under new rules governing visits, some parts of the CERN installations are now out of bounds or only occasionally accessible to visitors, and not more than 20 persons should be taken by any one guide.

4. Miscellaneous

The service arranged lectures on CERN to non-scientific audiences. On several occasions members of the Public Information Office staff lectured to Swiss associations.

The service assisted in compiling and editing the 1957 Annual Report.

Using a local photographer the service produced a complete new portfolio of photographs of CERN installations.

COSMIC RAY RESEARCH

1. The Jungfrauoch Experiment

All experimental work by the CERN group at the Jungfrauoch stopped at the end of April. The photographs of high energy interactions in paraffin are now being analyzed and it is intended to publish in the summer the results obtained from a sample of 20 events. If the conclusions promise sufficient scientific interest, a further sample of 50 interactions will be analyzed.

The comparable experiment of the Ecole Polytechnique - Imperial College collaboration is in approximately the same position. It is hoped to organize an informal meeting in Geneva during the month of July to compare results and, if possible, to arrange collaboration for some of the routine computing that is necessary in both experiments.

2. Future Use of the Jungfrauoch Apparatus

The cloud chamber, electromagnet and associated apparatus at the Jungfrauoch belongs to CERN and to the British D.S.I.R. in the proportion of about 1 : 8. Apart from any difficulty of disentangling ownership, the apparatus was all designed for use at the Jungfrauoch and would lose nearly all its real value if dismantled.

It is quite possible that some University will be able to provide the staff and finance necessary to make good use of the apparatus. For this reason, it is proposed to leave everything intact at the Jungfrauoch for the present. If no user is found, the apparatus will, of course have to be removed. However, Professor Sitte of the Haifa Technion has shown great interest in the apparatus

and it is very likely that he will shortly make a formal request to be allowed to use it. If this happens, it is proposed to offer him the apparatus on loan for an indefinite period.

3. Proposed Magnetic Spectrograph Experiment

At its last meeting, the Scientific Policy Committee considered a proposal for a cosmic ray experiment to study the interactions of 100 GeV protons - using a magnetic spectrograph to determine the energies of the incident protons.

After discussion, the Scientific Policy Committee recommended that CERN should not embark on such a large experiment but should be prepared to support any national or bi-national proposal for a similar experiment. The Scientific Policy Committee asked that the Ecole Polytechnique and Imperial College should be consulted to find out whether they would sponsor such an experiment.

No formal discussion has yet taken place. It is clear that the problem is not of very great urgency and it is proposed to consider it when the results of the present experiments at the Pic du Midi and the Jungfraujoeh are available.

4. Personnel

At present there are five physicists working in the Jungfraujoeh group. Of these, one will leave CERN in the summer. The remaining four will be assimilated into other, existing, CERN groups without difficulty. This process should be complete by the end of July.

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DIVISIONAL DIRECTORS PROGRESS REPORTS

PROTON SYNCHROTRON DIVISION

4993/E/p

PROGRESS REPORT

PROTON SYNCHROTRON DIVISION

(1 November, 1957 - 30 April, 1958)

by J.B. Adams

1. INTRODUCTION

The construction of the CERN proton synchrotron is proceeding satisfactorily without unforeseen difficulties.

The staff engaged in the construction programme, including all the local service groups, is now 160. In addition to this staff there is a group of 20 in the Division engaged in the study of new methods of accelerating particles and in accelerator theory. Furthermore, a small nuclear physics group has been set up in the PS Laboratories to start work on the nuclear physics experimental programme of the PS.

Several members of the PS Division have been working with members of the STS Division on the project of a large hydrogen bubble chamber, including the beam transport systems and services required by such a device.

2. PS ORBIT THEORY (A. Schoch and M.G.N. Hine)

a) Special PS Problems (M.G.N. Hine)

The orbit computing programme for the CERN Mercury computer is now being written in detail, for trial on the similar computer now operating at Manchester University, and the necessary magnetic field data have been obtained from the measurements made by the Magnet Group on the prototype unit.

The results of the magnet block measuring programme have been analysed statistically to see what special selection and arrangement procedures might be necessary in assembling blocks into units. The uniformity of the block production has been so good that the only desirable precaution is to avoid assembling blocks with serial numbers close together into the same unit, as there is some correlation of block errors inside production batches of about 50.

The theoretical work on "running in" the synchrotron has continued : a detailed programme of injection studies has been prepared, and the necessary apparatus, i.e. apertures etc. for observing the beam, has been designed. The behaviour of protons which are not trapped at injection has been studied, with the help of the phase equation analogue. This shows that under some conditions the untrapped protons remain bunched as they drift towards the inner wall of the vacuum chamber, and that these untrapped bunches could cause appreciable errors in the signals from the pickup electrodes round the synchrotron for some time after injection. Observation and recording methods and equipment for the Main Control Room are being studied.

A device for finding the azimuthal distribution of field errors from observed distortions of the closed orbit is being tested, using the electromechanical analogue computer for betatron oscillations.

b) Effects of Subresonances on Orbit Stability (A. Schoch)

Previously it was reported that a "many particle" model was under construction, for the dynamic study of beam loss by non-linear resonances. In this model a cloud of electrons is suspended in a uniform magnetic field plus an electrostatic quadrupole field. A vacuum of 10^{-9} mm Hg is required to enable the electrons to carry out $> 10^5$ oscillations without collisions. The instrument has been completed recently and first experiments were made to test it. The detection of electrons is effected by coupling their oscillations to an external circuit. Satisfactory signals are obtained in emission as well as in absorption.

3. RESEARCH ON NEW IDEAS FOR ACCELERATORS (A. Schoch)

General Lines

As pointed out in the preceding report, two new ideas had been taken up as subjects of research : (a) the suggestion by Budker (1956) to use plasma ring currents as guide fields for very high energy accelerators; (b) the principle of "beam stacking", shown by the MURA group (1956) to provide an interesting possibility of achieving very high currents of accelerated particles (which would e.g. permit colliding beam experiments).

It became clear very soon that the prospects of (a) were not encouraging, but that some effort was justified to investigate the feasibility of a self-constricted relativistic ring current, as in any case much can be learnt which would be of value for high current accelerators, or for plasma physics, in general. The prospects of (b) look far less dubious. Some formidable problems have still to be solved, however, before the feasibility of really high currents by beam stacking can be established.

A third line of work, added on recently, follows a suggestion by Linhart to compress an electromagnetic wave by the constriction of plasma boundaries, thereby producing an adiabatic increase of frequency (or phase velocity) and field intensity. This effect might be useful for particle acceleration.

a) Accelerated Ring Current in Plasma

The air-cored "plasma betatron" described in the previous report, and designed for experiments on the possibility of accelerated ring currents in plasma, has been put into operation. The gas contained in the toroidal chamber is preionized by an r.f. discharge (lowest pressure $\sim 10^{-3}$ mm Hg in H_2 , reduced to a few times 10^{-4} by O_2 or other heavy gases). Ring currents are produced by releasing a betatron acceleration cycle.

Acceleration of electrons should take place if the accelerating voltage exceeds a critical value depending on the plasma density. The accelerating field available (~ 6 V/cm) could be hoped to be above the critical value for the produced plasma, on the grounds of theoretical estimates. The observed ring currents (up to several hundred Amp., depending on the delay between switching off the r.f. discharge and starting the betatron cycle, i.e. on the initial plasma density) are, however, essentially "conduction" currents. But there is evidence - in the form of X-ray bursts - of a certain, though very small, proportion of "run-away" electrons (~ 200 KeV).

The object of the present work is to find out whether the small number of run-away electrons is due to the run-away mechanism or due to difficulties in guiding and confining the electrons.

Experimental studies on the generation of plasma at very low pressures (10^{-6} ... 10^{-5} mm Hg) by r.f. quadrupole fields have been continued. This work revealed a considerable importance of secondary electron emission from walls and electrodes. Measuring equipment to provide more information on the nature of this plasma is being developed.

b) Beam Stacking

Theoretical work on possibilities and limitations of beam stacking by r.f. acceleration in fixed field machines has been continued. A tentative design of an electron model for trying beam stacking in practice is being considered. This involves a number of theoretical and computational studies regarding the optimum frequency programme and r.f. system, optimum magnet structure, influence of various perturbations, injection and vacuum, which are in progress.

4. MAGNET (C.A. Ramm)

Most of the components of the magnet system are now in store in the main experimental hall and the assembly and installation of magnet units is commencing. No important contracts remain to be placed. Of a total of about 287,000 pieces ordered about 263,000 are already in stock.

a) Magnet Blocks

Progress with the production of magnet blocks by Ansaldo San Giorgio is considered highly satisfactory. Initial difficulties with this very specialised production were rapidly mastered by the firm and the cooperation has been excellent. By March 15th, 510 satisfactory closed blocks had been delivered to the site and by April 30th, 165 open blocks had arrived. It is expected that the last block will leave the factory before the end of May, and that the CERN team cooperating with the control and inspection of the production will return to Meyrin as soon as their equipment is packed.

The results of magnetic measurements indicate that the effort put into the initial development of the production technique has been amply repaid by the quality of the blocks, which is even better than anticipated.

In the 510 closed blocks the r.m.s. variation from block to block for the transition field (about 3kG) is of the same order of magnitude as the residual error in the block measuring machine, i.e. about 2 parts in 10^4 . This reflects great credit on the reproducibility of the mechanical form of the profile. At the injection field (150 G) the corresponding r.m.s. variation is about 5 in 10^4 . The injection variations reflect the very satisfactory result obtained by the mixing procedure for the steel, since a fluctuation of some 10 o/o could be expected without any mixing, and the variations at 14 kG indicate the successful solution to the problem of producing blocks with constant length and mass.

A complete analysis of the situation cannot be made until the blocks have all been measured, but these interim statistics are believed to be representative of the whole situation.

The blocks are considered to be adequately uniform to permit the operation of a system whereby they are selected for unit assembly before the full delivery is complete.

b) Other important Components

Satisfactory schedules have been kept for the deliveries of the coils, girders, jacks and indeed with few exceptions, for all components.

c) Measuring Programmes

Most of our measuring programmes have been on the scale of production testing, except for determination of the field distribution in a final prototype unit, and field distribution studies in connection with the vacuum chamber and the poleface windings.

The block measuring machine has been used to measure on the average about 12 blocks per day of 9 hours. No appreciable systematic drifts of the standard block in the machine have been detected. By April 30th about 180,000 current pulses had been supplied to the machine from its motor generator installation.

The unit measuring machine is assembled and is at present undergoing stability tests, before production testing of assembled units prior to their installation in the ring.

The extensive mechanical testing, by our own team, of blocks before despatch from the factory has enabled us to avoid any mechanical inspection of blocks on the site.

During delivery of the raw materials for the vacuum system the Magnet Group was invited to cooperate in the inspection of the permeability and electrical resistivity of more than 200 strips of stainless steel used for the chamber. A very high standard of uniformity in magnetic and electrical properties was obtained by the stainless steel manufacturer at Ugine.

d) Unit Assembly and Installation

Several trial units have been made and extensive tests have been conducted concerning the precision and stability of assembly. Problems regarding the most convenient use of the jig systems, the location and handling of optical sights and telescopes and the influence of thermal deformations of the supports during alignment have been studied in detail and adequately solved. A convenient sequence of positioning, clamping, tightening and aligning operations has been finally established. Special tools, jigs and supports have been provided to insure an easy and reproducible procedure and fitters have been trained.

The whole transport system for the units in the experimental hall and in the ring is ready and experience has been obtained with the use of the proper devices for unit handling and positioning. The stability of the units during transport has been checked.

All results are now satisfactory and systematic unit construction has just commenced, but the full assembly rate cannot be reached until the poleface winding delivery is adequate. An assembling and measuring programme for the most effective use of labour, devices and space available has been worked out.

e) Poleface Windings, Lenses and Power Supplies

Some difficulties have been experienced with production prototypes of the poleface windings, but a satisfactory solution seems to be at hand.

With a few minor modifications to the process it is believed that full scale production will be under way early in June.

Contracts for the fabrication of the octupole and sextupole lenses have been secured by A.C.E.C.

All contracts are placed for the delivery of the various motor generator sets required for the separate programmed excitation of the poleface windings and lenses. The design and construction of the programming and control systems for these motor generators is being done in the Magnet Group and it is scheduled to complete each of the systems ready for installation with the appropriate motor generator set. The first equipment, for the quadrupole lenses, will be ready in August.

5. RADIO FREQUENCY (Ch. Schmelzer)

a) Accelerating Stations

An improved model of an accelerating unit was received by end of March, 1958. It has been tested and found to meet the specifications. Some minor changes were incorporated and the final design has been frozen. The unit is now being installed in the machine tunnel for life tests. It is considered to be the first production accelerating unit.

A second unit has undergone preliminary tests at Magneti Marelli, Milan, and will arrive at CERN at the end of May, 1958.

A screened test room for acceptance tests has been installed and equipped.

b) Hall Computer

Work on the Hall computer has reached its final stage. The Mark III computer in its present form will be installed in the Computer Room and used during the initial running period of the machine. It has been equipped with facilities to apply empirical corrections to the theoretical frequency law in order to take care of, e.g., changes of the effective magnet length during the acceleration cycle.

The computer has undergone a long series of tests. The long term relative reproducibility has been found to be about $\pm 7 \times 10^{-4}$, which is well within the tolerances necessary during the early part of the acceleration cycle.

The dynamic performance of the computer, using the pulsed field of the first complete magnet unit, has been studied qualitatively and found to be satisfactory.

Facilities for adjusting and calibrating the frequency programme under actual working conditions were developed and, in part, have already been constructed and tested.

c) Master Oscillator

A Mark II Servo Master Oscillator has been built and successfully tested. It will be installed in the Computer Room and serve during the initial running period of the machine.

Its relative frequency stability is within $\pm 3 \times 10^{-4}$ over ten hours, the maximum relative frequency drift being approximately 2×10^{-4} per hour. The dependence of frequency on tuning voltage is linear within $\pm 2 \times 10^{-5}$. The bandwidth of the tuning servo loop is 33 kHz at injection frequency and 13 kHz at ejection frequency. The ratio of peak to peak frequency swing, due to spurious hum and noise modulation, to carrier frequency varies between 2×10^{-4} at injection and 5×10^{-4} at ejection frequency. The corresponding r.m.s. value for "white" noise frequency modulation is approximately 10^{-5} . A substantial improvement of these performance figures does not seem possible (with the exception of hum modulations), but is not necessary since the generator performance is about one order of magnitude better than that of the Hall computer.

At present a thorough testing programme of the complete programming system, i.e. Hall Computer plus Master Oscillator, is being carried out.

d) RF Distribution and Beam Control System

The distribution amplifiers, which will feed the 16 accelerating stations, have been designed and the final models are under construction. Other elements, e.g. the fast RF switch and the fast amplitude variator, are in the design state.

Design work has been started on a simplified version of the beam control system, which avoids complicated frequency independent phase shifters. The simplification mainly consists of running the beam control system at one preset, fixed stationary phase angle up to slightly above transition energy. The phase change at transition can then be produced by switching in a delay line. The stationary phase angle is adjusted by proper positioning of the phase pickup electrode along the particle orbit. Adiabatic changes of the stationary phase above transition, where the accelerating frequency is nearly constant, can of course be carried out.

e) Pickup Electrode System

A prototype standard pickup station for measuring the transverse beam position has been built and successfully tested. The necessary wide band (10 kHz to 30 MHz) amplifiers, using printed circuit techniques, are ready for production.

f) Timing Apparatus

Design work on the Master Timer for the proton synchrotron has been started.

The design of the peaking strip as well as of the frequency timers has been finished and the final models are under construction.

Design work on a precision transition timer has been started.

g) Phase Oscillation Analogue

The phase oscillation analogue has been used for studying the excitation of phase oscillations due to hum modulation. The work is being continued.

For the investigation of the influence on phase oscillations of statistic fluctuations of frequency, phase and amplitude of the accelerating voltage, a very low frequency (0 - 40 Hz) "white" noise generator has been constructed.

6. INJECTION LINEAR ACCELERATOR (H.G. Hereward)

In April, 1958 the first tank of the linear accelerator successfully accelerated a small beam of protons to its full energy. The main items of work required to achieve this result were as follows :

The ion source and horizontal accelerating column, and the associated electronics, controls, and vacuum system, were installed and put into operation.

Tank I liner and grid-focused drift tubes were installed, aligned and tuned, and an adequate vacuum obtained.

The RF drive chain up to the 350 KW level, and one RF output stage, were installed, tested, and put into operation.

A suitable RF window was developed, and the window and feeder assembly installed and tested.

Several other pieces of equipment, such as tuner drives, servo-tuner, RF monitoring system, water temperature stabilising equipment, and beam monitoring instruments, have been in use while operating the first tank. This has enabled us to verify that they are, at least approximately, satisfactory in practice.

The installation of the vacuum system for Tank II has been completed, and that of Tank III is 90 o/o complete. Both tanks have been tested and are vacuum-tight.

Tank II liner and a few drift tubes have been delivered, without damage in transit. Most of the new drift tubes and quadrupole magnets for Tank I have been manufactured and delivered, and so have their pulsed supplies. The main body of the debuncher has been ordered, and design work is proceeding on its other parts.

Progress is satisfactory on the whole inflector system, of which all major components are either in course of manufacture or in a fairly well advanced state of design.

7. ELECTRICAL ENGINEERING (F. Grütter)

1. Power Engineering

a) PS Main Substation and Power Distribution System

The PS Main Substation was completed according to the programme, and the equipment was tested on December 21st, 1957. Normal operation started in January, 1958. Provisional supplies from the PS Laboratory Substation were removed, and the whole power distribution system for the Experimental Halls, the Linac Wing, the Ring Building and the PS Power House was permanently connected to the Main Substation. A station battery with a capacity of 162 Ah was put into operation in February. Laying of 3 kV cables for supplying the RF final amplifier stations has just been started.

b) Magnet Power Supply

Most of the equipment has been completed and tested in the factory, and a large part has already been delivered and erected in the PS Power House. The M.G. Set, including the Scherbius Regulation, had been erected and tested with a pulsed load at the Brown-Boveri workshops in Mannheim early this year. One of the power converter sets was subjected to severe load tests at the Baden works of Brown-Boveri in February.

Installation work in the PS Power House is proceeding satisfactorily, and it is hoped that the equipment will be ready for first tests in the second half of June.

Seven firms have been invited to tender for saturable reactors, which may be necessary for achieving a slow rate of rise of magnet current at the start of the pulses.

2. Machine Controls

a) Cabling

Installation of trunking for local control and power cables in the Linac Wing is practically finished. Wiring and connection of the control boards has continued in step with the installation of equipment in the Linac Wing.

Control cable trays for the Ring Building and the radial tunnels have been ordered from Düllmann in Dortmund; they have already been installed. Additional trays were ordered in April for local control cables in the Ring Building. A further order is just being placed with the same firm for the main runs between the Central Building, the Linac main control centre, the Power House control centre and the PS Main Control Room.

Cable terminal boards are just being designed and will soon be ordered.

36 firms have been invited to tender for control cables, and a contract for the delivery of these cables is being negotiated with the Norddeutsche Seekabelwerke AG at Nordenham.

The selection of coaxial cables for special purposes is in progress.

b) Control Equipment

The final layout of the Control Room in the Central Building, and the Main Control Room is now established. Racks for control equipment have been standardized and a first order was placed in April with Davis and Thompson, Ltd. in Watford.

Detail design of control devices for various parts of the synchrotron has continued in step with the design and manufacturing of components and measuring devices. Studies about the personnel safety and protection in the whole PS area and the influence of radiation on materials and circuit components are in progress.

A new survey of control components available on the European market has been made, and most of the circuit components have now been standardized.

c) Intercommunication and Television

An order for intercommunication and public address equipment in the Linac Wing and the PS Power House was placed in February with the Süddeutsche Telefon-Apparate, Kabel- und Drahtwerke (Tekade) in Nuremberg. Installation of this equipment has started.

Various firms have been asked to demonstrate industrial television equipment which may be used for beam observation and other purposes in the Ring Building and the Experimental Halls.

8. MECHANICAL ENGINEERING (C.J. Zilverschoon and G.L. Munday)

a) Cooling System (C.J. Zilverschoon)

The pipe work for the well water supply in the ring has been installed and tested, and the pipes are now being lagged.

The heat exchangers, pumps and other parts of the magnet cooling system have been delivered, installed and partly tested (the final acceptance tests can only be performed when the magnet is powered).

The aluminium pipes of the magnet cooling system have been installed in the ring and are now being provided with the 400 branch pipes that will carry the cooling water to and from the exciting coils of the magnet system.

b) Vacuum System (G.L. Munday)

The tenders for the vacuum pumping equipment were adjudicated and a contract was negotiated with the Gerätebau Anstalt, Balzers, Liechtenstein. The equipment ordered uses oil diffusion pumps with water-cooled baffles and compressed air operated shut-off valves. No tender was received for any form of getter-ionisation pump.

A prototype pumping station is being manufactured to test the final details and is now almost ready.

All the high resistance alloy stainless steel, Fluginox 130, was rolled and processed by the Aciéries d'Ugine (Gueugnon) and each sheet was checked for magnetic permeability and overall resistance. In order to keep the magnetic field disturbance to the maximum acceptable for simple correction by the poleface windings, the maximum dispersion allowable from the nominal value of the overall resistance of all the magnet vacuum chambers was set at $\pm 3\%$. This figure was believed to be near the limit obtainable with the industrial processes available for their type of material. However, Gueugnon produced the steel sheets with a dispersion of about $\pm 1.5\%$, and as two sheets were necessary for each chamber, a pairing of high and low resistance valves was carried out so that a maximum dispersion of $\pm 0.25\%$ was obtained.

The Usines Jean Gallay produced a satisfactory prototype magnet chamber from mechanical, magnet and vacuum view points. Production of the chamber started and several items have already been delivered to CERN.

The preproduction prototype of one of the elliptical section bellows for use in the chamber assembly has been made by Metallschlauchfabrik AG, Luzern; production of this item has now started.

In the laboratory, preparations were made to receive, examine mechanically, leak test and install the total of about six hundred items that are due to arrive during the course of the year.

9. SURVEY (A. Decae)

a) The stability of the concrete beam supporting the magnet was studied during several months, together with the geodetic monuments around it.

Invar wires were stretched between the centre and the monuments, and between these and the beam, to record changes of radius. Steel girders fastened to the monuments and extending to the beam recorded tangential displacements. Steel wires on the beam itself recorded changes of curvature. Finally, temperatures were measured, both inside the beam at twenty points, and in the surrounding air.

The measurements were continued from October to February and a special fortnight was devoted to them during the Christmas holidays, with the ring closed to everybody else in order to be free of external disturbances.

The monuments were found to drift periodically with the rock (0.1 mm/100 m amplitude over a fortnightly period in a NE-SW direction). These slight deformations were found previously to be due to the action of the tides on the Atlantic Ocean bottom.

These deformations were not followed by the beam, owing to its elastic supports.

All deformations of the beam were found to be due to changes of temperature; even a slight change of the temperature of the air in the ring provoked noticeable bumps in a short time (half an hour). After the ventilation was on, the bumps disappeared and the deformations were only slow ones, due to internal changes of temperature inside the concrete. When the water is circulated through the pipes inside the beam, and its temperature checked, the beam is quite stable.

b) The beam response to small period vibrations of the ground was recorded in many instances, either during small earthquakes (by chance), or during long term agitations due to the impact of the Atlantic waves on the shores during western gales. In both cases the beam showed no tendency to resonances and remained quite stable, retaining both shape and position.

c) Optical refraction was studied inside the ring and the radial tunnels by :

- i) recording the temperature gradients of the air in several directions and their change in time,
- ii) making a continuous survey of the triangulation net inside the ring with theodolites.

The gradients were found most satisfactory, not varying more than $0.01^{\circ}\text{C}/\text{m}/\text{hr}$ in the absence of hot sources, with the result that the geodetic triangles kept a mean closing error smaller than 10^{-6} rad, so that the use of long pipes to take bearings inside is not contemplated for the moment.

10. BUILDING WORK

Apart from minor work, the buildings of the PS are completed. The site is being cleaned up and landscaped. It has become apparent that the accommodation is only just adequate for the groups engaged in constructing the machine and undertaking accelerator research. Later on, the same accommodation is also just adequate for the Operation Group for the machine, the local service groups, the accelerator research group and one or two experimental apparatus project groups. It is clear, therefore, that more accommodation will have to be foreseen for the nuclear physics teams, both of CERN and from Member States, from the end of 1959 onwards.

11. PS DIVISION REPORTS

CERN-PS/MM-33 November 1957		<u>Magnet Group</u> Pulsed Excitation of the Models and of Individual Elements of the Magnet
PS/MM-Int. 11 November 1957	Internal	<u>Magnet Group</u> Development of the Programming System for Lenses etc.
PS/MM-Int 12 November 1957	Internal	<u>Magnet Group</u> Steel Delivery
CERN-PS/JAG-1 December 1957	Internal	<u>J.A. Geibel</u> Hyperbolic Functions in Relativistic Mechanics
CERN-PS/JGL-2 December 1957		<u>J.G. Linhart</u> The Problem of Runaway Electrons in Plasma
CERN-PS/JGL-3 December 1957		<u>J.G. Linhart</u> Low Pressure Ring-Discharge in an External Magnetic Field
CERN-PS/MM-32 December 1957		<u>Magnet Group</u> Investigation of the Ripple in D.C. Generators
PS/RF Note 19. December 1957	Internal	<u>RF Group</u> Some Observations on Isabella's and Lucretia's Tuning System
CERN-PS/FHJ-1 January 1958		<u>F.H. James</u> An Accurate Method for Measuring the Q-Factor of an Electromagnetic Resonator
PS/RF Note 20. January 1958	Internal	<u>RF Group</u> On the Silicon Diodes, Types OA200 and OA202
PS/RF Note 21. January 1958	Internal	<u>RF Group</u> A Stepping Integrator
CERN-PS/AED-7 February 1958		<u>A.E. Decae</u> Survey of the Proton Synchrotron Concrete Beam
Linac Internal February 1958	Internal	<u>Linac Group</u> (M. Geiger) Magnet Coupling Loops.

PS/MM-Int. 13 February 1958	Internal	<u>Magnet Group</u> Permalloy Strip Magnetometer and Permalloy Strip Magnetic Field Marker
CERN-PS/NVN-1 February 1958		<u>N. Vogt-Nilsen</u> Theory of RF Acceleration in Fixed Circular Accelerators - The Concept of Buckets, Moving Buckets far from Transition Energy
CERN-PS/NVN-2 February 1958		<u>N. Vogt-Nilsen</u> Theory of RF Acceleration in Fixed Circular Accelerators - Moving Buckets at Transition Energy
CERN-PS/MJP-1 February 1958		<u>M.J. Pentz</u> Beam Stacking in F.F.A.G. Accelerators - Introduction
PS/RF Note 22. Fébruary 1958	Internal	<u>RF Group</u> Rapport préliminaire sur les pick-up électrodes
PS/RF Note 23. Fébruary 1958	Internal	<u>RF Group</u> Deuxième note sur le Calculateur de Hall (Situation en février 1958)
PS/RF Note 24. March 1958	Internal	<u>RF Group</u> Surface des diagrammes de phase
CERN-PS/LRF-5 March 1958	Internal	<u>Linac Radio Frequency Group</u> The Effect of Distributed Voltages in Operation of the FTH-470 Tube at 200 Mc/s
CERN-PS/MM-34 March 1958		<u>Magnet Group</u> Measurements on the Prototype Quadrupole Lens
PS/MM Int. 14. March 1958	Internal	<u>Magnet Group</u> Cold Cathode Gas-Discharge Tubes
PS/MM Int. 15. March 1958	Internal	<u>Magnet Group</u> Regulated D.C. Power Supplies (Entirely transistorized)
CERN-PS/MM-35 April 1958		<u>Magnet Group</u> A Method for Calculating Disturbances in Constant Gradient Magnets and its Application to the Vacuum Chamber Effects
PS/RF Note 25. April 1958	Internal	<u>RF Group</u> Cavity Tuning Amplifier Model T

CERN/268 (B)
Original : ENGLISH

DIVISIONAL DIRECTORS PROGRESS REPORTS

SYNCHRO-CYCLOTRON DIVISION

PROGRESS REPORT

SYNCHRO-CYCLOTRON DIVISION

December 1957 - May 1958

1. MACHINE PROGRAMME

By 15 December, 1957, the work on the radio frequency had progressed to such an extent that continuous operation of the machine was possible. From December to March, measurements were made on the internal beam, and its intensity as a function of radius and other characteristics was carefully studied. The cold cathode ion source was brought into operation and has proved satisfactory in operation. During this period the floating wire measurements on the extraction system was made.

A health survey of the cyclotron and of the experimental areas was carried out during this period. A great deal of work was done on installing cables and on the lifting platform and other ancillary equipment for the machine. The machine has been run ever since 8 April on a two-shift basis.

Since the beginning of April the cyclotron has run for 600 hours and a third counting room has been brought into operation.

The initial problems for the research programme were the extraction of the proton beam and the pion beams produced from internal targets. After extensive floating wire measurements, the proton extraction system was finally put into position at the beginning of April. Work on the extraction of the proton beam has continued since then and at present about $2\frac{1}{2}\%$ of the internal beam is extracted. Work is in progress to increase the efficiency of extraction and to bring the beam out into the experimental area. The strong focusing lenses and the bending magnet used for this have already been carefully measured.

2. RESEARCH PROGRAMME

In January a beam of 200 MeV mesons produced by bombarding an internal target was brought out of the machine. The range of these mesons was determined, and the beam used to test counting equipment. The nuclear absorption cross-section for copper was incidentally measured and found, as expected, to be geometrical. Extensive calculations and wire measurements were then made on the magnetic fields of the cyclotron and focusing magnets for the extraction of internally produced beams for mesons with energies of 150, 200, 250, 300 and 375 MeV. With the exception of the 375 MeV beam, all these beams have been brought out and give satisfactory intensities; the total intensity for 150 MeV negative pions, for example, being 4×10^5 pions/sec. So far, our attention has been concentrated on negative pions. Work on positive pions is proceeding. A study has also been started on the muon beams from the decay of the pion beams.

The lenses for the μ -meson focusing channel have been ordered and the analyser will be put out to tender shortly. In order to get an estimate of the purity of the μ -beam to be expected, we have to have exact data about the composition of the beam entering the channel. We propose to obtain this information from the exposure of a large stack of emulsion just outside the vacuum chamber. In order to prepare this exposure, we have to do two types of preliminary surveys at the same location. Floating wire measurements have already been carried out using a sensitive method. Because of their general interest, the measurements have been made for pion energies from 70 MeV to 400 MeV. The results are being compiled in an internal report. Counter measurements are still in progress using a telescope with very small detectors in the position in which the stack will be exposed. They should give information about possible unwanted sources of radiation and about the effectiveness of shielding arrangements made to cut out such radiation.

Apparatus has been constructed to search for the decay of the pion into an electron and a neutrino. If a universal interaction exists for weak interactions, then this decay should occur with a frequency of about one in 10^4 of normal pion decays. Part of this apparatus has already been tested in the pion beam.

Work has also started on the reaction $\mu^- + C^{12} \rightarrow B^{12} + \nu$. By studying the subsequent decay of the B^{12} the muon polarization can be measured. The anisotropy of the electrons from the decay of muons has already been measured and agrees well with the published data.

The emulsion group has exposed plates to the pion beams: this has given valuable information about these beams and has helped in the training of microscopists. The equipment for processing large stacks of thick emulsions has been designed and is under construction.

More targets were irradiated in the cyclotron for the spallation group. These targets have been used to study tritium production. A new counting system for measuring very low counting rates is now working and a study has already been made of new meteoritic material. For the first time tritium has been detected in this material.

The large multiplate cloud chamber originally designed for cosmic ray studies has been exposed to the 600 MeV neutron beam. It will be used to study the decay of the neutral pion.

Part of the new laboratory wing has already been occupied and the chemistry laboratory will be ready in July.

A considerable part of the polarized proton injector has been constructed. The apparatus to produce a beam of atomic hydrogen is working well and has produced dissociations of hydrogen molecules of 80%. The quadrupole magnets have been studied experimentally and part of the lens system is under construction.

The electronics group has built a large amount of equipment for work on the cyclotron, and has supplied equipment and development effort for the other divisions. In particular, a large amount of work has been done on the IEP project and the control electronics for the bubble chamber. Among other things, the electronics group has made 68 power supplies, 33 photomultiplier housings, 923 coaxial cables and have completed about 300 other jobs for the physicists.

3. VISITING GROUPS

In the period under review we have received a large number of requests from visiting groups to do experiments at CERN. Already the Padova group has exposed its propane bubble chamber to the meson beam. They have obtained about 10,000 photographs and are now studying these, essentially to judge their quality. They will return later to complete an experiment.

The Harwell/University College, London group has already arrived and are setting up their equipment to study polarization effects in neutron-proton scattering. Some equipment for their pion-proton polarization experiment has already arrived. They hope soon to begin work on these experiments.

We have already entertained representatives of the groups from Utrecht, Liverpool, Saclay, Birmingham, Lyon, Neuchâtel and Fribourg.

4. PRESENT STAFF

Including CERN Fellows in Geneva and abroad : 124.

5. PS NUCLEAR PHYSICS GROUP

The group was set up in October 1957 to study the problems of nuclear physics research with the proton synchrotron and to form a nucleus for the experimental teams on this machine. The group at present consists of 1 physicist and 2 fellows; 1 physicist and 2 technicians are being recruited.

The group based its work on the list of experiments established by Professor Ferretti and discussed at the Venice Conference. A more restricted list of experiments was chosen to illustrate the type of research which might be expected to be done with the proton synchrotron. These experiments were studied one after the other, in order to get a clear picture of the beam transport nuclear physics apparatus which would be involved. These studies were carried out by working groups of physicists from several divisions.

These discussions have indicated that a large hydrogen bubble chamber can be expected to play a decisive role in the research with the machine. The nuclear physics group has been closely connected with the preliminary study of the hydrogen bubble chamber project submitted to the Scientific Policy Committee. In counter experiments the gaseous Cerenkov counter is expected to be the best tool for identification of relativistic particles, and theoretical investigations of this instrument have been made. An experimental study is planned.

A detailed study of the principles of matching beams of high energy particles between a target and the experimental apparatus has been made as a basis for decisions on the beam transporting equipment, deflection magnets and quadrupole lenses to be used with the proton synchrotron. An electrostatic analyser, capable of separating anti-protons and pions up to 4 GeV/c has been studied.

6. PUBLICATIONS

- Morpurgo M., Septier A. : "Etudes expérimentales de lentilles quadrupolaires hélicoïdales pour la focalisation de mésons μ ."
(C.R.Ac.Sci. Paris, 245, 2496 (1957)).
- Lundby A., Stroot J.P. and Leontic B. : "G.T.-F. interference terms in parity experiments."
(CERN 58 - 1)
- Goebel K. : "Tritium production in iron by protons at energies between 50 and 177 MeV."
(CERN 58 - 2)
- Schlier Ch. : "Remarks on depolarization effects in a source of polarized protons."
(CERN 58 - 3)
- von Dardel G. : "CERN Meeting on Nuclear Instrumentation for High Energy Physics."
(Nuclear Instruments 2, No. 2, 1958 - CERN 58 - 4)
- Krienen F. : "Modulator, CERN Synchro-cyclotron."
(CERN 58 - 8)

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DIVISIONAL DIRECTORS' PROGRESS REPORTS

SCIENTIFIC AND TECHNICAL SERVICES DIVISION

PROGRESS REPORT

SCIENTIFIC AND TECHNICAL SERVICES DIVISION

(December 1957 - May 1958)

1. BUBBLE CHAMBERS

1.1. 10 cm chamber

Trials with liquid nitrogen took place from January to March. Many small improvements turned out to be necessary, but no basic fault was found. In particular, the thermostatic control system which is of novel design, is working well. Subsequently, the chamber was installed in the liquid hydrogen building with all the safety connections necessary to operate with hydrogen.

The chamber produced tracks the first time it was filled with hydrogen. The density of the bubbles and their quality are excellent. Sensitivity appears to be suitably homogeneous, and it is hoped therefore that the cooling system, which operates only on the upper half of the chamber and is being tried in this chamber for the first time, will ensure the maintenance of a homogeneous temperature in stainless steel chambers. The question of distortions cannot be studied on Compton electrons from radio-cobalt, but no excessive movement of the tracks has been noticed.

A fair amount of work still remains to be done to reach the routine operation stage, but it can be said that the chamber has achieved its primary purpose, which was to make the physicists, engineers and technicians familiar with the design, construction and operation of bubble chambers, on the lines likely to be used to solve the problems that would be encountered with larger chambers.

1.2. 30 cm chamber

The design of the 30 cm chamber is now complete; it was improved in many respects as a result of experience gained on the 10 cm chamber, particularly in regard to ease of dismounting thermostatic control and the expansion mechanism. The vacuum tank and some reservoirs are now being constructed in the Main Workshop. Pressure tests on the windows have begun at normal temperature and at the temperature of liquid nitrogen.

1.3. Plans for a large chamber

The Bubble Chamber Group undertook jointly with the PS Division the study of draft plans for a large chamber.

Two alternatives were considered, namely a 1.10 m chamber and a 2 m chamber. The various aspects of the scheme were examined, i.e. its scientific value, the technological feasibility of constructing the chambers, the implications as regards installations, the provision of an experimental hall, facilities for liquid hydrogen production and for the magnet power supply. It emerged that, from a scientific point of view, a 2 m chamber is infinitely preferable to a 1.10 m chamber; its construction would not require any more staff or time; only the cost and to some extent the installations required are affected by the size of the chamber.

A technical report on this question was presented by the Director-General to the Scientific Policy Committee.

2. LIQUID HYDROGEN

The hydrogen liquefaction plant has been run with success on several occasions. The last run lasted 9 hours without any blockage of the expansion valve and 140 litres of liquid hydrogen were produced and put into dewars, which implied a gross output of about 170 to 180 litres, namely about 20 litres per hour. This was the first long trial run; according to the data obtained in short trial runs, it seems possible to obtain an output of 25 litres per hour with the present installations.

3. I.E.P. DEVELOPMENT

3.1. A first prototype instrument for the evaluation of photographs has been completed. Observing an enlarged image of the event under study, the operator can center relevant points of the tracks on a pointer by moving manually a precision mechanical stage. The position of the stage is detected by an electronic device, which records the coordinates of the selected points on punched paper tape. An electric typewriter is used to punch identification signals on the tapes while simultaneously keeping a written record.

3.2. A second model is being assembled, with motor control of the film transport, and a motorized drive along the track, enabling the observer to take measurements on the fly.

3.3. The mechanical parts have been assembled for another prototype instrument, which records line directions instead of coordinate of points. Although of lesser precision this instrument will give a rapid analysis of simpler events such as elastic collisions.

3.4. Studied are in progress for an automatic pilot to center the track images on the pointer, and for an automatic echo-check of the tape perforations. The Berkeley proposal concerning a spiral scan was carefully studied.

3.5. Trials on the operations to be performed after the tape has been punched were made on the Paris IBM704, pending the delivery of the Mercury computer. A spatial reconstruction programme was devised for straight tracks and tested. The output of our instrument was modified to allow the use of the IBM equipment. Punching conventions were worked out for identification marks, error signals and internal checks; the corresponding input programme for the computer was drafted and is now undergoing tests, using measurements taken on photographs of artificially prepared tracks.

The programme for the direction-measuring instrument is in preparation and will be tested on a Mercury computer in Manchester.

4. ELECTRONIC COMPUTATION

A motor alternator and two refrigeration compressors which form part of the auxiliary equipment of the computer have been delivered and are being installed. The computer itself is not expected until the summer of 1958. The IBM704 computer in Paris has been used for the calculation of extensive tables on collision dynamics for the SC and PS Divisions. The staff of the electronic computer section is now five persons, and recruitment of further staff is in progress.

5. HEALTH PHYSICS

The section now has adequate laboratory facilities for its current needs. Progress in the experimental divisions has brought increased demands on the section : for example, the number of people included in the film badge service has grown from 40 to 90.

The staff now consists of one physicist and one technician with part-time clerical assistance. Routine demands on health physics services have been met, but development work has been slow and the tissue equivalent dosimeters are not yet completed. An additional technician has been recruited, and the need for further scientific and technical staff is now under discussion.

A scheme for the medical examination of staff exposed to radiation has been agreed.

6. SCIENTIFIC INFORMATION

The physical equipment of the library at Meyrin and its material organization are now more or less complete. There has been a broadening of the scope of the book stock in response to demands.

During the period under review 9 CERN Reports were published. Decisions were taken by the Director-General with a view to unify the presentation and numbering of various categories of reports, as well as to speed up their duplication. Recipients of reports have been asked to make a choice of categories which they may wish to receive.

15 new exchange agreements in 8 countries have been concluded, bringing the total up to 266 institutions on our exchange list. Preparatory work has started on the publication of the 1958 Conference on High Energy Physics under the editorship of Professor Ferretti. The quantity of offset work has increased in connection with the new decisions on duplication methods. Slides in the newly standardized size (5 x 5 cm) are being supplied in increasing quantities with a corresponding reduction in pictorial photographic work.

DIVISIONAL DIRECTORS PROGRESS REPORTS

SITE AND BUILDINGS DIVISION

PROGRESS REPORT
SITE AND BUILDINGS DIVISION

December 1957 - May 1958

1. CONSTRUCTION AT MEYRIN

General

The peak of construction work has now passed. This is evidenced by the reduced number of workmen which are at present around 340, compared with a maximum figure of 932 in the previous six months.

It might be noted that, recently, salaries for local building labour have again been increased and working hours limited to a five day week. This regulation will naturally have some implication on the work still going on on the Site.

The Cointrin barrack housing the cloud chamber has been transferred to the Site and is being erected near Labor III and used by the same group. The group working on tritium at the Institut de Physique is now also moving to the Site. After this move, all provisional premises, both at Cointrin and at the Institut de Physique, will have been finally evacuated.

Progress of construction

The remaining construction work is now concentrated on the Main Building and the finishing of the chemical laboratories in Labor Wing III. In the other buildings, there still remain some finishing jobs to be done, as well as some improvement or modification to work executed but not yet accepted, which fall under contractors' guarantee.

1) PS Buildings

The PS ring, experimental halls and laboratories are now completed and occupied by PS staff. The ventilation systems in the ring have been tested.

The construction work for the Generator Building - the last building in the original PS programme - is practically complete and the generators and equipment are being installed.

There has been during this period a complete change of emphasis from the construction work to the actual installation of the PS machine.

2) SC Building

As previously reported, the original building work is complete and the machine in service, but the installation of an additional generator and extensions to the Transformer Sub-station are being prepared. Other additional work to enable hydrogen equipment to be used in connection with the machine includes a separate extract ventilation system.

3) Laboratory Wings

Wings I, II and III are now occupied by SC and STS staffs. The radio-chemical laboratories in Wing IIIa have reached an advanced stage and the installation of a separate ventilation system for these laboratories is proceeding. The radioactive effluent delay tank and pumps are installed.

4) Main Building

Concrete work for the basement and ground-floor is complete and form-work is in place for the major portion of the Auditorium. The installation of the electrical services and heating is proceeding concurrently.

5) Main Workshop

This is now complete and occupied.

6) Power House

All building work is now complete and the emergency diesel generator has been put into service.

7) Surroundings

The winter weather which extended into March somewhat hampered outside work. However, most of the levelling and grassing in the north-west part of the Site will soon be complete. Due to the reduced credit for this year, levelling and grassing in the south-east part had to be postponed.

2. STAFF

As was forecast, the SB Division staff has augmented concurrently with the increase of maintenance and operational work due to the take-over of new buildings and with the increase of the total CERN staff at Meyrin. During the period under review the total SB staff has risen from 157 to 202.

3. OPERATIONAL AND MAINTENANCE SERVICES

As was to be expected this period involved, apart from the normal maintenance and operational activity, a great deal of work in connection with the installation of scientific and other staffs in their permanent accommodation.

The permanent systems for the distribution of gas, high pressure, hot and cooling water and compressed air, now supply all buildings and are controlled from the SB Power House, together with the distribution of electricity from the SB Sub-station.

The approximate consumption of electrical energy during the past six months was 3'200'000 kwh, an increase of about 100% over the previous six months. The maximum power demand was 2'363 KW during the period under review.

Cooling water consumption during the period under review reached 220'000 cu.m., i.e. an increase of nearly 70% over the last six months.

As for the previous period, the work of maintaining the buildings and equipment has covered only a small portion of SB Division's work and our staff are kept fully occupied dealing with numerous requests for special installations to meet the needs of the other Divisions, and which it would be difficult to give to an outside contractor.

4. MAIN WORKSHOP

The machines it was planned to purchase for 1957 are installed. The surface treatment plant (pickling, metallizing, mechanical polishing, etc.) will soon be completed. The heat treatment plant is in order.

The full complement of the 1958 staff has been recruited; this brings the number to 58, of which 12 are permanently on loan, working for the PS Division. In addition there are 8 mechanics working on a short term contract for the 30 cm bubble chamber.

Planning, including costing, now applies to all the work executed in the Workshop. The value of work completed for the different Divisions from January 1958 to the end of April amounts to :

for PS Division	Fr. 190.000.-
for SC Division	123.000.-
for STS Division	30.000.-

The work at present in hand includes the 30 cm bubble chamber; finally assembly and testing of rotating condenser for the cyclotron; optical measuring and control equipment for the PS ring; equipment and instruments for the apparatus of evaluation of photographs; experimental equipment for the cyclotron, such as beam extraction equipment; minor experimental equipment manufactured from sketches and simple drawings for rapid delivery to physicists and engineers; adaptation of work supplied by outside contractors.

5. COMMON SERVICES

1) Transport

This section continues to provide, in addition to the normal services expected on such a Site as this, a special heavy lifting and transport service for the large quantities of equipment and removals taking place during this initial period. The following statistics may be quoted by way of illustration :

Number of passengers carried	4455
Number of kilometers covered	89000
Tonnage transported	1500 T.
Tonnage lifted	30000 T.
Number of long distance journeys	7
Ambulance to doctor	3
Ambulance to hospital	11

As forecast this section is heavily committed in connection with the installation of PS equipment particularly for the magnet units and the Generator Building apparatus.

2) Fire Services and First Aid

Training of personnel proceeds but, fortunately, there has been no serious fire during the period under review. Exercises have, however, been held both to test the staff and assist in the training programme. As regards accidents, the position here shows great improvement, although our First Aid men had often to deal with incidents affecting contractors' men working on the Site.

The Safety Officer, in conjunction with the Safety Committee, has been able to assist the general trend of improvement reported in the last report. Further safety codes have been issued for the guidance and instruction of the staff, and a close control is being made of any potentially dangerous working practices. In this connection there has been close collaboration between the Safety Committee and the Health Physics Officer of STS.

3) Site Security

It has been found necessary to augment the watchman service in view of both the increased amount of valuable equipment now installed, and also the increasing amount of apparatus left in operation during non-working hours. Watchman services are particularly necessary at this stage where apparatus and equipment are being installed at the same time as the completion of construction work. Large number of visitors continue to visit the Site and the number of passes issued during this period amounted to 3.150.

4) Facilities to Staff

The temporary Canteen is working to capacity and there is an average attendance of about 300 persons at lunch time.

DIVISIONAL DIRECTORS PROGRESS REPORTS

THEORETICAL STUDY DIVISION

PROGRESS REPORT
THEORETICAL STUDY DIVISION
December 1957 - May 1958

1. STAFF SITUATION

The staff situation of the Division is presently as follows :

B.G. Ferretti	Divisional Director
B.G. d'Espagnat	Staff member
J. Prentki	Staff member
F. Cerulus	Staff member
R. Hagedorn	Staff member
A. Petermann	Staff member
V.F. Weisskopf	Guest Professor
A. Bodmer	Research Associate
S. Fubini	Research Associate
V. Glaser	Research Associate
T. Kanellopoulos	Research Associate
G. Molière	Research Associate
K. Wildermuth	Research Associate
B. Bosco	Fellow
C. Fronsdal	Fellow
S. Köhler	Fellow
P. Mittelstaedt	Fellow
M. Froissart	Fellow
P. Sergent	Fellow
D. Speiser	Fellow
A. de-Shalit	Ford visiting scientist
T. Toyoda	Ford fellow
H. Uberall	Ford fellow
L. Wolfenstein	Visiting scientist
D.R. Inglis	Visiting scientist

W. Thirring	Consultant
G. Wentzel	Visiting scientist
K. Gottfried	Visitor
C.B. van Wyk	Visitor

Most of the Research Associates, Fellows, Ford visiting scientists and fellows will have left by the end of September. Their place will be taken by approximately the same number of scientists, who were chosen at a selection board held on 1 April, 1958. A considerable flow-in and flow-out of physicists is thus maintained between the CERN Theoretical Study Division and the universities of member and non-member states.

2. RESEARCH ACTIVITIES

As stated in a previous report, research activities are subdivided among three groups, which have pursued their investigation in a) low energy physics and theory of nuclear matter, b) pion physics, nucleon structure and field theory, c) strange particles and general properties of elementary particles interactions. Sub-group meetings or seminars were held as a rule every week. No sharp separation between the three sub-groups was, however, ever thought advisable, and it turned out in fact that several problems called for common discussions. This was particularly the case as regards the theoretical views on elementary particles put forward by Heisenberg, whose various aspects gave rise to lively and stimulating discussions between all members of the Division.

A complete review of the activities of the Division would be far too lengthy : some characteristic aspects of them will, however, be mentioned.

a) Research on the physics of nuclei

Research in this sphere included, among other things, studies on the many-body problem as applied to nuclear matter, investigations on possible improvements to the shell model (e.g. estimate of coherence effects in the contribution of configuration mixing to quadrupole moments), compatibility of the shell model with other models etc.

b) Research on field theory, pion physics and nucleon structure

Research under this heading included a thorough investigation of the possibilities of eliminating the contributions from "ghost" states in physically observable phenomena, a study of the high energy

electron-nucleon scattering, calculations on the photoproduction of two pi mesons, investigations on computational methods for carrying out the renormalization procedure in higher orders, etc.

c) Research on strange particles and elementary particle interaction

These research activities involved a detailed study of the phenomena of mu minus capture by protons, with the purpose of determining the relevant coupling constants starting from the results of possible experiments which it suggested; a detailed computation of the bremsstrahlung of polarized electrons; a suggested general scheme for the description of weak interactions, both leptonic and non-leptonic; attempts at accounting for the fact that the pion electron decay is not observed, etc.

3. COLLABORATION WITH OTHER DIVISIONS

As is obvious, several of the research activities mentioned above are of more or less immediate interest for experimentalists working with the SC and were made subjects of private or public discussions with them. Further problems (e.g. concerning the pi-naught lifetime, the K three-body decay spectrum, etc.) were raised by experimentalists and were also discussed. Courses of lectures on pion physics made especially for experimental physicists were given during the academic year by Professor Weisskopf and Dr. Fubini.

As regards collaboration with the PS Division, a small group of theoreticians have made extensive phase-space calculations with a view to predicting the amounts of particles of given types to be expected from the machine under various conditions. This work is being carried out in close connection with the PS research group.

4. JOINT COLLOQUIA

The Joint Colloquia with the Institute of Physics of the University of Geneva were held at the CERN Site during the major part of the year, under the supervision of the Theoretical Study Division. The following colloquia have been held since January 1st :

8 January	J.M. Cassels	Recent experiments with the Liverpool Synchro-cyclotron
15 -	A. Abragam	Spin temperature
22 -	L. Wolfenstein	Weak interactions involving mu mesons
29 -	D.R. Inglis	Nucleon behaviour in rotating nuclei

5 February	T.G. Pickavance	The 7 GeV accelerator project at Harwell
12 -	A. Tollestrup	Photoproduction processes at 1 BeV from the C.I.T. cyclotron
19 -	H.B.G. Casimir	Van der Waals forces
26 -	C. Bloch	Application des méthodes de la théorie des champs à la mécanique statistique
5 March	L. Leprince-Ringuet	Données expérimentales sur les particules étranges - Les V^0 anormaux
12 -	N. Dallaporta	Les interactions des mésons K^+
19 -	L. van Hove	The application of field theoretic methods in solid state physics
26 -	G. Fidecaro	New views at the New York meeting of the American Physical Society about weak interactions
2 April	A. Salam	Application of dispersion theory to K-meson scattering
16 -	A. Lallemand	Quelques propriétés des photomultiplicateurs
23 -	W.O. Lock	Experimental techniques in the BeV region with particular reference to recent work at Birmingham.

DIVISIONAL DIRECTORS PROGRESS REPORTS

ADMINISTRATION DIVISION

PROGRESS REPORT

ADMINISTRATION DIVISION

December 1957 - May 1958

During the period under review, there has been no slowing down in the rate at which the 3 branches of the Administration Division, namely the Finance Office, the Personnel Office and the Purchasing Office, have worked. The following give a brief account of their activities.

FINANCE OFFICE

Contrary to what happened in previous years, the Finance Office had to undertake a considerable amount of budgetary work at the beginning of the period under review. The reduction of total contributions for 1958 to 56 million, decided upon by the Council at its Ninth Session, made it necessary to carry out a detailed and particularly difficult revision of budgetary appropriations.

Moreover, it also proved essential to review expenditure for 1959 in detail, chiefly on account of developments connected with experimental apparatus for the proton synchrotron.

The accounts for the financial year 1957 were audited after closure of the books. They show a breakdown of expenditure by groups and sections within Divisions. The growth of the Organization as a whole and, in particular, the starting of experimental research with the synchro-cyclotron and preparations for research with the proton synchrotron have made it essential to effect an increasingly detailed breakdown of expenditure. Nearly a thousand additional accounting cards have had to be made out.

The number of contracts and purchase orders transmitted to the Finance Office for checking has increased by 18% compared with the same period of 1957; the number of payment vouchers has increased by 35%.

The staff of the Finance Office is insufficient at present to deal with the work, and efforts will have to be made to build it up in 1959.

The Finance Office drafted a revised version of the regulations for the staff insurance scheme and prepared a set of rules for the management board of that scheme. These documents will be submitted to the Finance Committee and the Council at the end of the year for approval.

Original : ENGLISH

PERSONNEL OFFICE

The period 15.11.57 to 15.5.58 saw a further increase in the rate of recruitment; the maintenance of the 1958 staffing programme and the replacement of staff wastage, together with the continuing shortage of good technical and scientific candidates made it necessary to increase considerably our advertisement and interviewing effort. This is reflected in the following data :

	L+S	Tech.	Adm.	Ancy	Fellows	Total
Staff at 15.11.57	115	237	78	126	38	594
- - 15. 5.58	118	283	85	151	35	672
Net increase	+3	+46	+7	+25	-3	+78
Terminations (replacements)	1	2	3	7	9	22
Total recruitment	4	48	10	32	6	100

Selection Boards : 64 (33) *
Candidates boarded : 515 (195)*

* Figures for previous six months in brackets

The distribution of staff at 15 May, 1958 is shown in Table I.

The Personnel Office is now organized into three groups under the Personnel Officer (2 staff).

1. Personnel section (staff recruitment and control, pay and claims - 8 staff).
 2. General services section (travel, installation and medical insurance - 5 staff).
 3. Office services section (typing, reproduction, mail, messengers, telephones - 19 staff).
- Total staff - 34.

Apart from the recruitment effort, the general work load has been fairly steady, with a tendency to increase with the total staff number. A notable exception has been in the mail section which has handled incoming and outgoing mail in quantities some 30% greater than in the previous six months.

Table I.

CERN Staff as at 15 May, 1958

Distribution by Functions and Divisions

	DG	PS	SC	STS	SB	T	A	Total
<u>Grades 12 and above</u> : Sc. and Eng. :	1	13	10	6	2	3	-	35
Admin.	-	-	-	-	-	-	4	4
<u>Grades 5 to 11 inc.</u> : Sc. and Eng. :	-	36	21	17	5	3	-	82
Techn.	-	101	55	27	97	-	-	280
Admin.	7	8	5	6	5	1	53	85
<u>Grades 1 to 4 inc.</u> : Ancillaries :	-	19	11	4	92	-	25	151
Total	8	177	102	60	201	7	82	637
<u>Fellows and Res.Ass.</u> : CERN	-	3	16	3	-	13	-	35
FORD	2	4	3	2	-	5	-	16

PURCHASING OFFICE

During the period under review there has been an increase in the number of orders and contracts placed, although this increase has not been so steep as last year, and is estimated to have been a little over 10%.

The table below shows the number of orders and contracts placed as compared with previous years :

<u>Months</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>
January	155	620	880	1000
February	125	600	875	1025
March	270	610	910	1000
April	240	655	850	900
May	270	720	950	1050
June	325	630	770	950(estim.)

The value of orders and contracts placed during the first six months of this year will probably total about Sw.fr. 5.5 - 6 million. This figure is one million below the corresponding figure for last year, owing to the fact that some of the more important contracts were placed last year, whereas contracts placed this year are for smaller equipment such as lenses, poleface windings and power supplies.

A new type of contract has been evolved with some firms which are prepared to send specialists here at very short notice to assist in installation work.

Now that research work is in progress with the SC, demands for quite special equipment and rare materials show a marked increase which tends to complicate the purchasing work, the more so as these materials are usually wanted immediately. However, the Purchasing Office has so far been able to cope with these problems without undue delays.

The office is being kept extremely busy without interruption. It might be of interest to note that in private industry the cost of running an ordinary purchasing office is usually reckoned as about 3% of the value of orders placed, whereas last year the cost of running the CERN Purchasing Office was about 1.5% of the value of the orders it placed. Although these figures are not directly comparable, they should at least indicate that we are well within the cost limits calculated in industry, and, as a whole, our purchases are probably more complicated, covering a much wider range than is usual in industrial concerns.

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