24th Issue

ORBIT

June 1964

The Journal of the Rutherford High Energy Laboratory

CERN 1954-1964

The European Organisation for Nuclear Research has recently celebrated the tenth anniversary of the day, 17 May 1954, when work first began on the CERN laboratory site just outside Geneva in Switzerland. Britain's involvement in CERN has always been considerable. We contribute 25% of the budget and many of the staff, including several senior posts, are from the U.K. Also, it has become a second home to our high energy physicists. This seems, therefore, an appropriate occasion to review CERN's history, achievements and future.

The idea of European collaboration in a research institution first surfaced at a European Cultural Conference held at Lausanne, Switzerland in December 1949. By June 1950, when a UNESCO Conference was held at Florence, Italy, nuclear physics was strongly mooted as the appropriate area of the international co-operation and the Director General of UNESCO was empowered to 'assist and encourage' the venture. Italy, France and Belgium pledged financial support.

Early in 1952 matters had progressed to the stage when a Council of eleven European nations met at UNESCO in Paris to approve the first mandate of the provisional organisation. Amaldi (Italy) was appointed Secretary General and four groups were set up. These were the Synchrocylotron Group and the Proton Synchrotron Group, whose objectives were to present plans for two advanced accelerators : the Laboratory Group, to consider the siting of the accelerators and all their support facilities. and the Theoretical Study Group, under Niels Bohr, who pursued the theoretical aspects of the projects at Copenhagen. Geneva was selected for the Laboratory site from four locations (Copenhagen, Paris, Arnhem and Geneva). The proton synchrotron team began an intensive study of the newly discovered 'strong focusing' principle to produce an accelerator in excess of 10GeV.

On 1 July 1953, at the sixth meeting of the Council the Convention for the establishment of the European Organisation for Nuclear Research (O.E.R.N.) was presented to be signed by twelve nations. The twelve were West Germany, Belgium, Denmark, France, Greece, Italy, Norway, Holland, Sweden, Switzerland, Yugoslavia and the U.K. (Austria joined in 1959, Spain in 1960. Yugoslavia had to withdraw as a full member for financial reasons in 1962 but retained the role of observer. Turkey and Poland are also observers). Each nation contributes to the budget in proportion to its per capita national income — Britain's share on this basis is 25%.

CERN 1954 – 1964 - continued

The first major excavation work on the site at Meyrin on the French border near Geneva, started on 17 May 1954 and the foundation stone on the new laboratory, The European Centre for Nuclear Research, CERN, was laid on 10 June 1955.

The Accelerators

When it was proposed, the 600 MeV synchro-cyclotron at CERN was the highest energy machine of its type in the world. A synchrocyclotron or frequency modulated cyclotron uses the principle proposed by McMillan and Veksler in 1944 to develop cyclotrons a step further. Spiral ridge cyclotrons (such as the machine being built for AERE) are another advance and it was suggested that the CERN machine might be modified to a spiral ridge type, but this idea was rejected.

The synchrocyclotron produced its first full energy beam on 1 August 1957 only three years after the project was started. It accelerates some 10^{11} protons per pulse at a pulse rate of 55 per second. A polarised proton source has been constructed for the cyclotron.

The major accelerator at the Laboratory is a 28 GeV proton synchrotron whose energy is exceeded only by the 33 GeV machine at Brookhaven, USA. Usually referred to as the CERN PS, it took six years to build and reached design energy for the first time in November 1959. A 50 MeV injector feeds the protons into the magnet ring some 2060 feet in circumference where strong focusing is used to contain the beam as it is accelerated to 28 GeV in one second. The accelerated beam intensity, which has been as high as 9.10^{11} protons per pulse is one of the major achievements of the machine as the anticipated figure was a hundred times less than this.

Both accelerators provide 'good beam' time for over 90% of their scheduled operating time.

High Energy Physics Experiments

Experiments with the accelerators are broken into the following categories according to the type of detecting equipments used in the experiments – nuclear emulsions (10% of the experiments), electronic counters (18%), bubble chambers (45%) and spark chambers (27%). Five large bubble chambers are now at CERN – an 81 cm hydrogen bubble chamber from Saclay, France (equivalent in size to the Saclay chamber which has just arrived at the Rutherford Laboratory); two 1 metre heavy liquid bubble chambers (one from the École Polytechnique, Paris); the 1.5 metre British National Hydrogen Bubble Chamber (which should begin experimental work very shortly) and a 2 metre hydrogen bubble chamber at present under construction. One and a half million bubble chamber photographs are taken in a year and these are distributed to Laboratories and Universities throughout Europe, as well as at CERN itself, for analysis.

Each type of experiment (emuslions, counters and chambers) has its own selection committee to look at the proposals for experiments and a nuclear physics committee then looks at the recommendations of the selection committees.

Organisation

The highest authority is the Council which has two delegates from each member state and meets twice a year. It is assisted by a Finance Committee (13 members) and a Scientific Policy Committee (9 members).

At CERN itself a Directorate of 4 people, headed by the Director General, looks over eleven divisions. There are now just over 1,500 permanent members of CERN and about 220 visiting scientists are involved in the experimental programmes on the two accelerators at any one time. The CERN budget for the current year is 108.5 million Swiss francs (about £9 million)

Achievements

CERN rapidly established itself as one of the finest centres of high energy physics research in the world and the scientific results from CERN have figured prominently at all the recent major conferences. The performance of their accelerators also indicates the excellence of the machine teams.

To select a few of the major contributions to our knowledge of elementary particles which have come from CERN – in 1958 work on the synchro-cyclotron produced experimental evidence for the first time of the decay of a negative pi meson directly into an electron and a neutrino (predicted by theory to occur 10,000 times less frequently than the decay into a negative mu meson and a neutrino); in 1960 experiments of great precision were carried out on mu mesons which indicated that apart from the difference in mass the negative mu meson and the electron are identical; new particles have been identified such as the anti Xi minus and many resonances including the recently announced C nought;

A GALLOP POLL SURVEY CONDUCTED FOR THE SUNDAY TELEGRAPH ASKED PEOPLE WHICH OF EIGHTEEN PROFESSIONS THEY ADMIRED MOST. FOR SOME UNSPECIFIED REASON NUCLEAR PHYSICISTS WERE SEPARATED AS A GROUP FROM SCIENTISTS AND THE RESULTS, PUBLISHED ON 14 JUNE, CAME OUT AS FOLLOWS:-

1. DOCTORS (47%) 2. TEACHERS (12%) 3. SCIENTISTS (10%) 4. CLERGYMEN (8%)
5. LAWYERS, FARMERS AND NUCLEAR PHYSICISTS (5%)

the current neutrino experiments are throwing light on the weak interactions.

But it is not only in the field of science that CERN has been a great success. In this organisation, for the first time, many nations decided to work together to reach ambitious objectives. That the international co-operation has gone so smoothly from the conception, through the construction to the present operation of the CERN laboratory is a most encouraging sign of Europe's potential. In fact since the success of CERN several scientific organisations on a European scale (such as ESRO, ESO...) have been initiated following the CERN model.

The Future

The immediate future development of high energy physics research in Europe depends on how far the Member States will implement the recommendations of the Amaldi Report. There is no doubt that many years of work will occupy the existing CERN machines but the Amaldi Report (Report of the Working Party on the European High Energy Accelerator Programme) considering the next generation of accelerators, could greatly affect the future of CERN. The Report recommended that several new accelerators should be built on a regional or national basis and proposed a 'summit programme' for collaboration on a European scale.

This summit programme involves two major developments. The first is the construction of a proton synchrotron of very high energy (300 GeV). Design studies for this machine are in progress (see ORBIT October 1963). The second, which concerns CERN directly, is the construction of a pair of storage rings in association with the CERN PS. Design studies on this proposal are also underway and an electron storage ring model (CESAR – CERN Electron Storage and Accumulation Ring) has been built at CERN and is operating. Electrons have been successfully stacked in the ring.

The attraction of the storage ring project is that it will allow a limited number of experiments to be performed with particle collisions at energies very much greater than will be possible even with a 300 GeV machine. When two proton beams, each of energy 25 GeV, from intersecting storage rings collide moving in opposite directions, the effective energy is equal to protons of 1400 GeV from a conventional accelerator striking a stationary target. This would give the scientist a glimpse of what happens at these very high energies long before a conventional machine of such energy could be constructed.

The cost of the two proposals would be £120 million for the 300 GeV machine and £21 million for the storage rings. France has already offered to make available to CERN the necessary land, across the border on French territory, which would be needed for the storage ring project. In December 1963, the 26th Meeting of the Council agreed to finance the studies on the summit programme machines but did not commit themselves to the subsequent construction projects arising from the studies.

On 19 May 1964 CERN invited Press representatives from several member countries to the Laboratory on the tenth anniversary of the beginning of construction work on the site. Several of the senior members of CERN, including the Director General, Professor Weisskopf, spoke to the Press. The major talking point was the future European programme – its justification and its financing. Extracts from some of the addresses to the Press will be given in the next issue of ORBIT.

"IT IS SAID THAT HEAVEN IS A PLACE WHERE THERE ARE NO MORE PARTINGS. A FRIEND OF MINE MODIFIED THIS TO 'HEAVEN IS A PLACE WHERE THERE ARE NO MORE MEETINGS'."

LORD BOWDEN
'FRANKLY SPEAKING'
B B C HOME SERVICE.

FOLLOWING A RECENT ARTICLE IN 'SCIENTIFIC AMERICAN' ENTITLED 'STRONGLY INTERACTING PARTICLES' THE SCIENTIFIC AMERICAN OFFICE RECEIVED A TELEGRAM,

TO JEFFREY F. CHEW, MURRAY GELL-MANN AND ARTHUR M. ROSENFELD, AUTHORS OF STRONGLY INTERACTING PARTICLES. IF THAT'S THE WAY IT IS, I QUIT. – GOD.

'LIFE AT UNIVERSITY, WITH ITS INTELLECTUAL AND INCONCLUSIVE DISCUSSIONS AT THE POST GRADUATE LEVEL IS, ON THE WHOLE, A BAD TRAINING FOR THE REAL WORLD. ONLY MEN OF VERY STRONG CHARACTER SURMOUNT THIS HANDICAP.'

PAUL CHAMBERS, CHAIRMAN I.C.I.
CHUTER EDE LECTURE, 2 JUNE

The Accelerator World

Arrival of Atlas

The Atlas computer was switched off at the factory in Manchester on 28 April and from 4 May, some twenty lorry loads of equipment in nine consignments have made their way to the Atlas Computer Laboratory. The last of these arrived on 10 June and the only components still to come are the magnetic drums which are expected sometime in July.

The computer has already been assembled and power switched onto the whole machine. Commissioning is underway and small amounts of experimental time may be available by the end of June. These will become progressively longer as commissioning proceeds and by August the whole installation is expected to be functioning. On 1 October the Atlas computer will formally begin its work.

The second Atlas computer in the country began work in London on 26 May. The first came into operation in Manchester and, in addition to the machine for the Atlas Computer Laboratory, others are scheduled for Aldermaston and Cambridge. The London computer is owned by the University but since they could not meet the £2million bill in its entirety they have set up a company, Computers (Bloomsbury) Ltd., to hire out machine time to commercial users to help pay for it. B P have booked a quarter of the time and paid over £500,000. The University will take up to half the time.

C E R N placed an order in April for a new computer manufactured by the Control Data Corporation, Minneapolis, U S A. The computer, type CDC 6600 is one of the largest now available. The purchase of this computer is the outcome of a year-long study of C E R N's computer needs by a European committee of computer specialists.

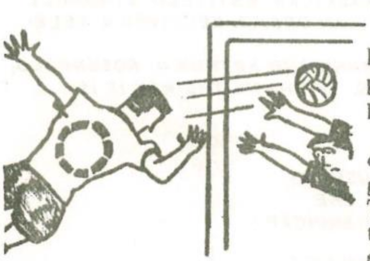
A variable energy cyclotron is to be built at the Yefremov Electrophysical Equipment Research Institute at Leningrad. The cyclotron will have azimuthally varying magnetic field in a magnet with poles 2.4 metres in diameter, weighing 800 tons. The Soviet news agency, TASS, reports that the cyclotron will be capable of accelerating protons to any energy in the range 7.5 to 100 MeV.

Construction of the first 'Emperor' tandem Van-de-Graaff machine at High Voltage Engineering Company, U S A has reached the stage of checking internal design. The novel insulating columns which support the high voltage terminal are installed and the charging-belt assembly has been running. The vessel has been pressurized and short circuit charging tests performed. To date all the measurements are in good agreement with the design figures.

The C° Resonance

The discovery at C E R N of a new 'particle' named the C-nought resonance was announced in May. It has a mass of 1230 MeV and a lifetime of 10^{-20} seconds. Scientists from C E R N and France took part in the experiment which detected the particle. An 18 GeV beam in the proton synchrotron bombarded a beryllium target and antiprotons were produced. The antiproton beam was directed into an 81 cm hydrogen bubble chamber (from Saclay). 300,000 photographs were taken and 770 showed the interaction in which the antiproton was annihilated when colliding with the protons at the nuclei of the hydrogen to produce a neutral K meson and the C^0 resonance. The latter rapidly decayed into another neutral K meson and a positive and negative π meson. The C^0 is the first to be detected in what could prove to be a new group of 'particles' in accordance with the Unitary Symmetry Theory.

Transfer Market



An 80 cm hydrogen bubble chamber has been transferred from Saclay in France where there is a 3 GeV proton synchrotron, Saturne, to the 7 GeV proton synchrotron Nimrod at the Rutherford Laboratory. The Transfer took place on 24 June. The fee is undisclosed.

As we are well all aware, Nimrod is at present 5th in the league table of high energy machines but it is hoped that the transfer of a consistently good performer from Saturne (9th in the league) will help improve our position. The arrival of this bubble chamber fills a deeply felt need at Nimrod since the transfer of the British National Hydrogen Bubble Chamber (Europe's star bubble chamber) to the C E R N P.S.(2nd in the league) a year ago.

A full account (serious) of the arrival of the Saclay chamber will appear in the July issue of ORBIT.

EDITORIAL

An all night festival at Sherborne in Dorset relives every year an extraordinary event in the 14th Century. It was then that the building of the magnificent Abbey was completed. The monks duly paid the Abbey builders their money, told them to go, and took over. All that night, the craftsmen lived it up in Sherborne before moving on to their next ecclesiastical assignment. That was how it was in the Middle Ages — the builders moved on from Abbey to Cathedral to Church to Abbey like the present day roadway gangs moving from M1 to M6.

At our Opening Ceremony, Professor Weisskopf said, 'A new accelerator is born. It is one of those great institutions that have been compared by other people with the Cathedrals in the Middle Ages,' and Mr. Quintin Hogg, 'It is as much an act of faith as Ely Cathedral.'

If this is so, why, when Nimrod first operated in August of last year, didn't we see a long caravan of accelerator builders, ordered to go by the high energy physicists, moving off up the runway (not overtaking, of course, during the outmuster), spending all night roistering at the 'Horse and Jockey' in Chilton before disappearing over the horizon in the direction of Daresbury.

The essential answer is that whereas the 'quality' of the worship in the cathedrals did not depend on the cathedral builders, nor to any great extent on the quality of the building itself, the quality of the nuclear physics at an accelerator is highly dependent on the continued active participation of the accelerator builders and the basic excellence of the machine they have built.

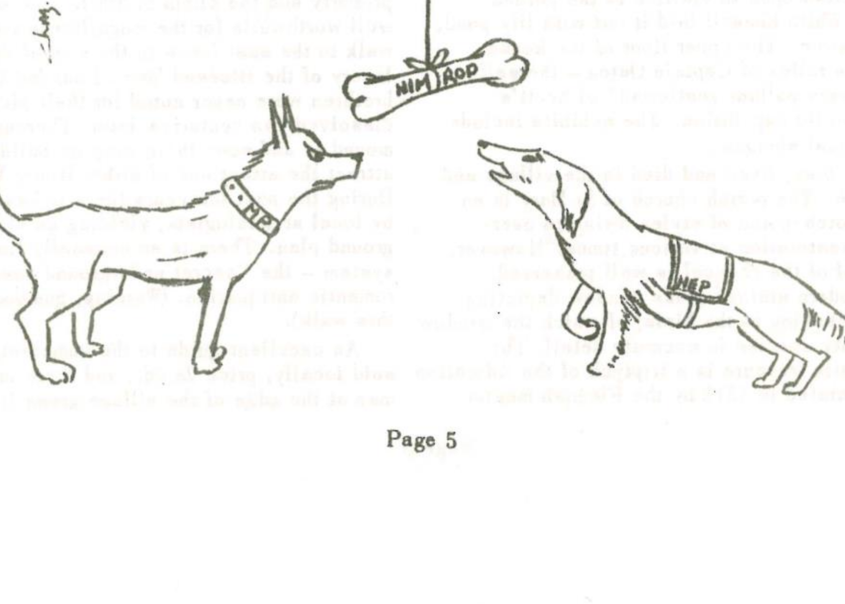
But the high energy physicist is the customer who is always right. The accelerator is not an end in itself. It exists to set up the conditions necessary for experiments. It would never have been built but for the nuclear physicist, and once built its operations are either for nuclear physics experiments or directed towards improving its calibre as a tool for nuclear physics experiments.

The particular requirements of an experiment reflect back through the whole complex machine. They dictate the energy setting, the pulse length, the beam intensity..... On the PLA, for example, the desire of the nuclear physicist to know one of the parameters influencing a particle interaction (the particle spin) led to the building of the polarised proton source. In this case a requirement in the experimental area called for special equipment at the beginning of the machine, the proton source itself. It is in meeting these requirements that the participation of the accelerator team is constantly needed.

The efficient operation of an accelerator requires the skills and co-operation of many people. The importance of their contribution, and the intellectual calibre of their contribution, is of the highest order.

There are several reasons why the accelerator team and the high energy physics team might not mesh well together. The accelerator team, who have been in complete command and in the place of honour throughout the construction of the machine, suddenly find themselves in a subsidiary, though still essential, role. Some of the high energy physicists arrive raw to the Laboratory and its atmosphere, unaware of the blood sweated in building and commissioning the machine, impatient of its inevitable faults.

Probably the most effective antidote to a potential Mods and Rockers situation lies in communication across the boundaries of the two groups. If the aspirations, the potential and the problems of each are known to the other, it is more likely that operation and use of the accelerator will be efficient and fruitful. There is every sign that this desirable situation is being achieved on Nimrod as it has already been achieved on the PLA.



Letters to the Editor

Pseudonyms are accepted provided
the author's name is known to the Editor.

EDITOR : B. Southworth,
National Institute for Research in Nuclear Science,
Room 40, Building R 20,
Rutherford High Energy Laboratory,
Chilton, Didcot, Berkshire.

Sir,

May I draw your readers' attention to the apparent appalling decline in moral standards at this Laboratory. Paganistic orgies are condoned under the guise of harmless entertainment - viz. - an apparently innocuous recent dance held in the Restaurant was advertised as being for dancers wearing flat shoes only! Now we are confronted with a notice announcing the Rutherford Laboratory Summer Dance at which the participating revellers' sole concession to normal modesty will be the wearing of black ties - Is there no end to this depravity ?

Yours disgustedly,

I. GRUNDY.

RUTHERFORD LABORATORY
SUMMER DANCE 1964
DRESS : BLACK TIE

Sir,

It is with great regret that I note the passing away of so many eminent members of the Rutherford Laboratory. That they should all be interred just outside my lab. in R 1 is an honour which hardly outweighs the sorrow of their loss.

However, I feel I must protest at the inadequacy and functionalism of the memorial plaques.

P.S. ROGERS.

Afternoon Out
Selborne

Selborne is to the natural historian what Mecca is to the faithful. "The Natural History of Selborne" by Gilbert White (1720-1793) is a classic, now translated into several languages, by the first Englishman to open his eyes to the treasures and beauties of his countryside.

His home in the centre of the village is called "The Wakes" and is now a museum dedicated to his life's work. Also open to visitors is the garden preserved as White himself laid it out with lily pond, topiary and lawns. The upper floor of the house accommodates relics of Captain Oates – the self-sacrificing "very gallant gentleman" of Scott's ill-fated Antarctic expedition. The exhibits include one of the actual sledges.

White was born, lived and died in the village and was its curate. The parish church of St.Mary is an unfortunate hotch-potch of styles owing to over-enthusiastic restoration at various times. However, the barrel roof of the chancel is well preserved. There is a modern stained glass window depicting St.Francis preaching to the birds, of which the window depicts seventy species in accurate detail. The church's artistic treasure is a triptych of the Adoration of the Magi painted in 1510 by the Flemish master Jan Mostaert.

The village itself is a pleasant medley of architectural styles, chiefly thatched cottages and early Georgian; modern additions are happily unobtrusive. A photogenic locality with fair hunting for the connoisseur of roofs and chimneys.

There are several pleasant walks in the vicinity, notably those leading up to the Hanger, a wooded prominence to the west. This is National Trust property and the climb of 300 feet or so to the top is well worthwhile for the magnificent views. Another walk to the east leads to the site of the Augustinian Priory of the Blessed Mary. Founded in 1232, its brethren were never noted for their piety and it was dissolved two centuries later. Thereupon the locals moved in and soon there were no buildings left to attract the attentions of either Henry VIII or Cromwell. During the past ten years the site has been excavated by local archaelogists, yielding an almost complete ground plan. There is an unusually fine drainage system – the "secret underground passages" of the romantic antiquarian. (Warning, gumboots advised for this walk).

An excellent guide to the immediate locality is sold locally, price 2s.9d., and there is a large scale map at the edge of the village green (the plestor), AFTERNOON OUT - continued.

where there is also parking space. Coffee, lunches and teas are available at either pub. The Museum is open from 11 a.m. to 1 p.m. and 2.30 p.m. to 5.30 p.m. each weekday except Friday, and from 2.30 p.m. to 5.30 p.m. on Sundays. The admission charge is adults 1s.6d., children 6d.

How to get there : From Newbury – A 34, A 339 – Basingstoke – A 339 – Alton – A 31, B 3006 – Selborne, 34 miles. From Reading – A 33, A 32 – Alton, then as above, 29 miles.

The Lecture Theatre

J B Worts

(SOUTHERN WORKS ORGANISATION)

No one person can take the praise, or perhaps the blame, for the final design of the Lecture Theatre as, during its development, it had its fair share of buffeting through the hands of the various architects, engineers, and committees.

It was always associated with the Restaurant so that facilities would be available for serving refreshments to audiences attending a series of lectures or conferences. In fact, the Restaurant (with a temporary west wall in readiness for the proposed Lecture Theatre) was being constructed while plans for the Lecture Theatre were still being discussed. The link was preserved and in the present arrangement the "assembly space" serves as a useful coffee lounge connected with the Restaurant.

Early proposals for the Lecture Theatre had generous ancillary accommodation such as projection rooms and committee rooms, and incorporated ample seating capacity arranged in tiers radiused from the speaker. However, it was decreed that the hall should be restricted to accommodating a maximum of 200, and that larger audiences would have to use Cockroft Hall. This requirement, and the need to keep costs down were controlling factors in the design eventually agreed, although in any event a plain shape was aesthetically correct to avoid conflict with the more complex shape of the Rotunda at the extreme east of the building.

While the broad principles were being settled, the important details concerning the comfort of the audience were also being considered and in particular, the seating and the acoustics in the auditorium were being studied. An extensive search round the furniture suppliers in London ended in a seat and back-rest which met our standards of comfort within the budget. Around this, the writing flap and brief case holder were designed and a full size mock up unit was supplied for approval. It formed the basic module in determining the internal auditorium dimensions.

One of the earliest notes in the file, refers to a lunch-time discussion between Dr.Pickavance and a member of the D.S.I.R., when advice was offered on the best means of obtaining the right acoustic properties. The Building Research Station gave us every assistance and helped achieve what appear to be very good conditions. A "reverberation period" of 0.85 seconds was advised, since the main aim was to achieve good acoustics for the human voice. By extensive use of various decorative surfaces fixed to battens on the walls with the interspace filled with fibreglass, this low figure was reached. That 'soft-to-walk-on' rubber flooring was also an early decision but a less expensive finish crept in under the seats to reduce costs.

With these requirements finally agreed, the design took shape quickly. Tiered seating, in straight rows, for 200 people with a seven foot wide "crush-space" at the back and a stage at the front, formed the main rectangular plan. The designers took a calculated risk in placing the ventilation plant room in the void created by the rising auditorium seating, thus saving the cost of separate external building as at Cockroft Hall. Of course, to avoid structure-borne sound transmission, the plant room walls, floors and roof were isolated from the main building structure except for flexible links. Also, calculations were made to determine the proper wall and roof thicknesses necessary to reduce air-borne noise in the auditorium to a reasonable background level. The decision has been justified by the results obtained. The last problem concerned noise from the input and extract fans passing along the ducts connecting with the auditorium. To save unnecessary expense, provision of the right absorbent treatment was left until the fans could be run,to obtain precise measurements of "peak" frequencies.

The N.I.R.N.S. Sponsor took the keenest interest in all the design problems and, not unexpectedly, was particularly exacting on those concerning acoustics and sound transmission. He also advised in the design of such items as the sliding and fixed blackboards, the lecturer's desk, and the screen for showing slides and films.

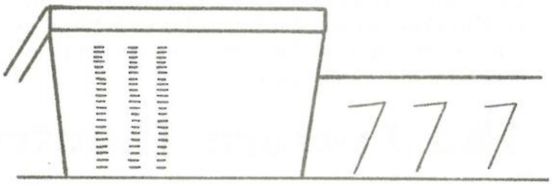
The ventilation plant draws fresh air through filters and heater batteries into the auditorium through controlled grilles at high level, while the extract fan draws air from the void below the seats and from the back of the hall at high level. Both the input and extract fans are driven by one motor which has variable speed control to give approximately five air changes per hour in winter and fifteen in the summer. The heater batteries are thermostatically controlled and would be off altogether during the summer when ventilation only is necessary. In the winter, at times when the auditorium is not in use, background heating is provided by a low pressure hot-water coil located in the void below the seats.

THE LECTURE THEATRE - continued

The lighting in the auditorium comes from an attractive flush arrangement of tungsten light fittings recessed into the ceiling. They can be controlled, including dimming, from the rear of the auditorium as well as from a panel on the stage. Emergency lights and walkway lights are provided and the stage is separately lit by an array of spot lights behind the proscenium opening.

Although I have so far concerned myself mainly with the auditorium it is worth mentioning the lighting of the assembly space where continuous lighting troughs, with intermittent fluorescent fittings, are a feature of the internal design. Arising from the desire to keep the fittings as high as possible and at the same time disguise a series of structural steel joists, the design provides an unusual contrast to normal installations.

A particularly pleasing feature to me is the absence of one of those little rectangular boxes (or perhaps you prefer them curved!) which appear on top of so many buildings, known as "tank" or "lift-motor" rooms. And anyone supposing that the three vertical lines of contrasting brick on the south gable were put there on the insistence of my cricket-keen manager are entirely mistaken.



Finally, I would add a word about the external landscape work. Rushed, as usual, as building completion approached, a noble job was done by a now retired member of the design team and the most efficient grounds staff from A E R E. The pathways lead in any direction you may care to go and light relief, in the form of York pavings, cobbled areas and flower beds, break up the forecourt to the assembly space to provide an interesting terrace facing the mid-day sun.

Recent Developments in High Energy Physics

From the 15 – 17 April, some 220 scientists from Eire, Russia, Switzerland, France, Holland, Denmark and Britain attended the first High Energy Physics Conference to be held at the Rutherford Laboratory. The following article is a brief review of topics discussed at the Conference.

N H Lipman

The aim of high energy physics is to discover the basic building components of the Universe and to understand the nature of the forces which hold these components, or particles, together. With the use of particle accelerators, new 'elementary particles' have been discovered, at first at the rate of one or two a year, until at the present time there is practically a deluge of new particles. Four new ones, provisionally named A, B, C and E were reported at the Conference, bringing the total number to over 100.

S U_3 Group Theory

With so many particles to be understood it is to be hoped that they will belong to groups, all the particles in one group having many characteristics in common. Each particle carries round with it an identity consisting of several 'quantum numbers' which control the behaviour of the particle, restricting the type of interactions it can have with other particles. The quantum numbers are spin (J), parity (±), g parity (±), strangeness (S), isotopic spin (T), charge (Q), baryon number (B), etc... As soon as a particle is discovered, every attempt is made to discover its quantum numbers.

S U_3 group theory puts particles which have some quantum numbers apart from Q and S, into an 8 or 10 fold symmetry. The most spectacular success of the theory came a few weeks ago before the Conference when the Ω^- particle was identified at Brookhaven. The properties and mass of the particle were predicted by the theory. Many S U_3 particle groups remain to be completed and many connections between interactions are predicted. With further experiments the theory will either gain in status or possibly be disproved. Even if it continues to be successful it will be necessary to understand the group theory in terms of some inner symmetry of nature.

Strong Interactions

Interactions involving the 'strong' force (such as operates in binding the nucleus together) have been investigated on accelerators with particle collisions at energies many times the rest mass of the particles involved. Thus two particles go into the collision and there is enough energy for many particles to come out. Early experiments supported this 'explosion principle' (known by theorists as the statistical model) indicating that with a large amount of energy available, general fragmentation occurs and particles such as π mesons and protons, fly out in all directions like shrapnel.

It has now become clear that what generally happens in these strong interactions is that the two particles go into the collision and two come out. The outgoing particles may each decay into several daughter particles while in flight and the experimentalist may pick up five or six particles apparently coming from the collision. The situation was summarised at the Conference by saying that the simplest interaction, two particles in and two out is the general rule.

The theoretical question is why does the most simple interaction prevail. The explanation is given in terms of the exchange of a single particle. In this particle exchange theory, the collisions are peripheral, the colliding particles skimming past each other exchanging a particle which carries across the correct quantum numbers to change the particle identities in the observed way. The heavier the exchanged particle, the larger the angle of scatter. The experimental evidence shows most scattering processes at high energy with small angular distributions, if anything smaller than expected from the theory.

We have many elementary particles to worry about and we are just starting to understand their interplay. It appears that some particles act as the binding force for others. Are some particles the building blocks of nature and others the mortar, or is the arrangement reciprocal?

Regge Poles

The 'Regge Pole' theory, based on the Schrödinger Wave Equation, has been of great interest in the past few years. Several important predictions can be tested experimentally. One of these, referred to as 'shrinkage' suggests that, thinking of a particle collision in terms of a model based on optical diffraction, the diffraction centre becomes larger in radius but less dense as the bombarding energy increases. Two years ago this was supported by proton-proton experiments but later investigations using pion-proton and K-proton scattering failed to show the shrinking effect. It appears that the theory is not as simple to treat as the Regge pologists had hoped and the theory has lost some of its usefulness.

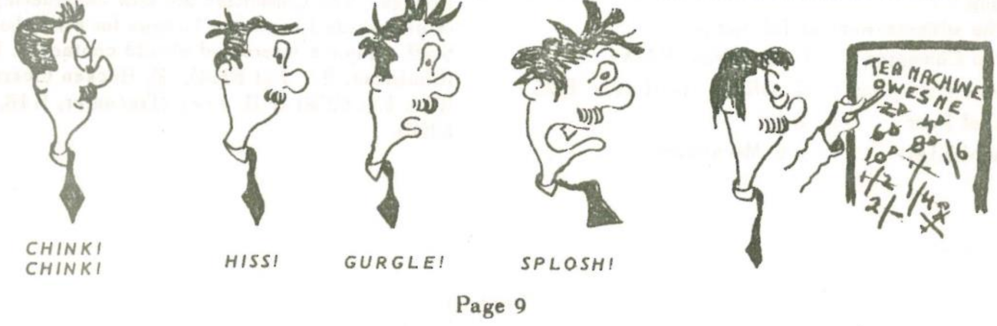
Weak Interactions

The weak interactions are in a tidier condition than the strong interactions. That is to say that experiments have continued to agree with predictions and a fairly neat set of rules are now well accepted. A particle known as the boson, W, presumed to be exchanged in weak interactions has not yet been seen experimentally. It is hoped that it will be discovered in the neutrino experiments now in progress at Brookhaven and C E R N. These are massive experiments with thousands of tons of iron and concrete shielding close to the accelerators so that only the penetrating neutrinos reach the detecting apparatus which record only a few interaction events per hour.

Most exciting of the events recorded are about 50 which are possible candidates for an interaction which would demonstrate the existence of the boson, W. It is too early to say that it definitely exists but the experiments are proceeding and it is hoped that soon we will have definite evidence for a W which could prove to be the very heart of the weak interaction.

Conclusion

It is clear that the subject is still wide open, and that many important discoveries remain to be made. There are several promising theories to be tested, and Nimrod starts its operations at a very exciting time. The present data suggests that in weak, electromagnetic and strong interactions the interaction forces are explained by the exchange of particles. The large number of 'elementary particles' may be a direct consequence of complicated force patterns. The force-particle relationship must still be understood, but with several new accelerators being built throughout the world many of these problems will be solved in the next decade.



Personnel News

Dr Hanna

Dr. Roger Hanna has been appointed Head of the Proton Linear Accelerator Division.

Dr. Hanna was born in 1924. He studied physics at Cambridge and was associated with the early days of the atomic energy project at the Cavendish Laboratory, Cambridge and later at the Chalk River Laboratories in Canada. He returned to the Cavendish to work for his Ph.D. degree.

After obtaining his doctorate, he joined the Nuclear Physics Division at AERE, Harwell working on the BEPO reactor and the Van de Graaff electrostatic generator. While with AERE he was a joint leader of a combined AERE – University College, London, team at CERN, working with the synchrocylotron accelerator. He returned to England to take part in the nuclear physics experimental programme on the PLA and became Group Leader of the PLA Nuclear Physics Group. His appointment as Head of the Division was announced on 25 May.

Dr. Hanna lives in Abingdon, is married and has two children – a daughter born in 1954 and a son born in 1956.

Comings and Goings

B. Boardman joins Nimrod Machine Engineering; H.T. Medhurst joins Nimrod HEP Engineering.

Mrs. A.A. Jefferies and F. Smith join Finance and Accounts.

Miss J.L. Smith and Miss J.D. Fry join Atlas Operations Group.

A.E. Richards, L.J. McKenry and M.K. Oliver join Central Engineering.

Mrs. A.M. Carpenter, Miss B.M. Martin, Miss N.J. Ricketts, K.W. Winsper and C.L. Wray have left us.

Congratulations to –

David Lord, Bubble Chamber Group, and his wife Shirley on the birth of a son, Nicholas Dominic, on 24 May.

Tom Gubbins, PLA Accelerator Physics, on his marriage to Betty Doreen Proffitt on 23 May.

A.P. Banford has succeeded J.B. Marsh on the ORBIT Editorial Board.

Dance Band

It has been suggested that a Rutherford Laboratory Dance Band might be formed. If any musicians, with their own instruments, are interested, will they please contact Ron Hecken, R8, or Tom Stewart, R1, Lab. Workshop. A drummer with own kit is especially required.

Darts Tournament

About 90 members of the Laboratory Industrial Sections watched the finals of the inter-section darts tournament held at the AERE Social Club on Friday, 22 May. The high attendance and high standard of play produced a very successful and enjoyable evening.

The winners were as follows :–

Singles Champion	C. Grindrod PLA
Doubles Champions	W. Oliver, G. Horton R25
Team of Four	R25
Team of Eight	R9, Mechanics.

The cups and medals were presented by R. Tolcher who proposed a vote of thanks to the Committee who, in their turn, thanked everyone who helped. The singles and team challenge cups will be on permanent display in the Restaurant Coffee Lounge. The Committee are now considering a four or six-a-side Lunchtime League for all Laboratory Staff. Anyone interested should contact R. Hecken (Chairman, R8, Ext.6214), M. Hecken (Secretary, R18, Ext.6258) or B. Keen (Treasurer, R18, Ext. 6258).

Record Society

Requests for music to be played at these programmes may be directed to Ron Hazell, R 25. The July programmes, beginning at 12.30 in the Lecture Theatre, are as follows :

7 July

'South Pacific' Overture.

Dietrich Fischer Dieskau, Joan Hammond, Heddle Nash — Opera

Duke Ellington:
- Black and Tan Fantasy, East St. Louis Toodle-oo — 1927
- Such Sweet Thunder, Half the Fun — 1957

21 July

Brass Band : 'Washington Post' Sousa
Miles Davis : 'Miles Ahead' arranger Gil Evans
Ravi Shankar – Indian sitar music

28 July

Ravel — Bolero
Reverend Kelsey, The Ward Singers, Sister Rosetta Tharpe and Marie Knight — singing Negro Spirituals
Eddie Condon — Dixieland Onestep
Louis Armstrong — Threepenny Opera
All in the April Evening, Two choruses from 'Messiah' — Choral

Recreational Association

An attempt is being made to gauge the extent of interest in the Laboratory in forming a Recreational Association. A list has been circulating to collect the names of people willing to help, or just interested, and also to learn the sort of activities people would like to see an Association taking up, e.g. tennis, darts, table-tennis, etc. If anyone has not seen a list they can leave their names and the items they are interested in with any of the following :–

Mrs. Griffiths (353), Mrs. Owen (597), R. Hazell (6116) or T. Harper (6116) all in R 25; M. Hecken, S. Warley or E. Kirby all on 573, R 18; R. Hecken (6214) in R 8.

"Words like "She'll do" must be eliminated from the NIMROD vocabulary," said Dr. Hobbis at a NIMROD reliability meeting.

How Right Can She Be ?

People who say "She'll do" and "She'll be right"
Mean that she's near or good enough if not quite
And no Error can be more than a trifling Oversight.

Of course, when I say "She's right" or "She'll do"
I mean she's really a Hundred per cent, and true
To Specification–within an Inch or an Ounce or two!

I mean also that it is perfectly safe to make
An Assertion which Nobody can easily shake –
"She's right" means I defy you to find my Mistake.

When I boil my Egg, paint my House or compose my Verse
I know it could be better– it could also be worse.
"She'll be right," I say, not giving a Tinker's Curse.

Since we All say "She's right" to each Other, it is clear
That we can't go very far wrong, we needn't fear
Getting seriously out of Line or out of Gear.

It's a Manner of Speaking, a Variety of magic Spell.
"She's right"–and you're giving Value for What you sell
Or getting it for What you buy–fair to middling or pretty well.

The Aeroplane is crashing, the Ship about to sink,
But with "She'll be right" we'll scramble back from the Brink
Of Disaster, meanwhile calling for another Drink.

Dear Reader, whether You enjoy these Lines or not,
"She'll be right" (won't she?) even if she's not so hot,
So take them as you find them, and be grateful for What you've got.

WHIM WHAM.

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