CERN COURIER

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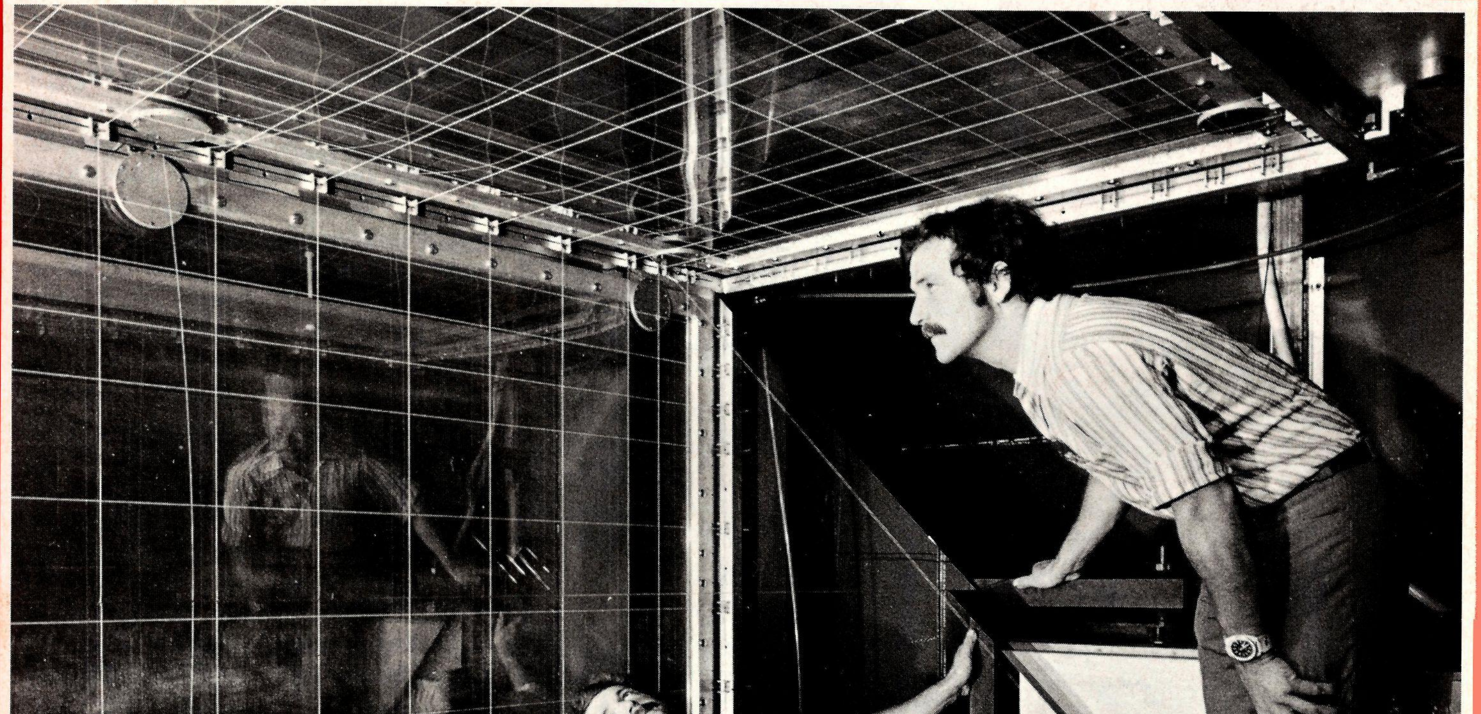

CERN, the European Organization for Nuclear Research, was established in 1954 to '... provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto'. It acts as a European centre and co-ordinator of research, theoretical and experimental, in the field of sub-nuclear physics. This branch of science is concerned with the fundamental questions of the basic laws governing the structure of matter. The Organization has its seat at Meyrin near Geneva in Switzerland. There are two adjoining Laboratories known as CERN Laboratory I and CERN Laboratory II.

CERN Laboratory I has existed since 1954. Its experimental programme is based on the use of two proton accelerators — a 600 MeV synchro-cyclotron (SC) and a 28 GeV synchrotron (PS). Large intersecting storage rings (ISR), are fed with protons from the PS for experiments with colliding beams. Scientists from many European Universities as well as from CERN itself take part in the experiments and it is estimated that some 1500 physicists draw research material from CERN.

The CERN Laboratory I site covers about 80 hectares almost equally divided on either side of the frontier between France and Switzerland. The staff totals about 3100 people and, in addition, there are about 1000 Fellows and Scientific Associates. Twelve European countries contribute, in proportion to their net national income, to the CERN Laboratory I budget, which totals 391.1 million Swiss francs in 1974.

CERN Laboratory II came into being in 1971. It is supported by eleven countries. A 'super proton synchrotron' (SPS), capable of a peak energy of 400 GeV, is being constructed. CERN Laboratory II also spans the Franco-Swiss frontier with 412 hectares in France and 68 hectares in Switzerland. Its budget for 1974 is 227.1 million Swiss francs and the staff totals about 350 plus 10 Scientific Associates.

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CERN News

Around the Laboratories

Cover photograph: It is all done with mirrors. An article in this issue describes the streamer chamber installed at the Intersecting Storage Rings. This is a view below the chamber where a 45° mirror bounces the light produced in the wake of charged particles towards a camera system to be recorded on film. At the top of the picture is a window (lined with a grid) which is the floor of the streamer chamber. (CERN 181.8.73)

All the world's a hadron

Recent results from experiments with colliding beams of electrons and positrons have overthrown some well-rooted beliefs

Ten years ago in February 1964, it was announced from Brookhaven that they had identified the omega minus particle in photographs taken in the 80 inch hydrogen bubble chamber. This crowned one of the great achievements of high energy physics and perhaps marked the end of a particular era in our research.

The story of why the identification of this rare particle was so important has been told many times before. Following the coming into operation of the 6 GeV Bevatron at Berkeley (which, to stick to the anniversary peg, was exactly twenty years ago in February 1954) the population explosion in the number of discovered particles had defied understanding. Then came a beautiful theoretical application of unitary symmetry theory which grouped the particles together in an orderly way with well-defined relationships between them.

It was in noticing an absent member in one of these groups that the existence of the omega minus was predicted and all its properties could be specified in advance. The Brookhaven discovery fitted the predictions excellently and gave hefty support to the theory. We can consider ourselves on to a really good theory when it not only wraps up what we know but also makes accurate predictions concerning what we previously did not know.

If there is an orderly grouping of the particles there must be some underlying reasons for the relationships between them. The famous quark hypothesis is one attempt to get at these underlying reasons. It postulates three types of fractionally charged particles which could come together in different ways to build up the multitude of particles that we have discovered. Thus all the hadrons (all the particles which respond to the strong interaction) could be explained on the basis of a few quarks.

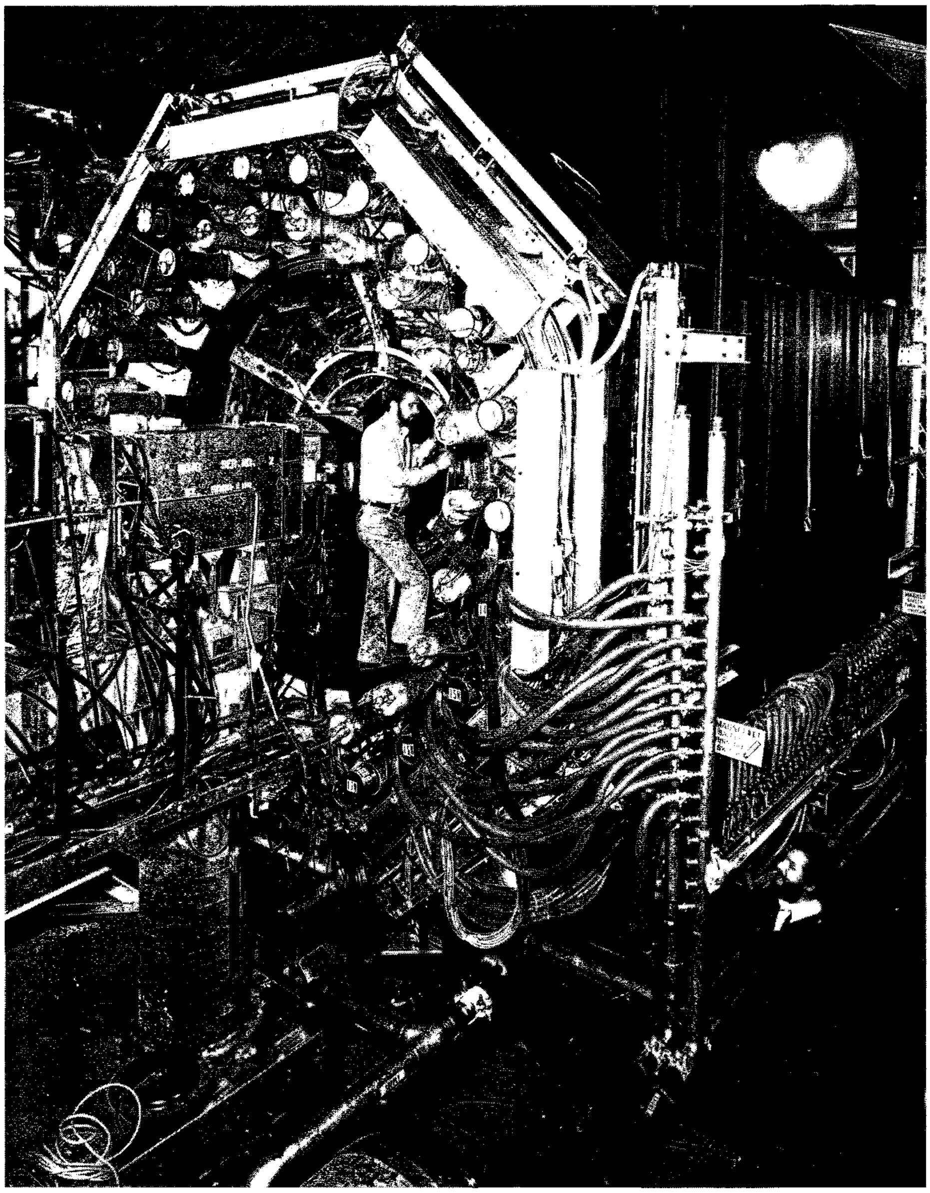
The quark theory has had great success in explaining many of the phenomena involving hadrons and has been a fruitful springboard for developing the theory of particle behaviour. However, on the one hand, quarks have never been isolated as separate entities despite a multitude of searches and, on the other hand, there are some results which do not line up precisely with the predictions of the quark model.

It is for this reason that we picked out the identification of the omega minus ten years ago as, in some ways, the end of an era. It resulted from the accumulation of a mass of completely new information and from theoretical attempts to understand this information. It gave strong hope that we were cracking the mysteries of the world of hadrons. But from that point on, the cracking has proved harder than we thought.

The past ten years have certainly

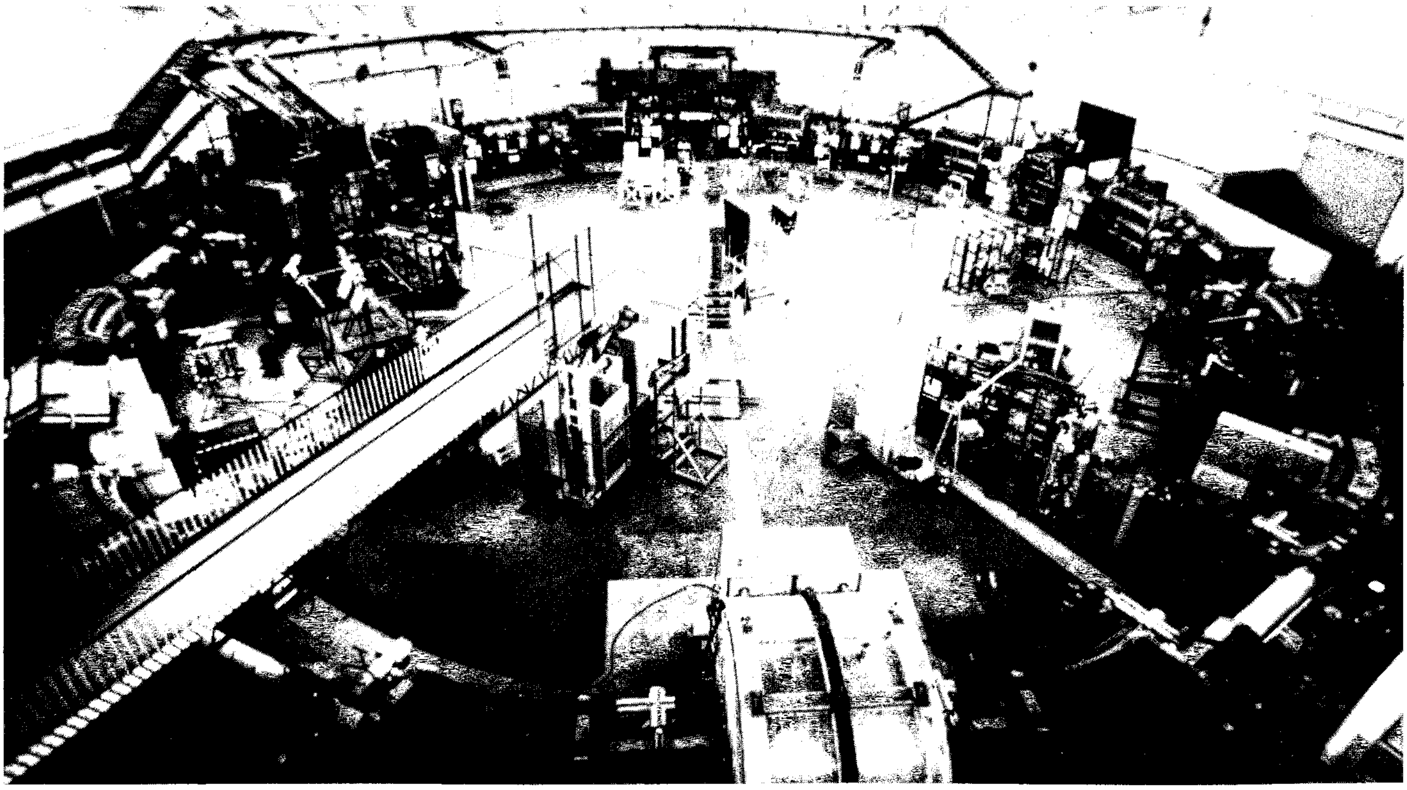
The detection system which surrounds one of the beam collision regions at the Stanford electron-positron storage ring, SPEAR. A large solenoid magnet encloses cylindrical wire chambers and trigger scintillation counters. Shower counters give the octogonal shape outside the magnet. This detector was used in gathering the new astonishing results on hadron production.

(Photo SLAC)



The ADONE storage ring at Frascati where combined electron-positron energies of up to 3 GeV had already indicated that the hadron production cross-section was high.

(Photo Frascati)



seen no let-up in the accumulation of fresh information. This has been particularly true of recent years when, as usual, the opening up of new energy ranges has spilled fascinating results in front of us. The 76 GeV proton synchrotron at Serpukhov, the CERN Intersecting Storage Rings, the 400 GeV proton synchrotron at NAL Batavia have all contributed something new.

Some of the recent results from these machines were described in the January issue, pages 3-6. This month we turn to a series of fresh surprises coming from experiments on electron-positron storage rings. They were reported by B. Richter (SLAC) at the American Physical Society Meeting in Chicago on 4-7 February.

Despite the fact that the electron and positron are well entrenched as leptons (particles which do not feel the strong interaction), we are staying with hadrons because the major surprises concern the way in which hadrons are produced in the electron-positron collisions.

The high energy collision of an electron and a positron brings matter and antimatter together resulting in annihilation into energy. This energy (photons) can convert into hadrons (predominantly pions). Thus hadrons emerge from lepton collisions.

The first inkling that things were going adrift compared with what was expected came from the experiments at the 1.5 GeV storage ring ADONE at Frascati. Their measurements indicated that hadrons are produced much more plentifully than anticipated — the production cross-section up to 3 GeV centre of mass energy is over twice as high as expected on the basis of the simplest models of what is happening (see vol. 13 page 75).

A few measurements with electrons and positrons with energies up to 2.5 GeV (giving 5 GeV centre of mass energy) then came from the Cambridge bypass. These results were very much higher than the predictions but, before they could be checked again, the accelerator was closed down and the experimental team were in the galling position of holding in their hand some very exciting results without being able to build on them. The results were so way out that the rest of the high energy physics world sat back and reserved judgement.

In recent months the same energy range has been covered at the electron-positron storage ring SPEAR at Stanford. Experiments there have resoundingly confirmed the Cambridge measurements and completely overthrown our understanding of what is going on.

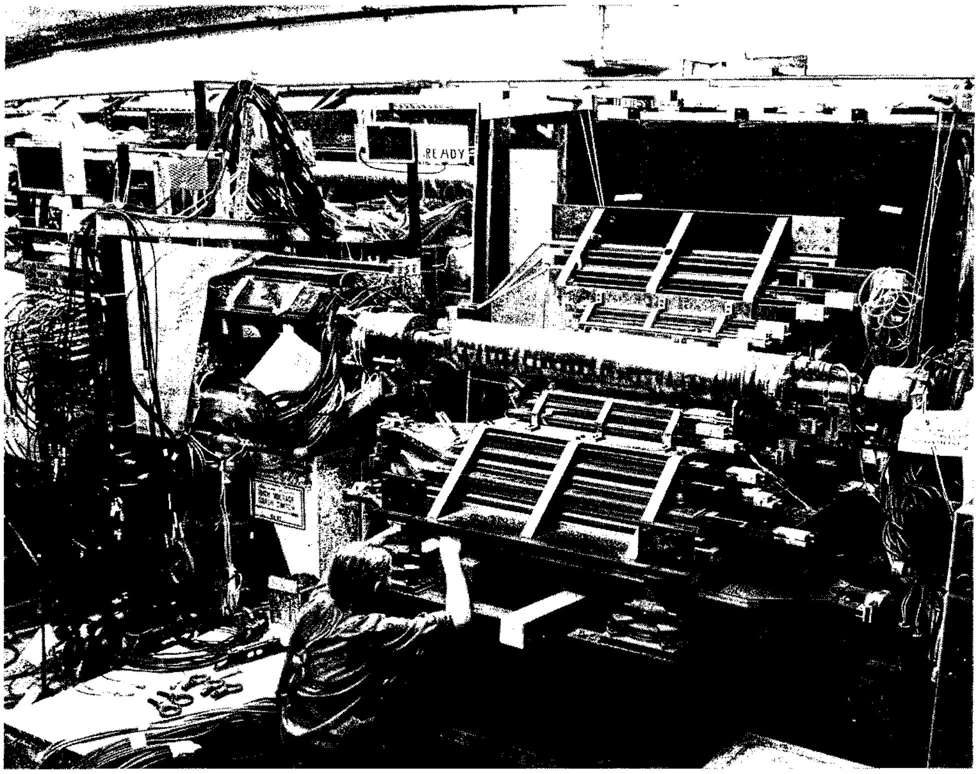
First of all the results give the total cross-section for the production of hadrons as about 25 nb and this figure is virtually constant over the energies investigated up to 5 GeV. This is in complete contradiction to the prediction of the quark model, for example, which says that the cross-section should fall off as the square of the energy (proportional to $1/E^2$). Hadrons are obviously being produced like mad compared with what the quark ideas say they ought to be.

The quark model gets another jolt when the total cross-section for producing hadrons is compared with the total cross-section for producing pairs of muons. The simple quark model makes quite specific predictions — it says that the ratio should be a constant at a value of 2/3, independent of the energy at which the measurements are made.

ADONE results had already upset the apple cart of the simple model but (with the possible exception of one measurement) were still compatible with a more complicated variant of the quark model involving 'coloured' quarks (built up by introducing another property for the quarks like an ultra-strangeness). The coloured variant still insisted on a constant value for the ratio, this time of 2. Coloured quarks had been around before the ADONE results, and are desirable commodities for other reasons, but ADONE brought them more into the limelight.

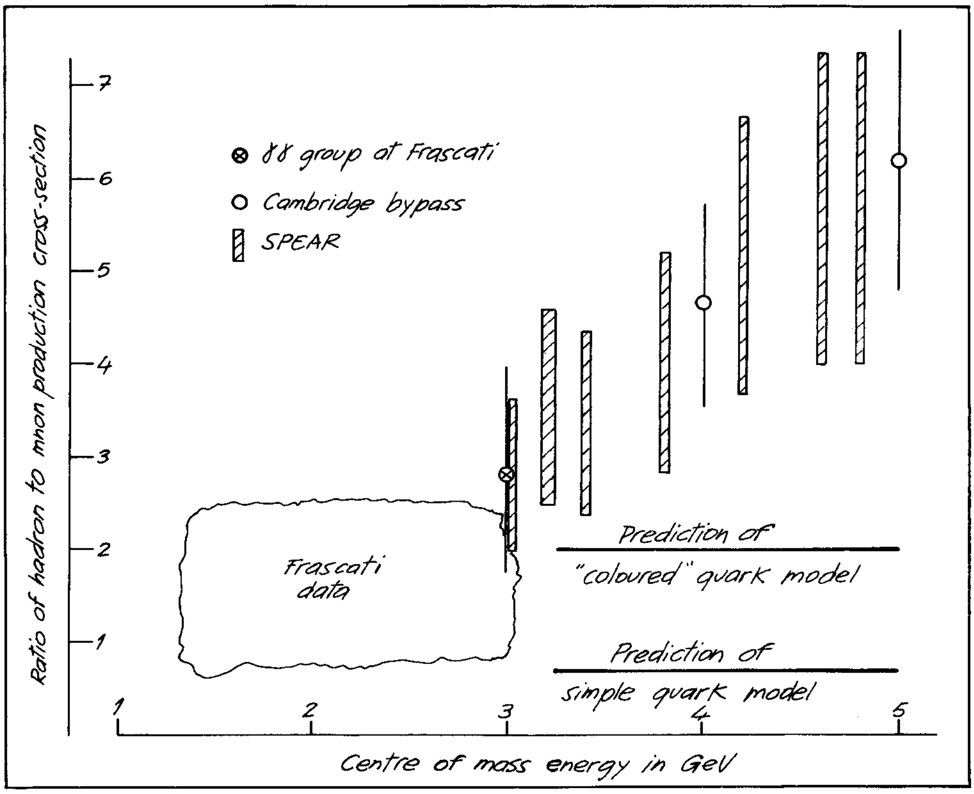
The Cambridge and SPEAR measurements can be explained by no quark model, no matter how coloured. They show that the ratio is rising with increasing energy and by 5 GeV it has reached a value of about 6. This is illustrated in the graph. (The error bars on the SPEAR data are there to take generous care of systematic errors — the statistical errors are only 6 to 7 %.)

Having played havoc with the quark model, the results can also be applied subversively to another revered concept — that of scaling. It was expected that the energy distribution of the hadrons emerging from the



Installation of the BOLD detector in the bypass at the Cambridge Electron Accelerator. With combined electron-positron energies of up to 5 GeV they showed clearly for the first time that something is seriously wrong with our understanding of the electron-positron interaction. They had no time to build on these results before the accelerator was closed down.

(Photo CEA)



The graph which carries the message. On the vertical scale are plotted the ratios of muon production to hadron production observed in electron-positron colliding beam experiments at Frascati, Cambridge and Stanford. Quark models predict constant values as indicated and lower energy measurements (up to 3 GeV) at Frascati were within the quark ball park except for a result from the γγ group which was already pointing the way. The Cambridge bypass plugged in two measurements up to 5 GeV and now ample data from SPEAR has confirmed the spectacular rise in the ratio beyond doubt.

electron-positron collisions would exhibit a certain regularity. It is known as scaling and essentially makes it possible to predict the energy distribution of the hadrons at any energy once they have been measured at another energy.

Scaling has worked beautifully in the studies of the lepton-hadron interaction in other types of experiments. For example, watching how electrons elastically scatter off nucleons gives measurements in line with the scaling laws. But drawing the diagram of the electron and positron collision producing hadrons illustrates that the same interaction is at work as in electron-nucleon scattering. Why then does scaling not apply? The fact that scaling has broken down is really more disturbing than the contradictions of the quark model that we concentrated on above because no model, quark or anything else, which is in line with scaling can explain the new results.

What is also intriguing is that the sort of hadron energy distribution which is seen from the electron-positron collisions looks like the energy distribution which is seen in very high energy proton collisions. The data looks the same as that for pion production at 90° in the centre of mass measured at NAL or the 90° data from the ISR. The electrons and positrons are showing the type of behaviour we expect from hadrons. It is just as if the electron is sensitive to the strong interaction within a tiny radius of 10^{-16} cm. So is even the best known of all the leptons really a hadron at heart?

These are new, completely unexpected, clues to help us understand the true nature of matter.

Progress with the ESO Telescope

Since 1970, CERN has been collaborating with the European Southern Observatory in the design and construction of a large optical telescope. The telescope has a 3.60 m mirror and is the largest ever built by Europe. Once it is installed at the ESO Observatory on Mount La Silla in Chile, 600 km north of Santiago, its users will enjoy conditions for observation which will be among the best available anywhere in the world, with an exceptionally pure atmosphere and a sky which is almost always cloudless.

The telescope is to be used to study the skies of the Southern hemisphere where the famous Magellanic clouds and the central region of our galaxy are among the items of special interest. An impressive building is needed to house this telescope, with its height of 18 m and weight of about 250 tons. The building has a diameter of 30 m and a height of 40 m, equivalent to that of a twelve storey block. 3000 m^3 of concrete and 350 tons of steel are needed for its construction, and its dome will contain 400 tons of steel.

The main mirror was made by REOSC in Paris and was finished in the spring of 1972. Since then, six other contracts have been concluded for the manufacture of the mechanical components, the secondary mirrors and their supports, and the telescope control system.

The structure of the telescope is being built in Creusot-Loire's workshops at St. Chamond, France. All the mechanical components have already been welded and a start has been made on machining them. The structure consists of about fifteen large sections weighing five to twenty tons each, the total weight being about two hundred tons. The telescope will be put together in one of this company's assembly halls, which has already been prepared; it was necessary to dig out the floor in order to accommodate the eighteen metre high telescope. Once assembled, with all its mechanical components and motors, it will undergo a six-month programme of tests.

The main declination and polar drive gear-wheels are being manufactured by MAAG in Zürich. The truing of the polar drive wheel is already at a highly advanced stage, and the wheel will be ready at the beginning of March. The main declination drive wheel will be ready two months later.

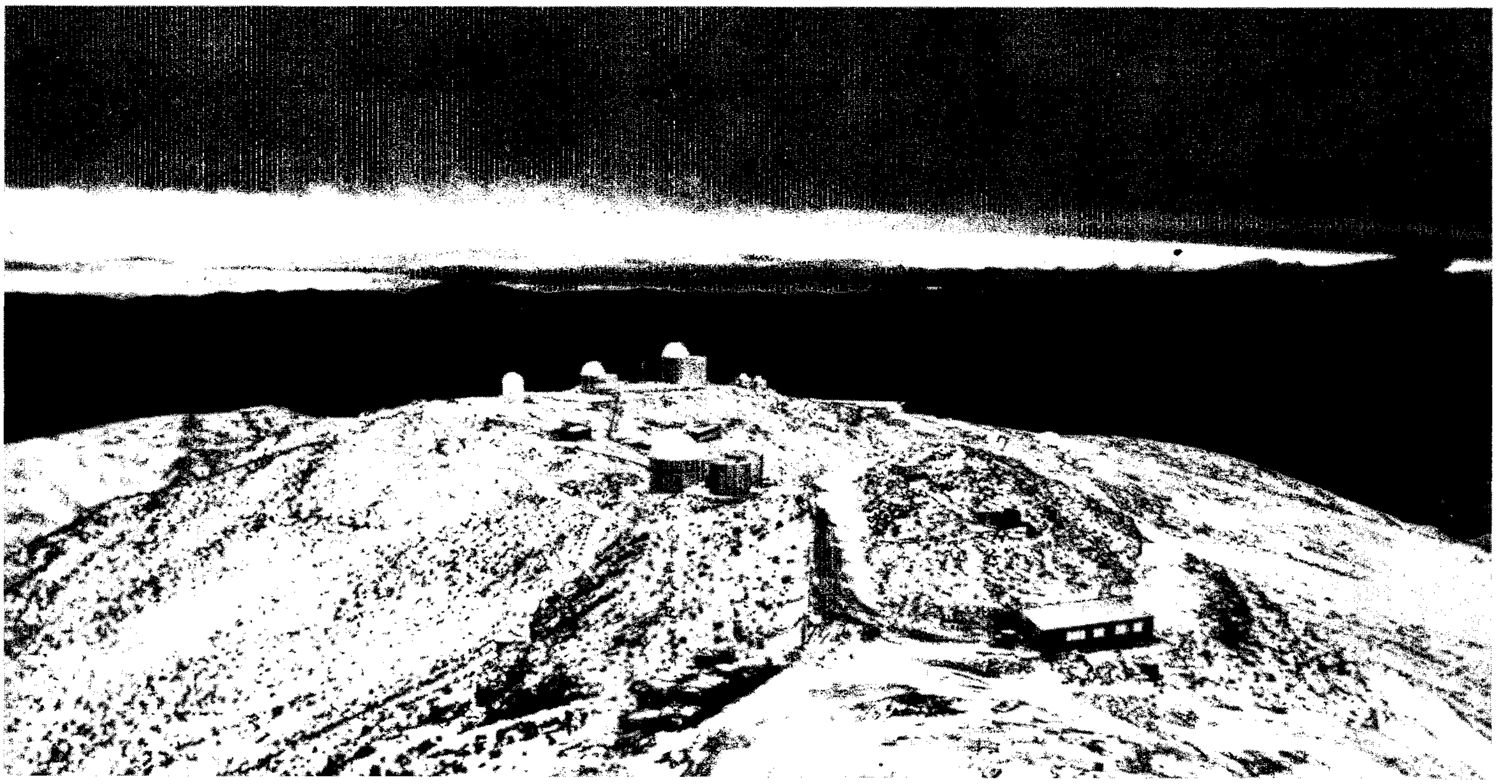
The secondary mirror and prime focus units for the various modes of observation (prime, Cassegrain or Coudé focus) will be made by Bouvier in Grenoble. Manufacture should start within a month or two.

The cabling and motor control systems are being constructed by a CERN-ESO collaboration. Several Hewlett Packard 2100 computers will be used to control the telescope and to collect data. They are already installed in the ESO building on the CERN site. In normal conditions, the computers will provide totally automatic control for rotating the dome, setting up the mirrors in accordance with the mode of observation and aiming the telescope in the desired direction. It will always be possible, nevertheless, to control the system manually. These control operations require more than 120 motors. A model has been set up close to the computer and is being used to perfect the control system. An automatic tracking prototype is already operational on one of the ESO telescopes in Chile.

A pumping station for the hydrostatic bearings of the declination and polar axes will be built by Rexroth of Lohr, Germany. An advanced stage has been reaching in drawing up the plans for this pumping station and a start should be possible on production in one or two months' time.

Work began on the building itself

A view of the ESO Observatory at the top of La Silla mountain in Chile. The photograph was taken in rare weather conditions when the region was covered in snow.



last Spring. On 1 April 1973, three ESO engineers detached from CERN went to Chile and took charge of the organization of the work site (recruiting workers, erecting site buildings, obtaining materials, etc.). A start could be made on the actual work from June and work continued throughout the year in spite of the difficulties encountered during the troubled times through which Chile was going. For example, more than a ton of dynamite which was needed to blast some 7000 m^3 of rock to flatten off the mountain peak where the building is being constructed never arrived at the site because the Chilean army had confiscated it. The July lorry drivers strike completely prevented materials from arriving on site until September.

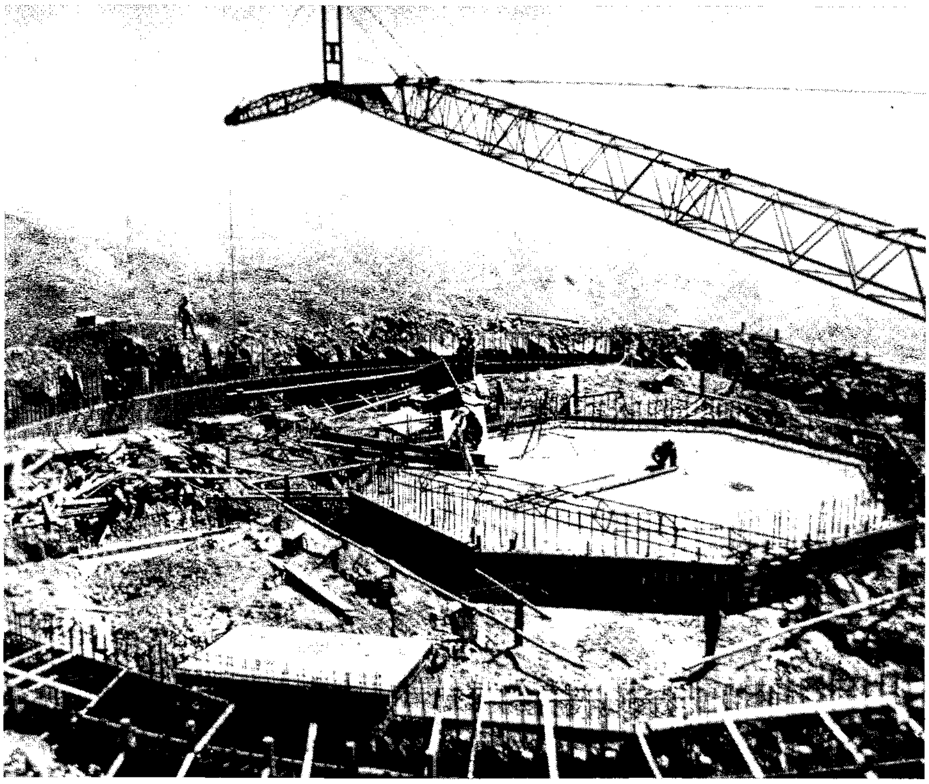
The situation at the Observatory became very difficult. There were no goods left in the shops. It was impossible even to buy nails, but the roads were strewn with them, making road travel more than a little hazardous. By the middle of September, conditions had improved considerably, shops had something to sell once more and supplies to the site recommenced. Throughout the troubles, work had never stopped.

By the end of September, the excavation was completed. It was therefore possible for concreting, carried out by the Dutch firm of Interbeton, to begin in October and by the end of January, with the foundations and the basement built, the building reached ground level.

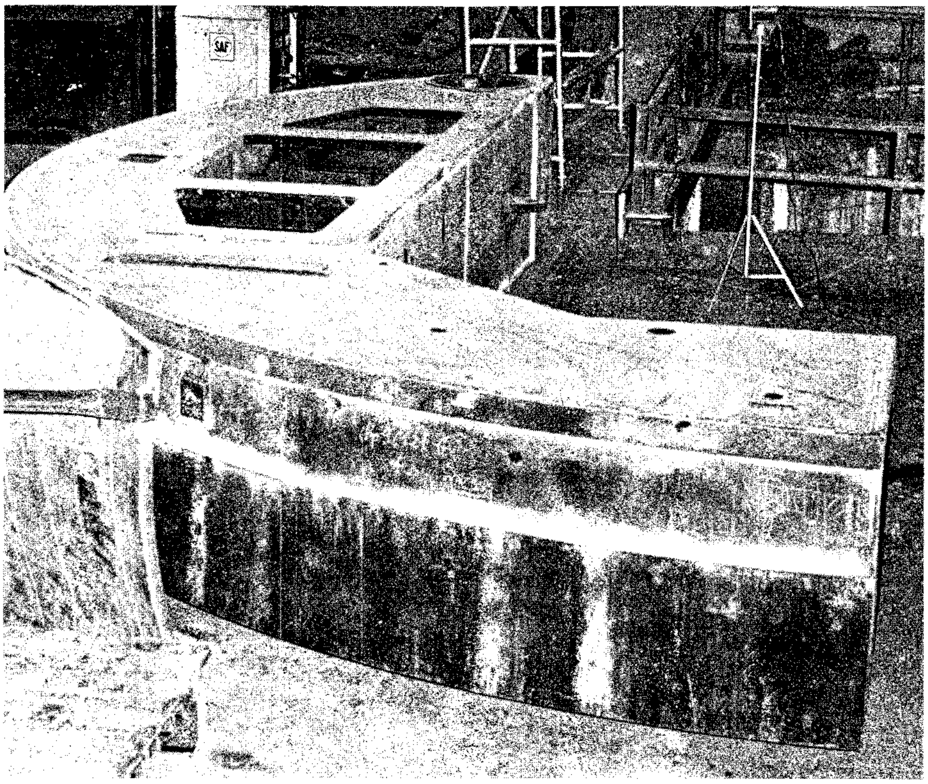
Concreting should be finished next December. The steel components of the dome, being built in Germany by Krupp, will then be welded and assembled. This work should be completed by November 1975. The building's air-conditioning system, which is now being installed, is manufactured by Sulzer, Switzerland. The civil engineering part of the work will be finished at the beginning of 1976 and it will then be possible to start assembling the telescope, the various components of which will be sent to Chile by sea.

A new electric power plant comprising three 500 kVA diesel generators has been assembled by Motoren Werke of Mannheim and will supply electricity to the Observatory. Once the 3.6 m telescope has been installed, a 1.5 m Coudé auxiliary telescope (CAT) will be associated with it, positioned very close to the main building. It also will be controlled by the Hewlett Packard computers and a corridor linking the two buildings will allow it to send its optical beam into the Coudé laboratory of the large telescope and to use the spectrograph installed there.

Despite the problems, Europe's astronomers can look forward to using their large optical telescope in the course of 1976.



The building to house the 3.6 m optical telescope under construction at the Observatory. The octogonal shape at the centre is the foundation for the support system of the telescope itself surrounded by the outside wall of the circular building.



One of the heavy (19 ton) components of the 3.6 m telescope. The bearing surface of the polar axis, which will float on an oil film, is of 'horse-shoe' shape. The photograph shows half the horse-shoe with a 9 m external diameter.

CERN News

Seeing it all with the ISR streamer chamber

In the January issue we reproduced a photograph taken in the streamer chamber installed at intersection region I-7 of the ISR. We will now give some more detail on this detection system which can see almost all the produce of a proton-proton collision in the storage rings and promises to be a fruitful source of information during 1974.

The streamer chamber technique was proposed at CERN by E. Gygi and F. Schneider in 1964. It was developed particularly in the Soviet Union by the late G. Chikovani and his collaborators and at the Stanford Linear Accelerator Centre in the USA. By now the technique is thoroughly mastered and its use is very widespread (see the report of the Frascati Instrumentation Conference vol. 13, page 179). The chambers have grown to very large sizes — one of the latest versions is a streamer chamber system with a total length of almost 9 m which has been built for the study of kaon decays at the Institute for Theoretical and Experimental Physics at Moscow — it was built by a collaboration of ITEP and the P.N. Lebedev Physical Institute.

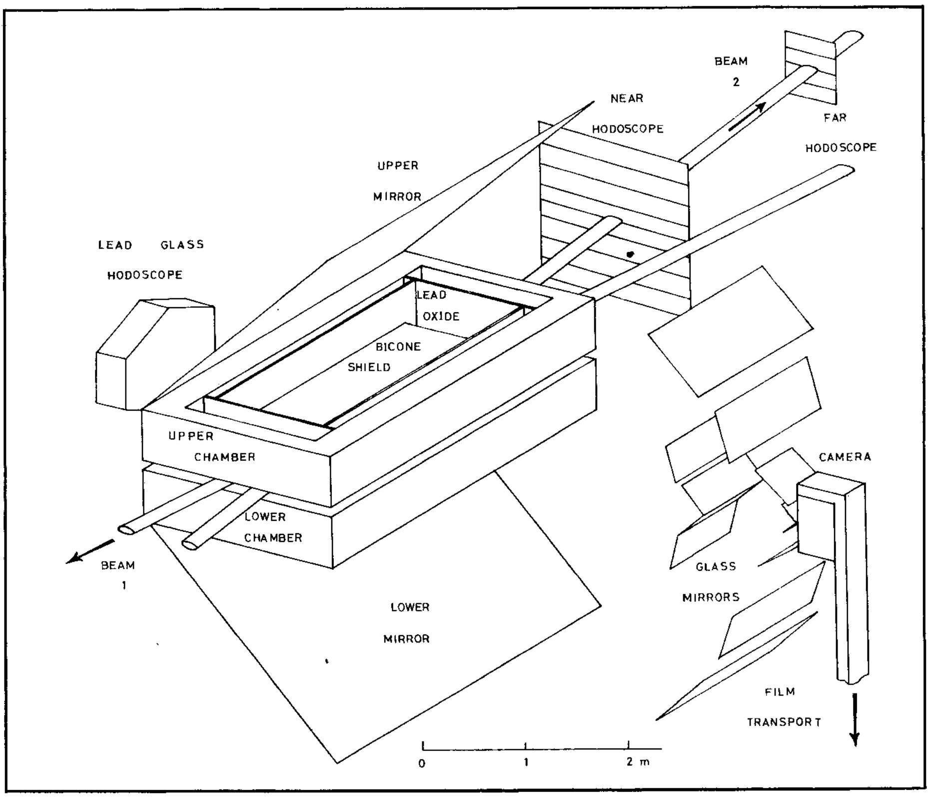
Streamer chambers are visual detectors photographing the streamers produced in the wake of charged particles. The streamers are produced by applying high voltage pulses across the chamber volume shortly after the particles have passed. This initiates sparks where ionization has been caused but the pulses are kept very short so that the sparks do not develop but are photographed as a series of tiny streamers along the tracks. Compared with the more common visual detector, the bubble chamber, it has the advantage that the high voltage pulse need only be applied when other detectors (counters) have indicated that the type of event which is of interest in a particular experiment has occurred. This pre-selection ensures that most of the photographs record the sort of information which is required.

The installation of the streamer chamber at the ISR aims to catch a high proportion of the particles emerging from the high energy collisions. It was built by the Max Planck Institute Munich. Strictly speaking there are two identical streamer chambers one above and one below the plane of the intersecting beams. They cover 95 % of the solid angle around the beam intersection position and each has a sensitive volume of $270 \times 125 \times 50$ cm^3.

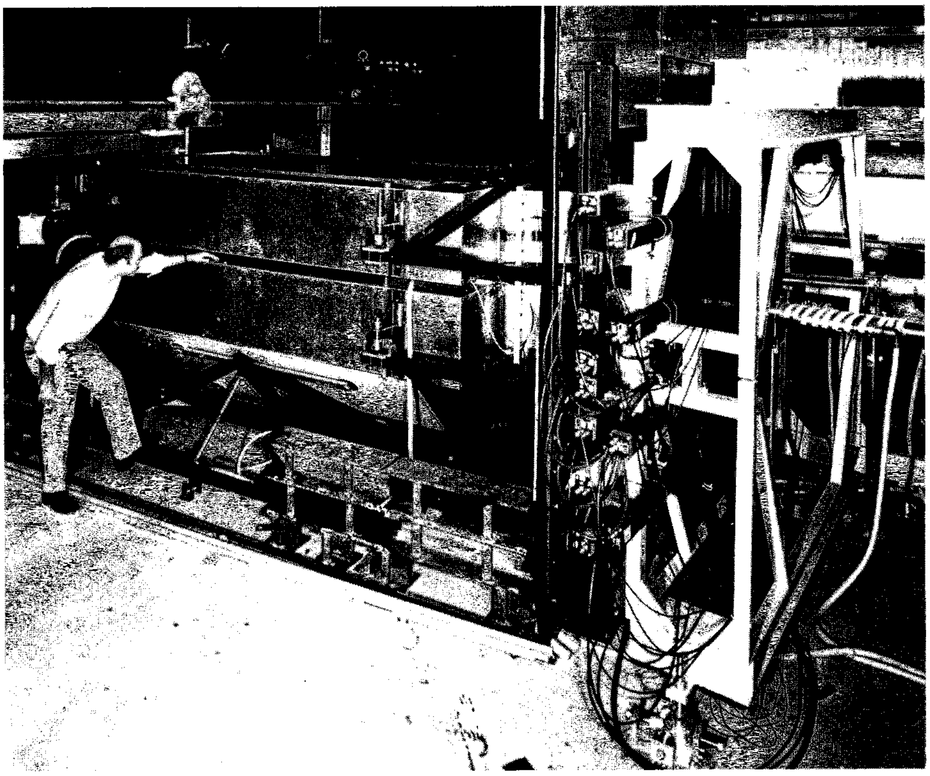
There are three parallel electrodes in each chamber, the top and bottom ones being earthed and the central one receiving the high voltage pulses which initiate the streamers. Close to the vertical walls of the chamber, lead oxide plates are inserted so as to 'materialize' the gamma rays which come from neutral pion decays. Thus the streamer chambers can also spot neutral particles emerging from the collisions. The top of the upper-chamber and the floor of the lower chamber are windows through which a camera system looks via two 45° mirrors.

When the chambers were first operated there were problems of picture quality. Very high voltage was needed on the central electrodes in order to see the tracks of particles which were travelling almost at right angles to the electric field (the density of the streamers along a track is then quite thin). On the other hand particles travelling nearly parallel to the field (out in the direction that the camera is looking) have a high streamer density. They were a source of flares which were obscuring a lot of the useful information in the photographs. Oper-

Schematic diagram of the streamer chamber showing the separation into two distinct units above and below the ISR beam-pipes, the internal lead oxide box for the identification of gammas, the mirror system for bringing all the information onto one film, and the triggering hodoscopes.



The streamer chamber in the flesh at intersection I-7 of the ISR. The two units are in place above and below the beam level and the lower 45° mirror is suspended at the bottom. On the right is a triggering hodoscope.



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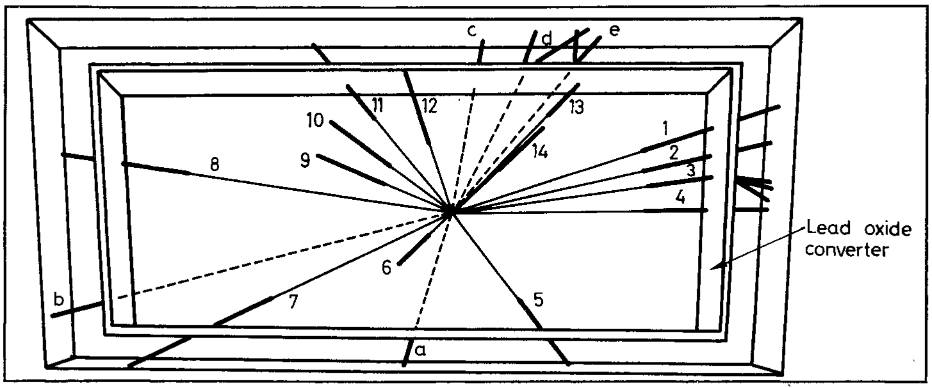
Photograph taken in the streamer chamber. It records a proton-proton collision producing fourteen charged particles (annotated 1 to 14 in the diagram of the event given below), which recorded as streamers in the main body of the chamber, and at least five neutral particles (annotated a to e) which materialized due to the presence of the lead oxide converter.



ating with very high voltage led to breakdowns both within the chamber and in the pulse supply system.

Image intensifiers were added and they made it possible to see the 'thin' tracks while operating at lower voltage. In addition a new type of film with a non-reflecting emulsion reduced the problem of the flares. Picture quality is now very good and conditions for reliable operation can be set up without difficulty.

The streamer chambers are being used for two experiments. The first is a study of multiplicities and correlations, counting the numbers of both charged and neutral particles and measuring their angles. The interest in this sort of information was described in the last issue — it has, for example, conveyed a clear picture of the collisions as resulting in the 'fragmentation' of one or other proton or in the disintegration of both protons in a 'central region' collision when particles fly off in all directions.

Counter detection systems, such as that set up around intersection I-8 by the Pisa/Stony Brook team, have given a first look at these phenomena. The streamer chamber photographs will continue the same job but with much greater ability to distinguish true events from background events and much better spatial resolution. Later, the Split Field Magnet system, with its multiwire proportional chambers and its magnetic fields for momentum measurements, will be able to carry these multiplicity and correlation studies even further.

The high voltage pulse is applied in the streamer chambers and a picture taken when hodoscopes (of dimensions 3×1.5 m^2 located around the downstream vacuum pipes) record particles emerging from a collision. These hodoscopes 'see' 95 % of the particles emerging from the inelastic collisions. (Elastic collisions which often deviate the protons very little from their initial paths are efficiently detected only by getting in very close to the circulating beams.) For this experiment, data can be taken just as fast as the chambers can recover from the previous trigger and pictures are taken at the rate of one every two seconds.

The second experiment looks at particles emerging with high transverse momentum. The high rate at which such particles are produced has been one of the surprises coming from work at the ISR and has indicated some substructure in the proton — possibly point-like objects given the name of partons. The parton idea suggests that when such a high transverse momentum particle is produced it will be accompanied by a spray, or jet, of other particles in the same direction and on the opposite side.

The streamer chamber is a good instrument for seeing these jets. This time the high voltage pulse is triggered by the detection of a high momentum (over 2.5 GeV/c) gamma ray emerging at near right angles to the beam directions. The gamma is detected in the lead glass Cherenkov hodoscope previously used by the Aachen/CERN/Torino collaboration. They are comparatively rare events and are photographed at the rate of about one every ten seconds as they occur. The resulting pictures should record the jets coming off in both directions, if they exist, and provide much more information on these phenomena than was ever possible before.

The film is being measured and analysed at the four laboratories participating in the experiments — Aachen, CERN, Heidelberg and the Max Planck Institute at Munich. They are likely to continue taking data throughout most of 1974.

Responding to the energy problems

The energy problems which have arisen in recent months have obviously had their effects at CERN also and a number of short and medium-term measures have been taken. The immediate application of these measures has given satisfactory results, their effects varying according to the field involved: heating, the operation of motor-generator sets, the use of electricity and fuel consumption.

In 1973, the heating and air-conditioning installations at Laboratory I consumed some 10 000 tons of heavy fuel oil. The measures taken affect only the heating of the offices, laboratories, halls and workshops where the ambient temperature has been reduced from 22 to 20 °C during the day and to about 15 °C at night and on public holidays. The saving has been of the order of 10 to 15 %.

A working group has been set up to look into the possibilities of recovering heat from the cooling water used for the large machines. The temperature of this water is not very high (around 40 °C on an average) and the installation of heat pumps would require considerable investment. Nevertheless the possibilities are being studied.

Light oil is used for operating the motor-generator sets which produce emergency power. The quantity of this type of oil used at CERN in 1973 was 5000 tons for three diesel sets, with a total installed power of about 7 MVA. The sets supply power to the installations where safety is a major criterion (large bubble chambers, cryogenic magnets, vacuum systems, etc.). It will be possible to make a saving of 25 % by modifying the safety network. Since mid-February, for equipment allowing the possibility of a cut-off of the order of a few seconds, an emergency network is in operation.

Consumption of electric power in 1973 was 220 million kWh. Steps have already been taken to reduce the lighting on roads and car parks and several hundred lamps have been removed from corridors, etc. New regulations have been drawn up with the aim of reducing the power consumption of the large physics installations to the minimum outside periods of operation.

At the PS, for example, during machine stops or breakdowns of longer than two hours, current from power supplies to all beam transport magnets and other large magnets will be cut to 50 A or less. During longer stops (12 hours or more) all these power supplies will be switched off. In general beam equipment will not be powered until it is actually required.

CERN uses a total of 350 official vehicles: cars, mini-buses, lorries, forklift trucks, ATV's (all-terrain vehicles), cranes, etc. The fuel economy plan, by which it is hoped to save some 20 % of petrol, is being successfully implemented.

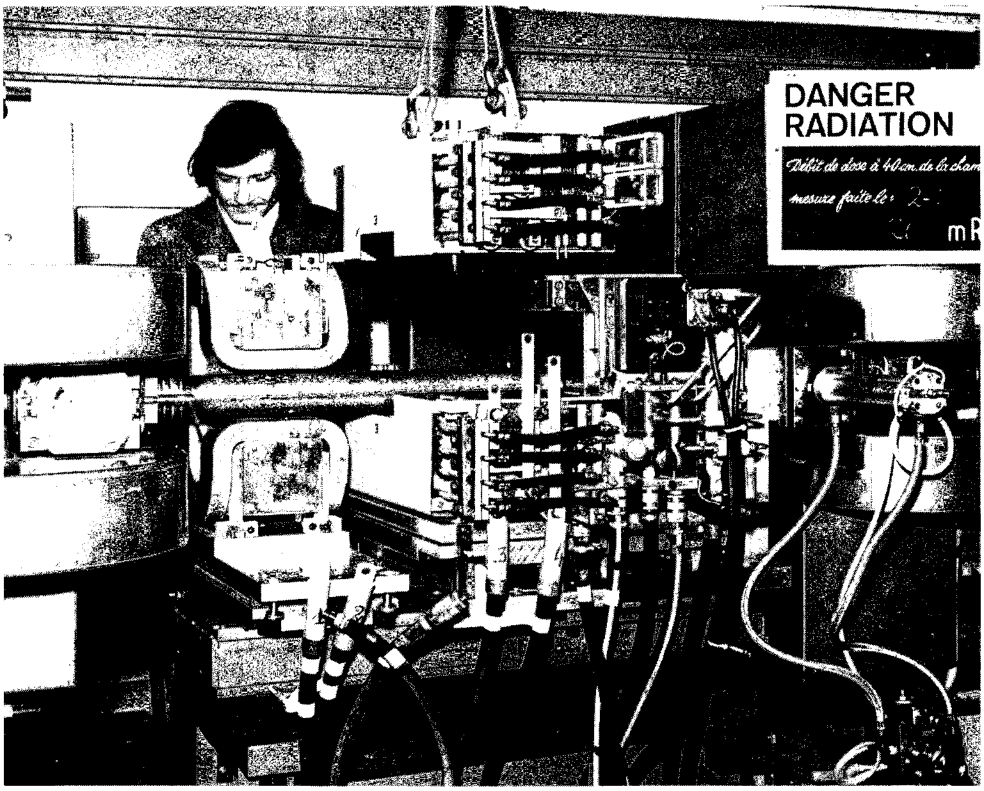
At present, CERN's fuel reserves are relatively limited. Storage capacity for heavy oil is 2250 m^3 which represents, in Winter, a reserve of less than three weeks. A project for the installation of two additional heavy fuel oil tanks is being examined. The most worrying question is not that of the reliability of supplies but that of the cost of the different types of fuel. This justifies the continued application of these emergency economy measures which were taken at the end of last year.

Magnets galore

Another unsung aspect of the PS improvement programme has been the replacement of the whole system of auxiliary magnets by up-to-date versions which are compatible with the new modes of operation at higher intensities and repetition rates.

The original system was designed in the 1950's when beams hundreds of times less intense than those now attainable were envisaged. The new magnets are shorter than their predecessors which were being squeezed out of the machine by the growing space demands of the injection and ejection systems. They can produce a stronger effect on the beam and withstand high radiation levels. Installation and removal of the new elements is much easier and does not involve opening the machine vacuum chamber.

The new auxiliary magnet system now consists of 33 dipoles, 93 quadrupoles, 16 sextupoles and 8 octupoles. In one year's time 12 dipoles, 8 quadrupoles and 16 sextupoles will be added in order to cope with the high



A whole new series of correction magnets has been installed at the proton synchrotron. They are more powerful than their predecessors and more resistant to radiation. As seen in the photograph they can be maintained without opening the machine vacuum system.

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intensity beam and the continuous transfer ejection towards the SPS.

Outside the PS tunnel, a similarly growing number of new static power supplies has replaced the original rotating amplifiers. Their output pulses are faster, stronger and more precise. Adequate computer control will be introduced in the coming years in line with the trend towards more flexible programming of the PS. Also behind the scenes, the maintenance of this widely spread system has to be organized to ensure that breakdown time is below 0.1 %.

ERASME

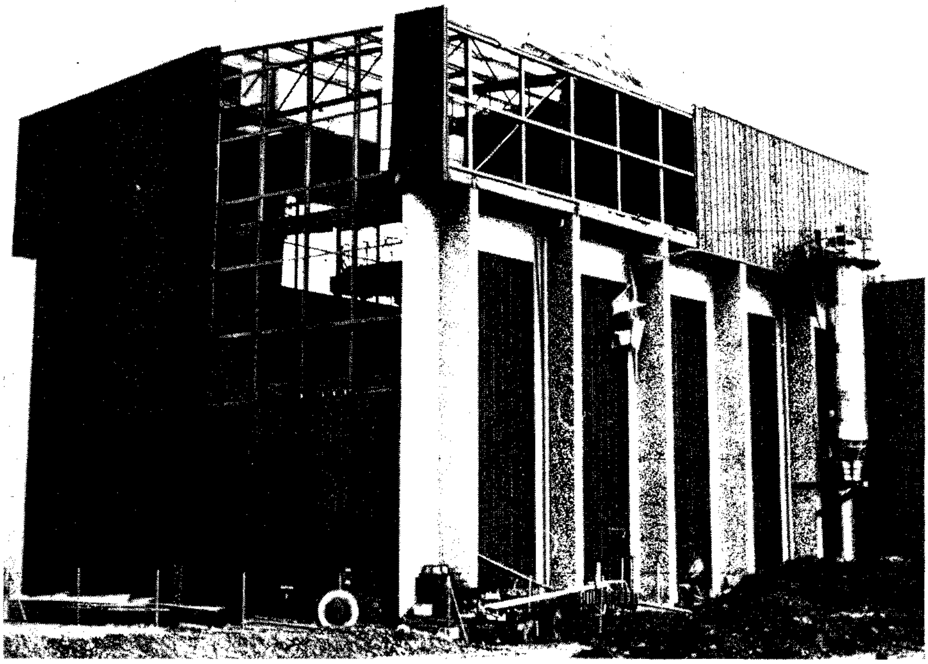
ERASME is an instrument developed at CERN for the analysis of film from the 3.7 m bubble chamber, BEBC. It is planned to build five ERASME units in all. The novel feature of the system is that it can perform the full sequence of operations (scanning and measurement) which in other systems have been carried out as several separate steps. In view of the difficult design problems and poor efficiency of a fully automated instrument, preference has been given to a broad application of the philosophy of operator intervention in both the scanning and measurement stages.

The operators of ERASME units will be able to search for interesting events (scan the film) using optical projection facilities and then to request the measurement of these events by means of precision CRT digitizers incorporated in the units. Each unit will also contain two displays whereby the operator can correct or aid the measuring process and the subsequent analysis of the resultant data.

ERASME requires an extensive and highly versatile computer system. The focal point of the complex is a PDP-10 computer with a store which has just

On 5 February, Mr. Lennart Sandgren, Sweden's Under Secretary of State for Education, visited CERN's Laboratories. He is photographed here (second from the left) at the bottom of Pit No. 2 while taking a look at the SPS tunnel.

CERN 82.2.74



Because of the potential explosive dangers of large volumes of hydrogen, bubble chamber buildings are of specially light construction. The fierce winds of 6 February (gusting up to 130 km/h) took advantage of this and stripped away large sections of the building housing the 3.7 m European bubble chamber, BEBC. Fortunately, apart from the building, very little damage was caused.

CERN 127.2.74

been increased by 64 K words to 160 K words of 36-bit core. The computer is also equipped with 15 M words of disk store. Each scanning and measuring unit has its own PDP-11 computer, with 8 K words of 16-bit memory, linked to the PDP-10 by an interface.

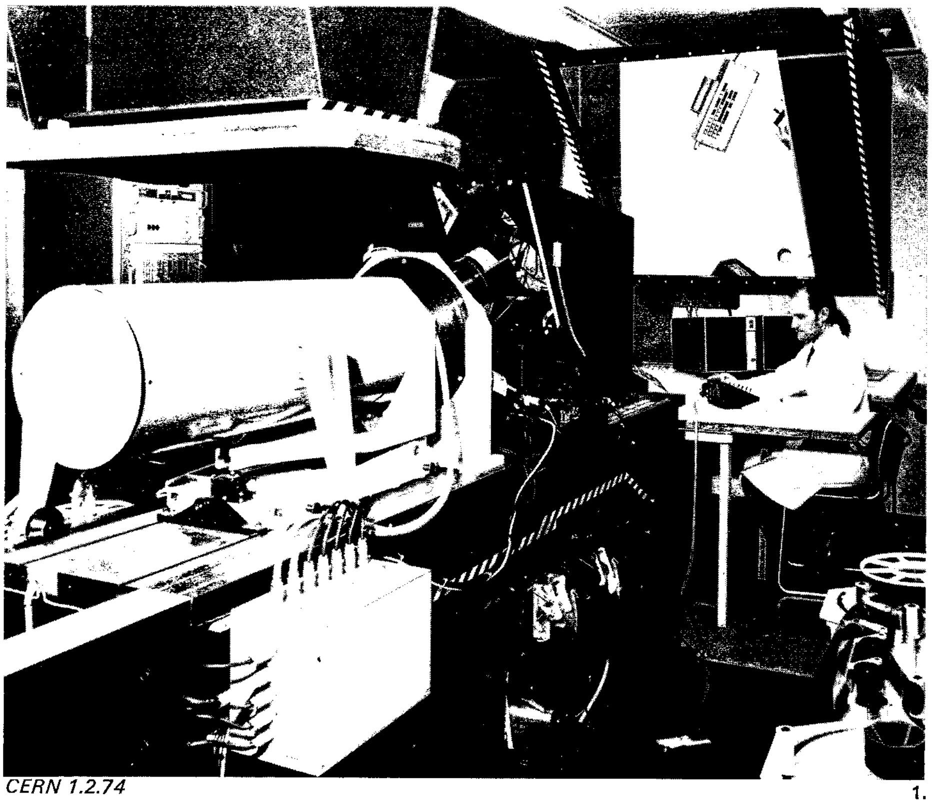
Of the five units planned, two are now running. The first came into operation in the autumn of 1972. Since no 70 mm film was available from BEBC at that time (the chamber was not yet in operation) it was modified to take the 50 mm film from the 2 m chamber. It was thus possible to test the quality of the instrument and perfect the necessary programs. At present the on-line geometric reconstruction of events is being incorporated into the system. These tests are now drawing to a close and the unit has measured about 10 000 events with excellent results compared with other machines.

The second unit, which was completed last summer, has been analyzing the first pictures from BEBC and becoming acquainted with the peculiarities of this chamber: fish eye optics and low contrast track images against a dark background. Moreover, although the contrast of the tracks against the background remains the same, the background itself is not uniform in any one exposure. To offset this, the photomultiplier's gain is controlled automatically, and the discrimination threshold is adjusted via the PDP-11 as a function of the area scanned by the CRT light spot.

The third unit will be ready at the end of March. It was to have been finished by the end of 1973 but the cathode ray tube proved defective and had to be replaced. Some alterations have been made to this unit, compared with the first two units, in order that it can analyze BEBC film and also film from the 2 m chamber. Similar alterations will be made to the next two units, and all three will then be able to

1. One of the ERASME units for scanning and measuring film from BEBC. In the foreground is the film transport system and the high precision cathode ray tube. The operator sits at a projection table with display screens on his right and controls on his left. In the photograph, the control panel can be seen reflected in the overhead mirror.

2. The PDP-10 computer which will be used by all five of the ERASME scanning and measuring units.



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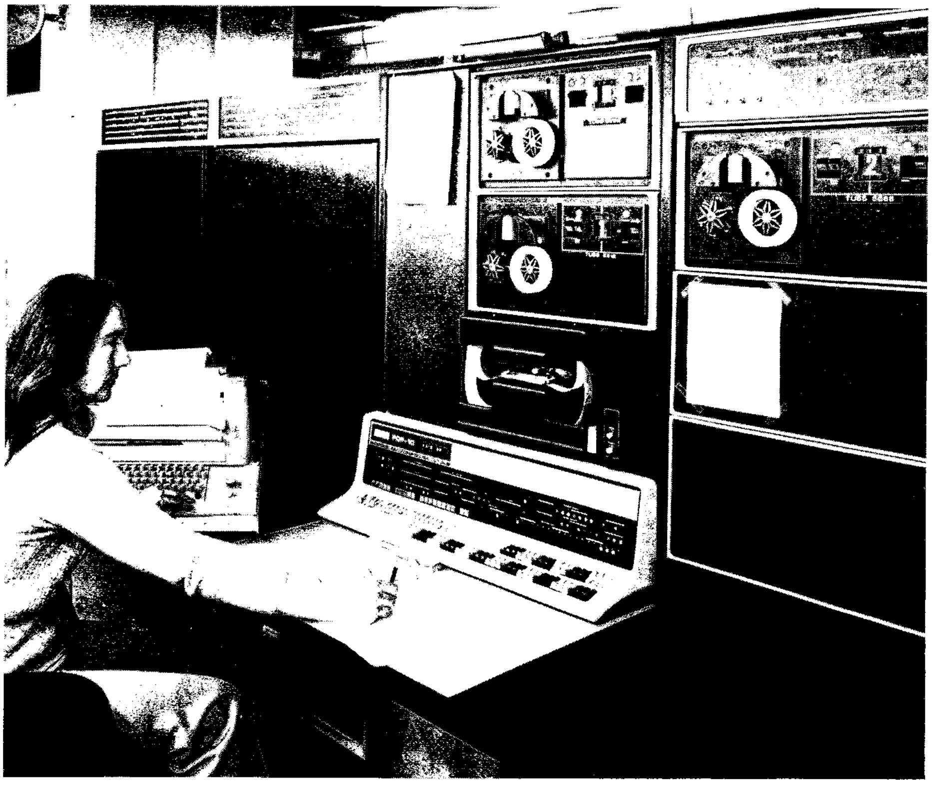

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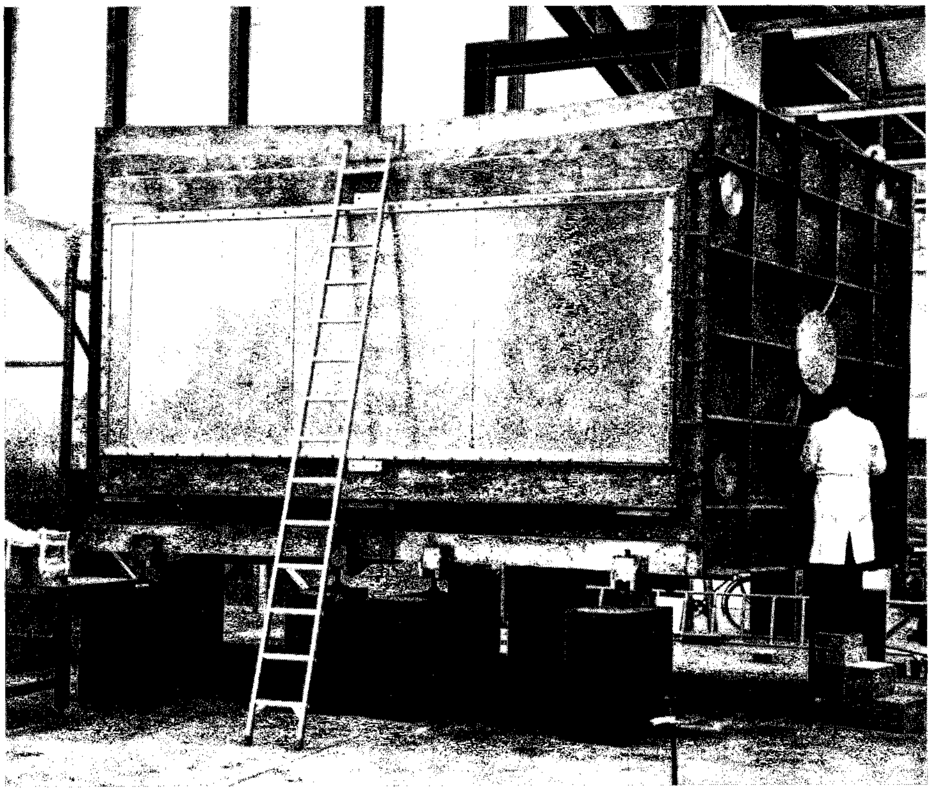


Returned from Saclay, the 50 m^3 Cherenkov counter now doubled in size for use with the Omega spectrometer. The counter stands 3.5 m high; its maximum width is 6.7 m and maximum depth 3.9 m.

switch quickly from one type of film to the other. The fourth unit is now being assembled and will be ready this summer: the fifth and last unit is due to be commissioned at the end of the year.

The ERASME system has been well tested and is ready to analyze the film which will come from BEBC.

Omega Cherenkov counter doubled

For its future experiments, the Omega spectrometer will be fitted with a Cherenkov counter of twice the volume it has had up to now. The new Cherenkov will cover the whole of the horizontal aperture of the magnet.

The Cherenkov counter, which was installed in 1972, effectively covered half the magnet aperture. It had a volume of 25 m^3 and was built at Saclay. Saclay teams participated in the first experiments using Omega plus the counter — a study of baryon exchange (in collaboration with CERN, ETH, Freiburg and Karlsruhe) and a study of baryon-antibaryon production (in collaboration with Glasgow).

This counter was used with Omega up to the last minute before the PS shutdown in the middle of December and was then uprooted in a single day and returned to Paris. Saclay financed and built the additional Cherenkov counter section and the completed counter was returned to CERN on 7 February.

A symmetrical section has been welded to the existing counter thus doubling its volume to 50 m^3. It weighs about ten tons. The area of the mirrors has been doubled and there are thirty-two photomultipliers (in two rows of sixteen). While this modification was being made, the gas pressure regulating system was improved. Filled with isobutane at atmospheric pressure, the counter had proved very sensitive to external pressure and temperature fluctuations.

A team from Saclay is reinstalling the counter at Omega and it will be ready for operation again by the beginning of March. The physicists will then be able to carry out experiments giving fuller results since the counter now covers the whole of the solid angle available downstream of the magnet.

Around the Laboratories

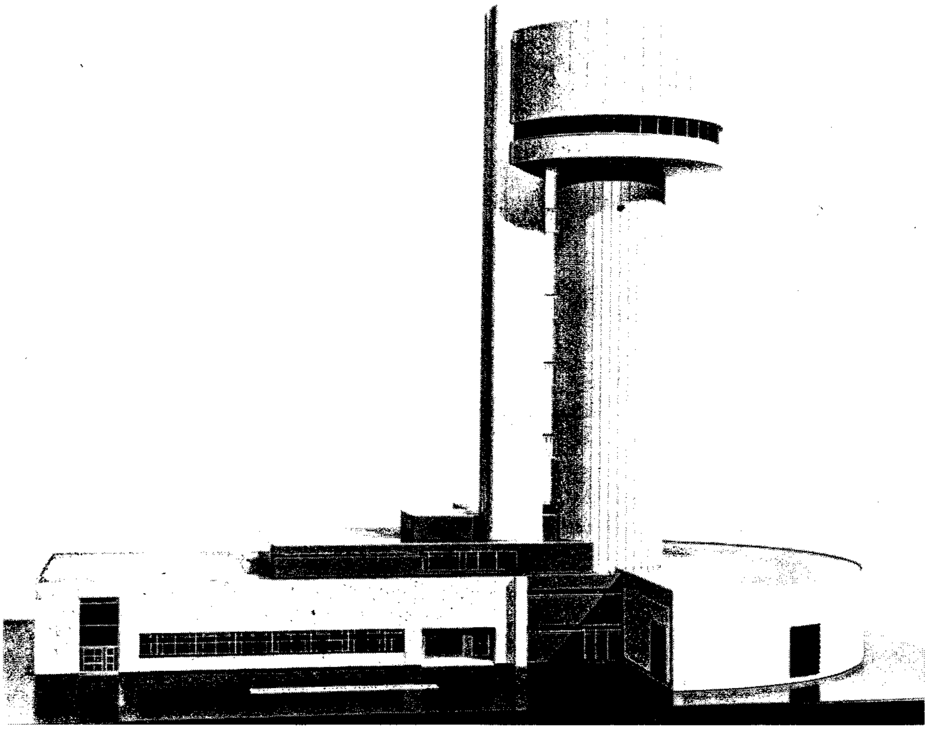
DARESBURY
NSF go ahead

Authorisation has been received for the construction of a 'Nuclear Structure Facility' at the Daresbury Laboratory. The NSF has been under study at the Laboratory and at other interested research centres and Universities in the UK for several years. It will be a tandem Van de Graaff capable of sustaining 30 MV on its central terminal, making in the highest energy machine of its type in the world.

The accelerator was described in vol. 13, page 150. It will be mounted vertically with an ion source platform at the top capable of supplying many varieties of ion. The steel pressure vessel will stand 43 m high and be 9 m in diameter containing 110 tons of insulating gas (sulphur hexafluoride). Among the novel aspects of the design are a new type of charging system, known as the Laddertron, which is capable of carrying high currents in stable and clean conditions, and a light link operating at 10 MHz which can convey signals from earth potential to apparatus at the high voltage terminal without voltage insulation problems.

The pressure vessel will be housed in a building 70 m high and it was this tower which required a special investigation by the Department of the Environment, delaying the project for many months until authorisation at the beginning of this year. An experimental area fans out at the base of the tower and there is space for the addition of a linear accelerator or a cyclotron, if the physics programme should call for this at a later date.

About eighty physicists from the UK Universities are expected to be attracted by the refined studies of nuclear properties which the Nuclear Structure Facility will make possible and the participation of physicists from elsewhere in Europe will also be encouraged. The first contracts are now being placed and major building work should begin in the Spring. Construction and commissioning are expected to take four and a half years.



A model of the nuclear structure facility to be built at the Daresbury Laboratory. The tower, 70 m high, will house a tandem Van de Graaff with up to 30 MV on its central terminal. Accelerated ions will be deflected to experiments in the semi-circular building at the foot of the tower.

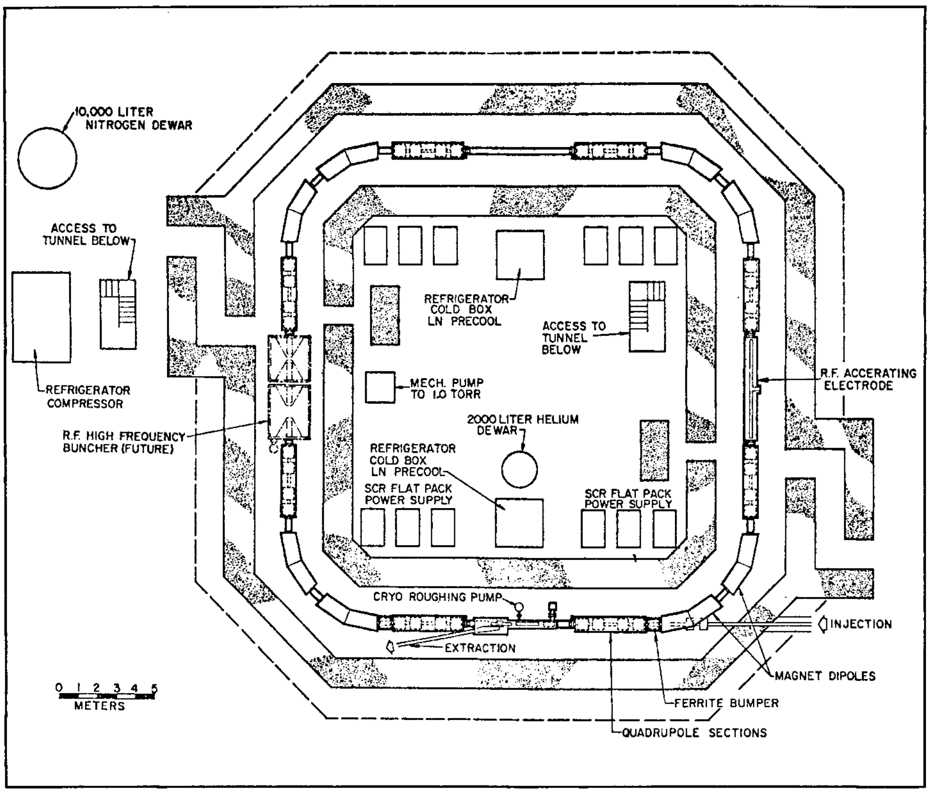
(Photo Daresbury)

BERKELEY Mini superconducting synchrotron project

The construction of a small superconducting synchrotron has been proposed at the Lawrence Berkeley Laboratory. In its early days, it was known as the 'Mini' project; more recently it has acquired the less diminishing name of ESCAR for Experimental SuperConducting Accelerator Ring. The aim of the exercise is to check out the use of superconducting magnets in a true accelerator environment so as to go into the large superconducting accelerator/storage ring complexes, which are now under discussion, with more information, more experience and more confidence.

The design also aims to make it possible to store high intensity beams, since this is another important parameter of the large complexes, and incorporates provision for studying machine performance in great detail. Although the accelerator has been conceived wholely and entirely to answer these important questions of machine physics, the community who use accelerated particles are known to be occasionally scratching their heads about possible uses of ESCAR. The very high vacuum, for example, could help preserve highly ionized heavy ions which will be around in connection with the Bevalac project. Such ions need a higher vacuum than in conventional accelerators.

ESCAR would be fed with protons by the 50 MeV linac (late of Brookhaven) and would be located at the



Layout of the 4 GeV superconducting synchrotron, ESCAR, which may be built at Berkeley. The ring has a radius of about 14 m. The injection point from the 50 MeV linac is at the bottom right of the diagram.

1. *Installation of Wideroe tank number 4 for the heavy ion accelerator being built at Darmstadt.*
2. *Assembly of the drift tubes in a Wideroe tank.*

Late news: It was announced on 11 February that ESCAR (now listed as a 5 GeV machine) has been approved in President Nixon's AEC budget for fiscal year 1975.

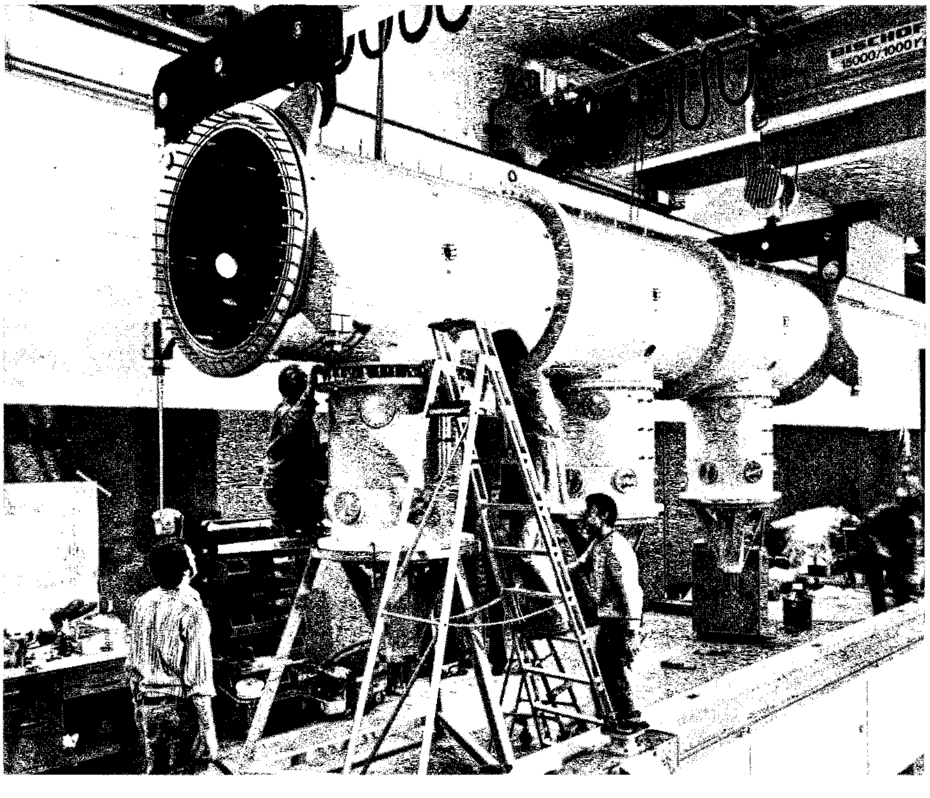
back end of the Bevatron experimental hall (thus avoiding the costs of new buildings and the provision of power and water supplies) close to where the linac has been installed. The accelerator would have superconducting bending magnets to give a peak field of 4.5 T distributed in a ring of 14 m radius with four 6 m long straight sections — one for injection, one for the r.f. accelerating cavities and two for equipment for machine experiments. This layout can give a peak energy of just over 4 GeV.

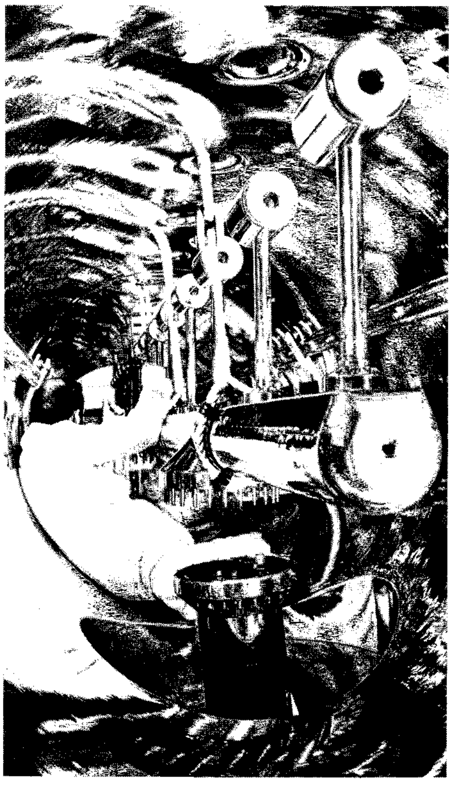
The magnets are 'separated function' with sets of quadrupoles (field gradients up to 20 T/m) to provide the necessary focusing. Transition energy is set above 4 GeV to avoid introducing additional complications especially with a high intensity beam — it is hoped to accelerate 5×10^{12} protons using injection and stacking over twelve turns. Another problem of having a high intensity beam in an experimental accelerator is what to do with it when it has lived through its pulse cycle to full energy. To avoid building up high radioactivity in the machine components during normal operation, the beam would be decelerated and dumped at a low energy (below 150 MeV). The pulse rate is set at about six per minute with a field rise time of 5 s or lower.

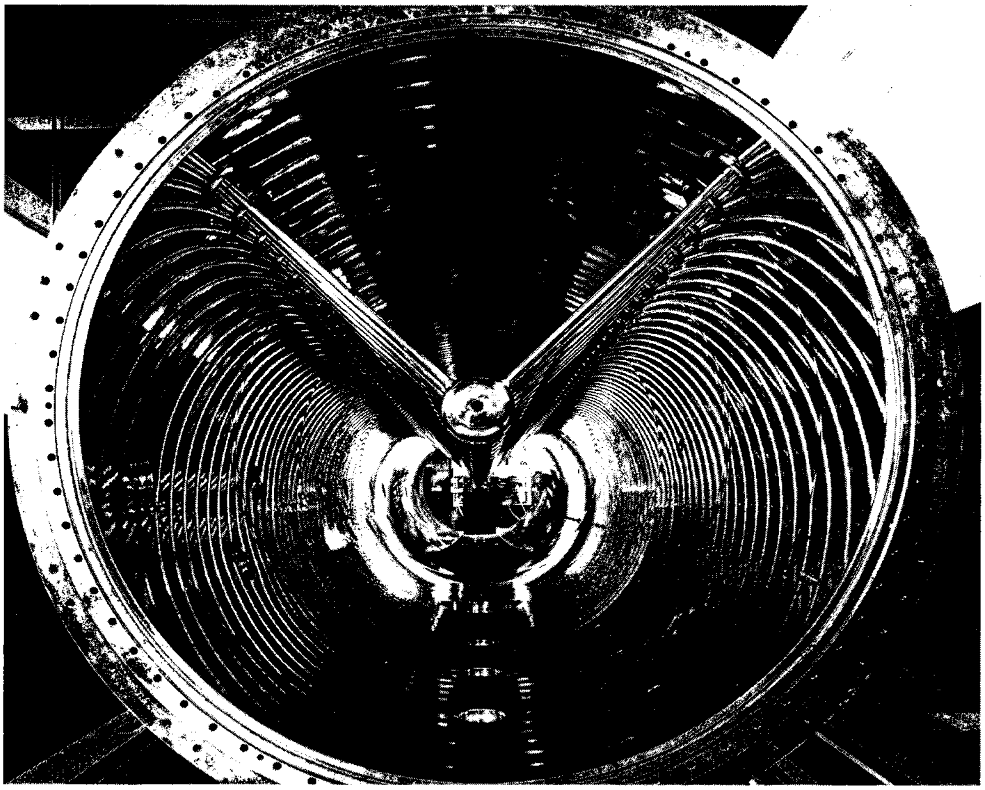
The bending magnets would be installed in pairs in cryostats 3.2 m long, each pair giving a 45° bend. Sets of quadrupoles (four in each 2 m long cryostat) would then flank two bending magnet cryostats. The straight sections would also be maintained at superconducting temperature requiring a refrigeration system of something like two 1 kW helium refrigerators. This would give excellent conditions for cryo-pumping around the whole ring with the possibility of a vacuum of the order of 10^{-11} torr.

To attempt to build the world's first superconducting synchrotron is a bold step but one which needs to be faced if the promise of superconductivity is ever to be realized. Also, it would certainly not be the first time that Berkeley has been pioneering. European Laboratories, which had a head start in developing superconducting magnets appropriate for use in a synchrotron, still seem a long way from confronting a comparable project even of mini size.

It is estimated that, by making use of many of the existing facilities at the Bevatron, the cost of building ESCAR can be held to about $ 5 million. Money has been requested from the AEC so that a start could be made this year. First operation could then be in 1976. Because of the importance of spreading widely the knowledge which would emerge from such a pilot superconducting accelerator, the AEC has set up an advisory board for ESCAR with representatives from all







Beautiful photograph taken inside the first Alvarez-type tank which follows the Wideroe structure. The two stems holding each drift tube are reflected in the polished copper walls of the tank. The beam will, of course, pass through the central hole in the drift tubes.

(Photos GSI, Darmstadt)

the major high energy physics Laboratories in the USA. This is a sign that the project is being taken very seriously.

DARMSTADT UNILAC progress

The first units have been installed for the heavy ion accelerator, UNILAC, at the Gesellschaft für Schwerionenforschung, GSI, Darmstadt. Major features of the accelerator were described in vol. 13, page 190. It is meant to be a verstatile source of heavy ions capable of accelerating beams of high intensity. With intial aims of accelerating ions up to xenon with intensities around 10^{11} per second and energies in the range 3.6 to 5.9 MeV per a.m.u., the machine is scheduled to come into operation at the end of this year. When further improvements are made, such as the addition of more r.f. power, it is hoped to reach energies up to 10.2 MeV per a.m.u. and intensities up to 10^{14} ions per second for mass number 70 and 2×10^{12} for mass number 238.

The linear accelerator has a series of tanks using different acceleration techniques. There are four with a Wideroe structure; their final assembly has been delayed by vacuum problems with the outer drift tubes. These have been cured and the drift tubes should reach Darmstadt in the next few weeks after which r.f. tests can start as soon as the drift tubes are in place.

A r.f. power supply giving 520 kW peak and 130 kW average output is ready to feed Wideroe tank No.4. It has already been tested successfully in a 32 hour run with 50 kW into a matched load and the performance will be increased to the desired level when the external cooling system is complete.

The second of the two Alvarez type tanks is now being installed without problems and the twenty single gap cavities which complete the acceleration system have been received. They are being prepared for copper plating.

Two injectors are planned for the machine. One is installed and has provided its first beams; the other is almost ready. Using a duoplasmatron ion source, a beam of krypton ions (Kr^{2+} and Kr^{3+}) with an intensity of 200 μA at 260 kV has been extracted from the completed injector.

With this first sight of heavy ions as a stimulus, more attention is turning to the experimental facilities. The beam transport systems have been designed and the ordering of components has started.

KARLSRUHE Superconducting r.f. separator on its way

In collaboration with CERN, Karlsruhe have been working on superconducting separators for several years. The aim is to provide a separator for the high energy beam-line to the Omega spectrometer when the SPS sends 200 GeV protons to the West Hall in 1976. The separator will then separate pions up to a momentum of 40 GeV/c and kaons of 20 GeV/c with an intensity of 10^6 kaons for every 3×10^{11} protons on the target.

The separator will have two deflectors — 2.7 m long, each consisting of five niobium sections. The separator will operate at 2855 MHz (S-band) to give a deflecting field of 2 MV/m with a peak magnetic field of about 310 gauss and a quality factor Q of at least 5×10^8.

We reported encouraging results on a first section of 20 cells in the May issue of last year (page 152). These tests have continued and a second 20 cell section has been completed. The first section, after being held for a month at room temperature under vacuum, has achieved a Q of 1.8×10^9 corresponding to a magnetic field of 400 gauss and a deflection field of 2.6 MV/m; the second section has achieved a Q of 1.2×10^9 corresponding to a magnetic field of 370 gauss and a deflection field of 2.4 MV/m. They are thus both well above the required performance. An inter-section joint was also tested and worked better than expected and in a completely reproducible way.

All five sections of the first deflector have now been manufactured at Siemens and are having surface treatment at Karlsruhe followed by perturbation measurements and measurements at superconducting temperature. Tests on all five sections will be carried out in a 4 m cryostat already in action at Karlsruhe. Manufacture of the five sections of the second deflector began in January and they are expected to be available in the Summer.

The two cryostats for the deflectors are scheduled for completion at the end of 1974. It will then be possible to assemble the whole system at Karlsruhe during 1975 and the move to CERN is foreseen for early 1976.

RUTHERFORD
Lead cavities

As described before (see vol. 11, page 136), a different approach to superconducting r.f. cavities has been taken at the Rutherford Laboratory. The chosen superconducting material is lead rather than niobium since although the potential performance figures from niobium cavities are higher, good results from full-scale lead cavities seemed initially easier to achieve in practice.

The aim at Rutherford has been to build a separated beam for pions and kaons with a central momentum of 4 GeV/c. This requires two cavities each 1.25 m long separated by a distance of 7.5 m. Each cavity would consist of ten cells and operate at 1.3 GHz. They are designed to give a deflecting field of 2.5 MV/m which involves peak fields at the lead surface of 9.56 MV/m and a peak magnetic field of 375 gauss. The anticipated high field Q value is about 4×10^8.

The first assembled cavity was under test in 1973. There were some vacuum problems at the location of the r.f. couplers and some power losses at the junctions between the cell sections (a cavity has three sections of 3, 4 and 3 cells) but these problems were tidied up for a third series of tests at the end of the year. A vacuum of 1.5×10^{-7} torr was then sustained down to operating temperature of 1.85 K and the re-machined inter-section joints performed satisfactorily.

With low power into the cavity at 1.85 K the measured Q value was 2×10^8. However, this went down to 8.1×10^7 when the power input was raised to a few milliwatts, though it remained at this level from then on up to peak power. The required deflecting fields were obtained, reaching 2.6 MV/m after cavity conditioning. The corresponding peak fields at the lead surfaces were 10 MV/m and 380 gauss.

To complete the system a new refrigerator is required (operating at 75 W rather than 60 W as originally planned). The design of the second cavity and cryostat is complete and it is estimated that, if the decision is taken to go ahead with the project, the full separator could be ready by the end of 1974.

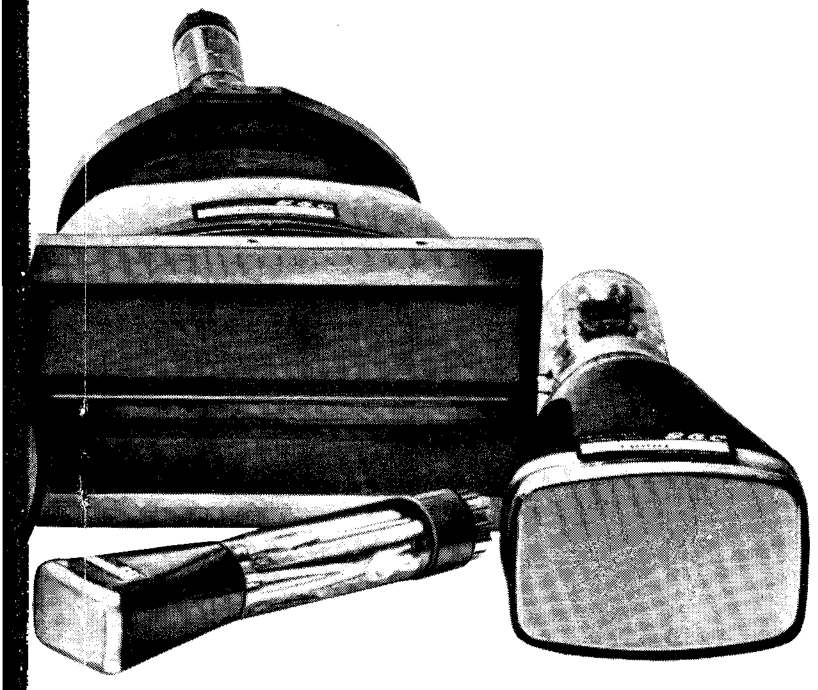
VILLIGEN

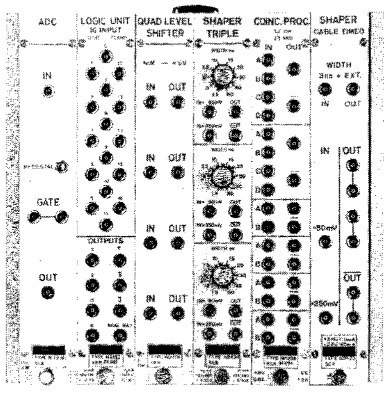
Protons accelerated in cyclotron

On 18 January the first protons of energy about 585 MeV were extracted from the ring cyclotron at the Swiss Institute for Nuclear Research, SIN. The intensity of this first emerging beam was low but only three of the four r.f. cavities were in action and it was later found that a poleface winding had come adrift.

During a second series of tests on 8 February a beam of 0.5 μA was accelerated and extracted. The extraction efficiency is not easily measured but was certainly over 80 %. Commissioning is continuing and by the end of February it is hoped to have protons producing pions at the first target station and to test the beam transport system into one of the pion experimental areas.

We hope to have fuller information on commissioning progress in the next issue.

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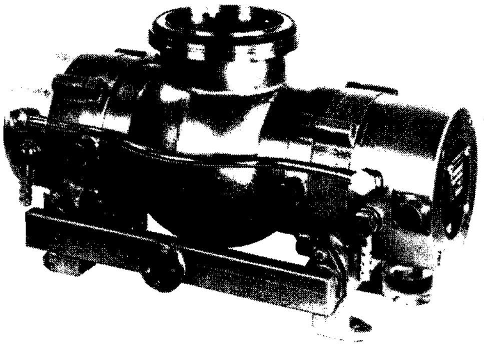

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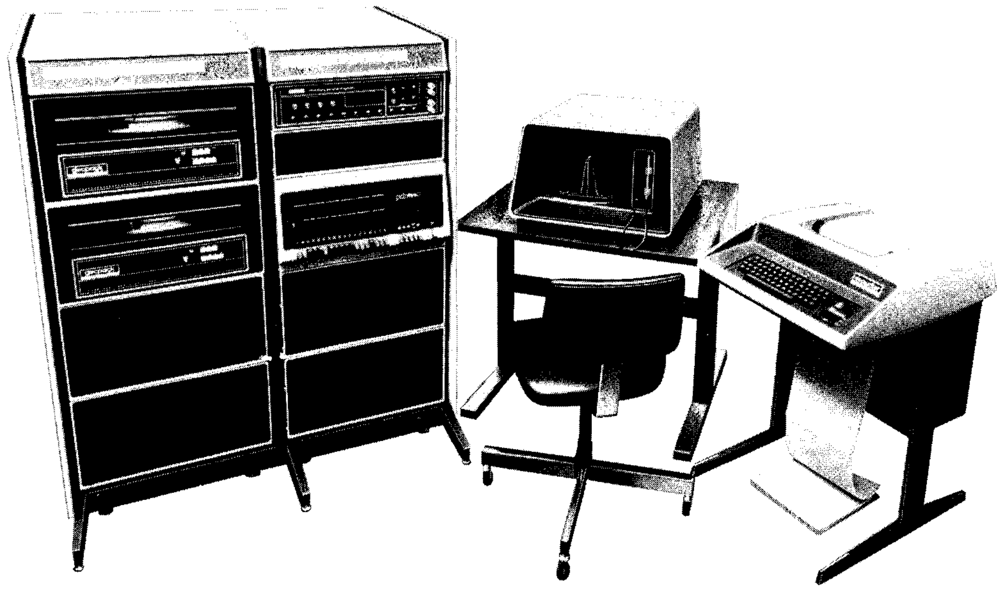

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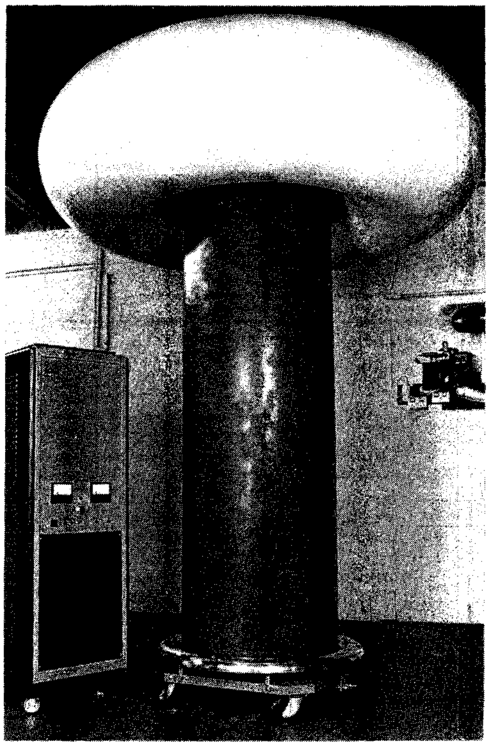
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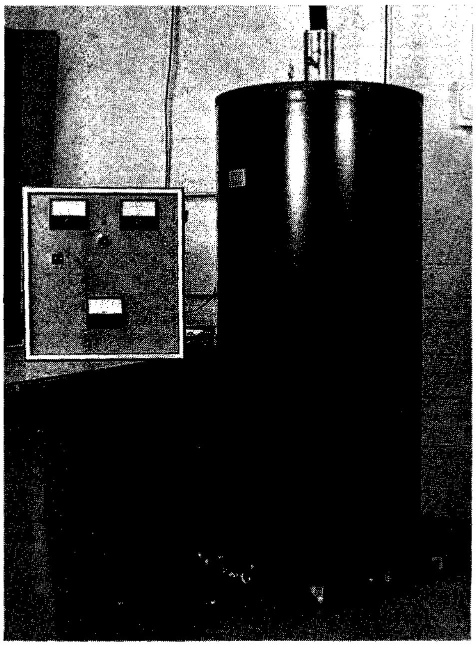
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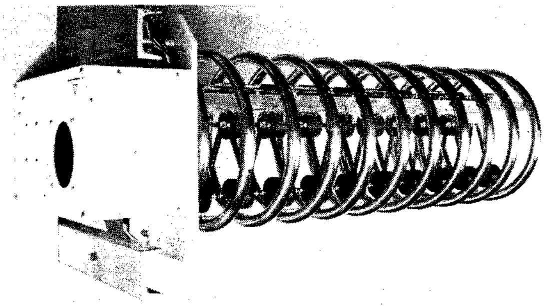
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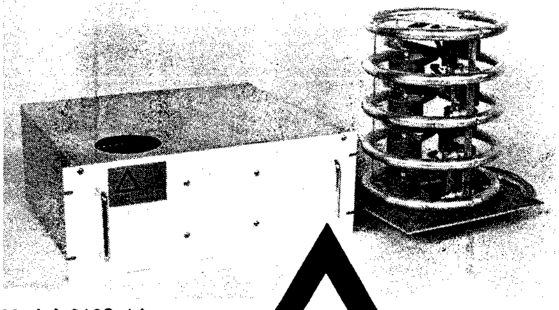
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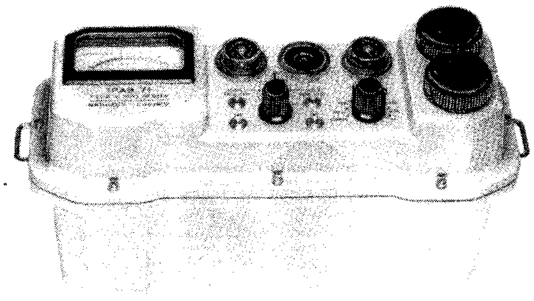

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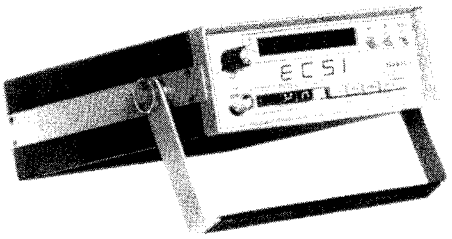
  CPA - BF3 - semi conductor detectors 0.04 pF

COUNTING



ELECTRONIC COUNTING SCALE

E.C.S. 1 Réf. E.521

Portable, self-powered, six decades

ELECTRICAL CHARACTERISTICS

- Pretime : 1 - 10 - 100 - 1000 s (accuracy 10^{-3})
- Resolution time : < 5 µs frequency > 200 KHz)
- Input pulses : positive or negative, duration ≥ 100 ns
- Threshold adjustement : 0.1 à 10 V
- Input impedance : 1000 Ω
- Working temperature range : - 10° C to + 50° C

NARDEUX

85 Bd Gabriel Péri 92240 MALAKOFF - 656-65-35 +
Usine : 37600 Loches - FRANCE

FELDMÜHLE AKTIENGESELLSCHAFT
D-731 Plochingen (Germany)
Telefon 07153-611
Telex 07266825

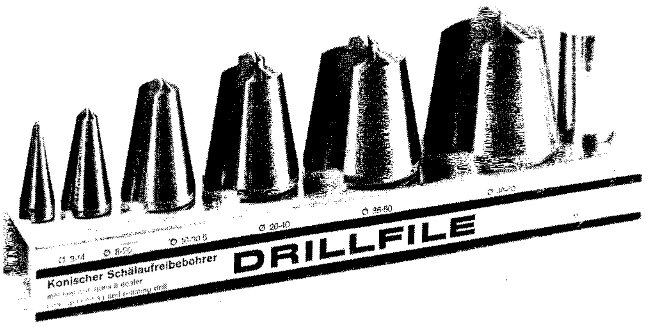
Molded parts made of sintered aluminium oxide 96 – 99,9% Al_2O_3

Aluminium Oxide Ceramics MoMn-Ni- and WNi – metalized.

Ceramic/Metal Combinations particularly Vacuum-Chambers UHV-Feedthroughs

The tapered slabbing and reaming drill is economical and very useful

DRILLFILE
special drill

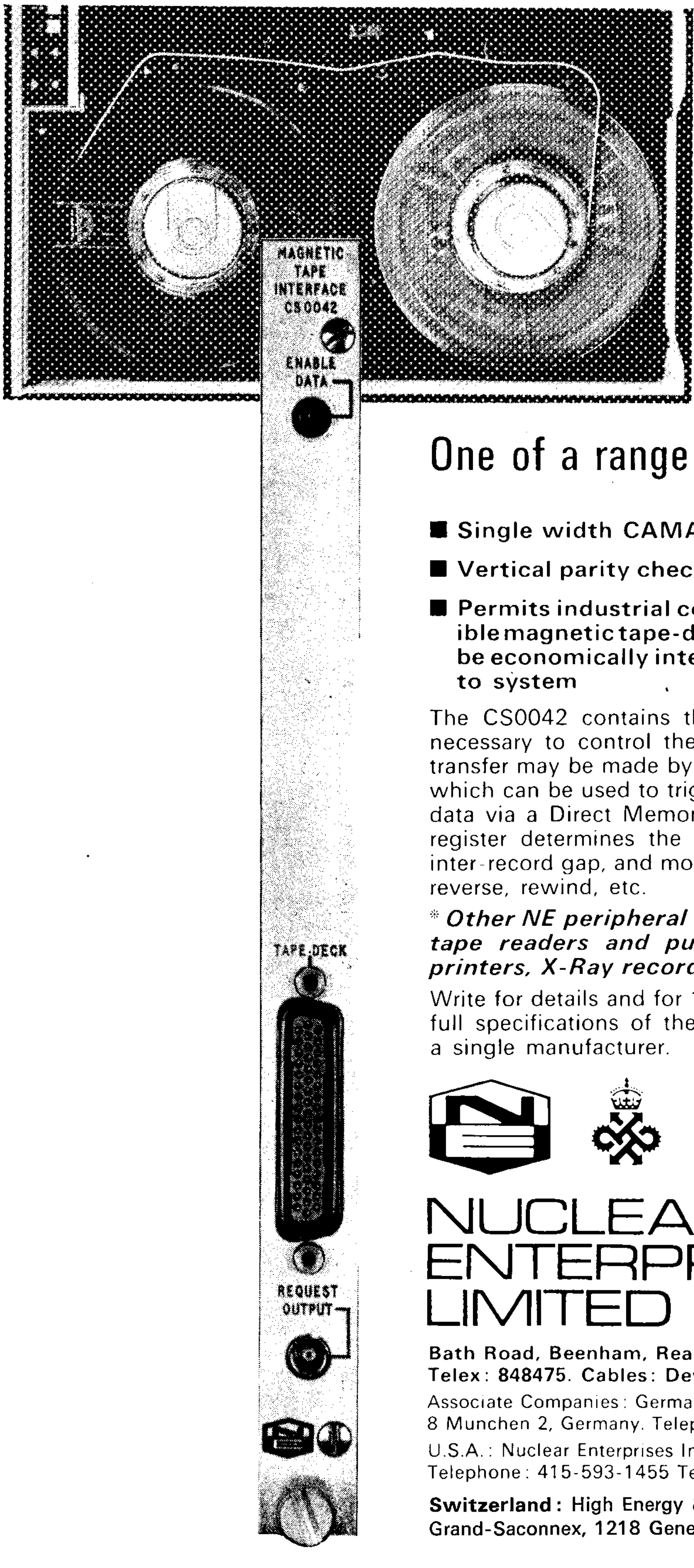


for the economical mounting of car aerials and car radios, car calling units as well as telecommunication devices **DRILLFILE** is recommended by leading firms all over the world. In its measurements **DRILLFILE** accommodates all requirements.

TIPSWITOOL
1564 DOMDIDIER/Switzerland

CAMAC

MAGNETIC TAPEDECK INTERFACE CS 0042



One of a range of NE peripheral interfaces*

- Single width CAMAC unit
- Vertical parity check
- Permits industrial compatible magnetic tape-decks to be economically interfaced to system
- Choice of formats and word lengths
- Control register permits multi-tapedeck selection
- Suitable for most popular cassette tape decks

The CS0042 contains the read, write, command and status registers necessary to control the operation of a tape deck. Demands for data transfer may be made by LAM requests or via a front panel trigger pulse which can be used to trigger an Autonomous Controller into transferring data via a Direct Memory Access channel of a computer. A command register determines the recording density, parity, normal or extended inter-record gap, and mode of operation, e.g. write, read, space, forward, reverse, rewind, etc.

* ***Other NE peripheral interfaces include units to interface paper tape readers and punches, keyboard display terminals, line printers, X-Ray recorders, etc.***

Write for details and for 125-page CAMAC Catalogue No 66 containing full specifications of the most extensive range of units available from a single manufacturer.

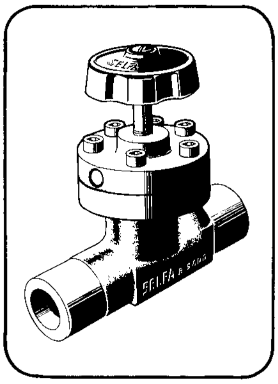
NUCLEAR ENTERPRISES LIMITED

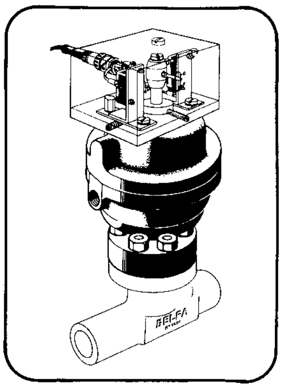
Bath Road, Beenham, Reading RG7 5PR, England. Tel: 073-521 2121.
Telex: 848475. Cables: Devisotope, Woolhampton.

Associate Companies: Germany: Nuclear Enterprises GmbH, Schwanthalerstrasse 74
8 Munchen 2, Germany. Telephone: 53-62-23 Telex: 529938

U.S.A.: Nuclear Enterprises Inc, 935 Terminal Way, San Carlos, California 94070
Telephone: 415-593-1455 Telex: 348371.

Switzerland: High Energy & Nuclear Equipment S.A., 2 Chemin de Tavernay,
Grand-Saconnex, 1218 Geneva Tel. (022) 98 25 82/3 Telex 23429


SELFA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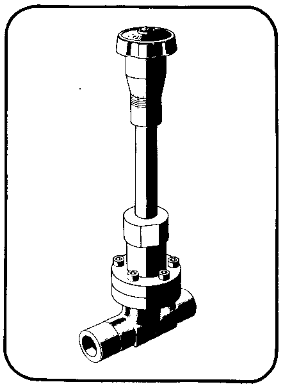
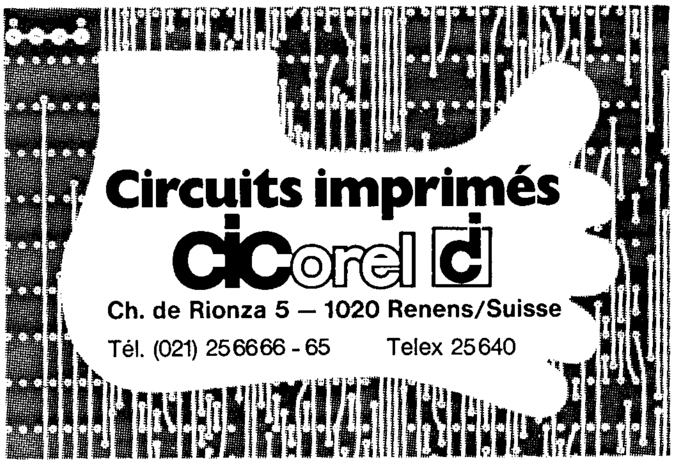
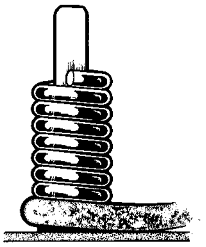
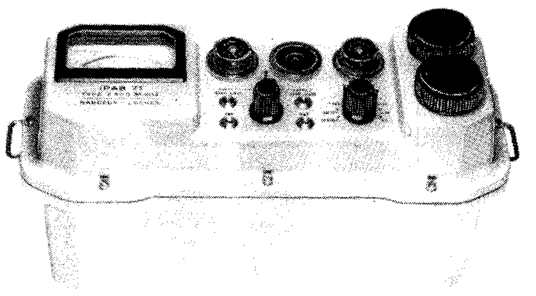






RADIO PROTECTION



POLYRADIAMETRE PORTATIF

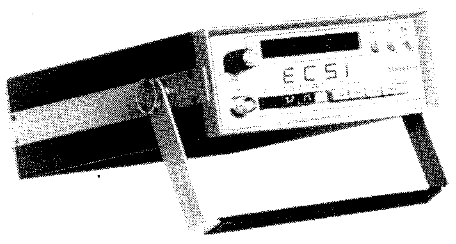
IPAB 71 Réf. 500

Autonome, étanche, alarme

CARACTERISTIQUES ELECTRIQUES

- Haute tension : variable de + 200 à + 2200 volts sur sonde 1 et sonde 2
- Echelle de mesure : 10 - 100 - 1000 - 10000 c/s
- Précision : meilleure que 5%
- Limites de température : - 10° C + 50° C
- Seuil du discriminateur : 1 volt
- Capacités équivalentes : GM - PM : 0,6 pF
  CPA - BF3 - diodes 0,04 pF

COMPTAGE



ECHELLE DE COMPTAGE SIMPLIFIEE

E.C.S. 1 Réf. E. 521

Portative, autonome, 6 décades

CARACTERISTIQUES ELECTRIQUES

- Prétemps : 1 - 10 - 100 - 1000 s (précision 10^{-3})
- Temps de résolution : < 5µs (fréquence 200 KHz)
- Impulsions à l'entrée : polarité positive ou négative durée ≫ 100 ns
- Réglage du seuil : 0,1 à 10 V
- Impédance d'entrée : 1000Ω
- Température de fonctionnement : - 10° C + 50° C

NARDEUX

85 Bd Gabriel Péri 92240 MALAKOFF - 656-65-35+
Usine : 37600 Loches - FRANCE

VAT

news!

All metal indium seals for small flange connections

They are interchangeable with the centring rings comprising an elastomer used so far.

They ensure perfect leak-tightness between small stainless steel flanges, as well as between those in light alloy.

As they are centred on the outside of the flanges, they can therefore fit flanges to the old NW 10 - 20 - 32 standards and to the Pneurop 16 - 25 - 40 range.

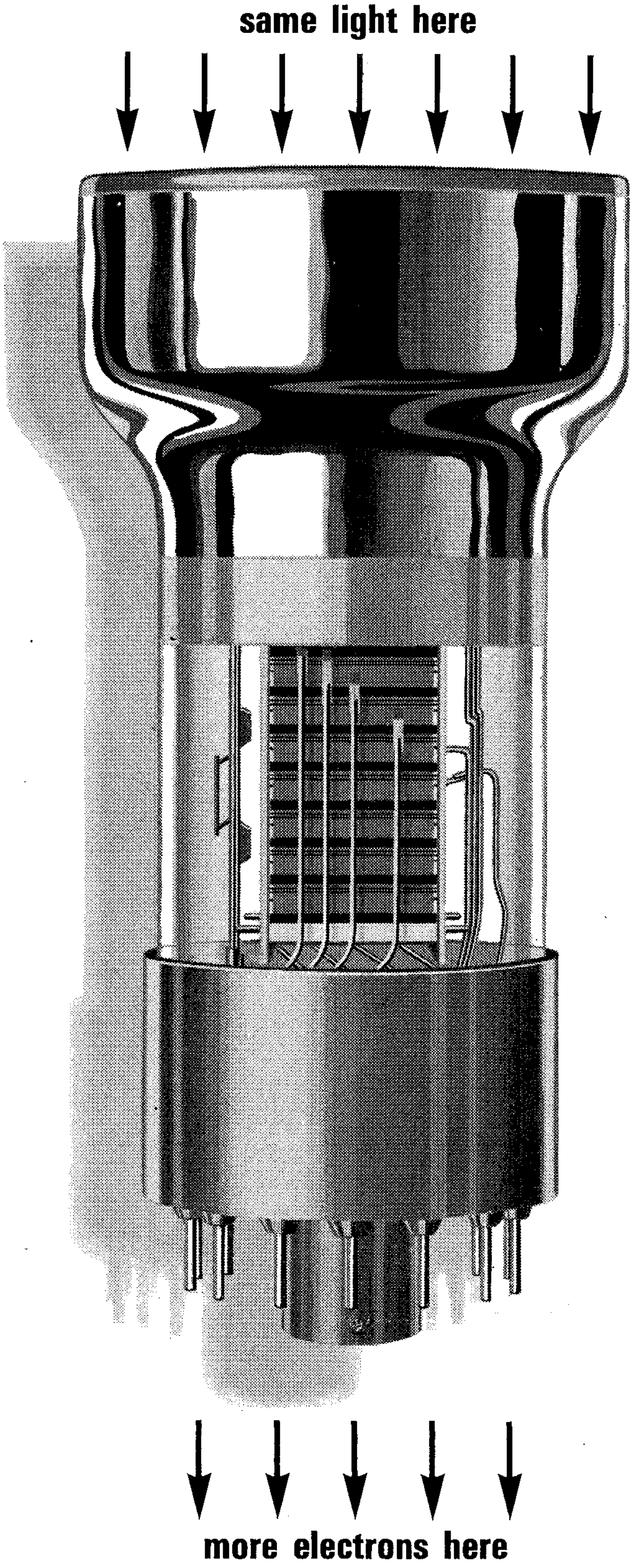
They are leak-tight as many times as required, even when using a standard clamp.

The sealing material being an indium/silver alloy, there are no leaks nor measurable degassing.

Unlimited resistance to radiations.

VAT

VAT AKTIENGESELLSCHAFT
für Vakuum-Apparate-Technik
CH-9499 Haag/SG, Switzerland
Phone: 085/71585



conventional photomultipliers with unconventional efficiencies

These new Philips tubes are direct replacements for the types you're probably using right now.* That's what we mean by conventional.

Their cathode sensitivities, however, are anything but. Type XP 2000 gives 100 mA/W and the XP 2030 is specified at 115 mA/W. To date that's the highest conversion efficiency on the market.

More output for the same light input could give a competitive advantage. Moreover our prices are competitive, so this important extra performance is more or less a bonus.

The main specification figures are given in the table below. Data sheets and samples for evaluation are available on request.

	XP 2000	XP 2030
Spectral response	type D	type D
Useful photocathode diameter	44 mm	68 mm
Quantum efficiency at 400 nm	31 %	35,6 %
Gain at 1.5 kV	2,5 x 10^5	2,5 x 10^5
Pulse height resolution for ^{137}Cs	7,5 %	7,5 %

* type XP 2000 is a direct replacement for types 8053, 4523 and 9655; type XP 2030 for types 8054 and 4524.

For more information on these new tubes plus an updated product survey of the extensive Philips range write to :

Philips Industries, Electronic Components and
Materials Division, Eindhoven - The Netherlands

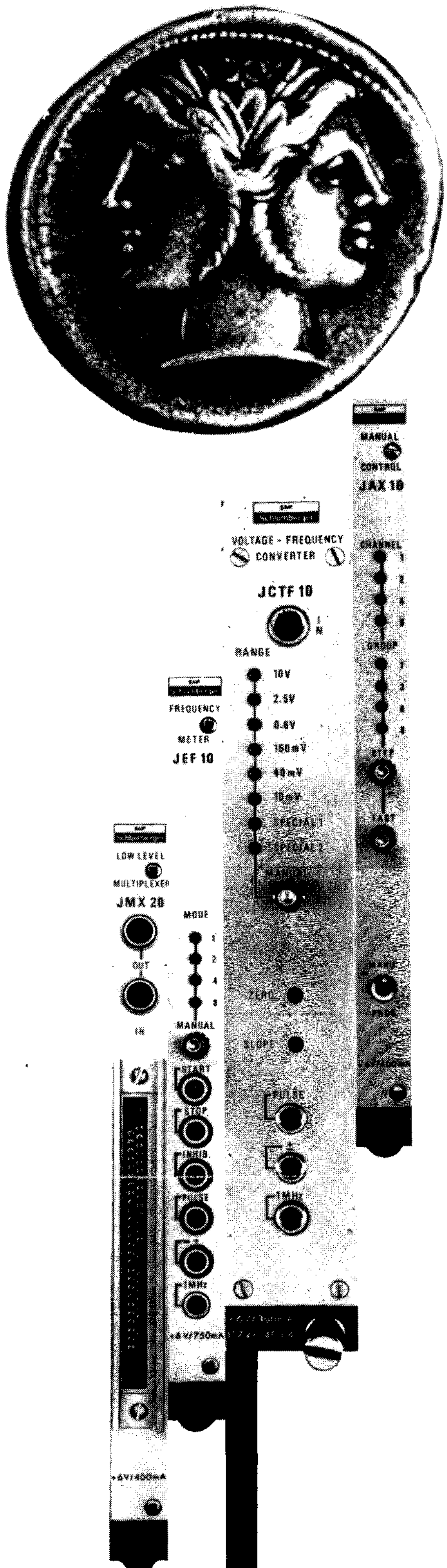
Distributed and sold in the U.S.A. by : Amperex Electronic Corporation
230 Duffy Avenue, Hicksville N.Y. 11802

In Canada : Philips Electron Devices
116 Vanderhoof Avenue Toronto 17 - Ontario

PHILIPS Electronic Components and Materials

PHILIPS

camac



Data Logging Set

Up to 256 measurement channels, all contained in a crate

wired multi-addressing allowing to give

- channel number
- measurement range
- conversion time
- measurement command

in one CAMAC instruction

Up to 40 measurements/second

RELAY MULTIPLEXER - JMX 10 High Level
- JMX 20 Low level (signals lower than 40 mW)

16 channels using three pole relays - up to 16 modules (256 channels)

MANUAL CONTROL - JAX 10

Channel number read-out, manual control of channel selection

VOLTAGE FREQUENCY CONVERTER - JCTF 10

Accuracy : ± 10^{-3} - 8 programmable sensitivities between 10 mV and 10 V

Résolution : 5000 points for a 20ms measurement time.

UP-DOWN SCALER FREQUENCYMETER - JEF 10

Capacity : 2^{16} max.

Measurement time : 20ms, 50ms, 1280 ms

Negative values in two's complement code.

FOR MORE INFORMATION PLEASE CONTACT :

SAIP/SCHLUMBERGER : BP 47 - 92222 Bagneux (France)
Tel. : (1) 655.22.11 Telex : SAIPEX 25 075 F

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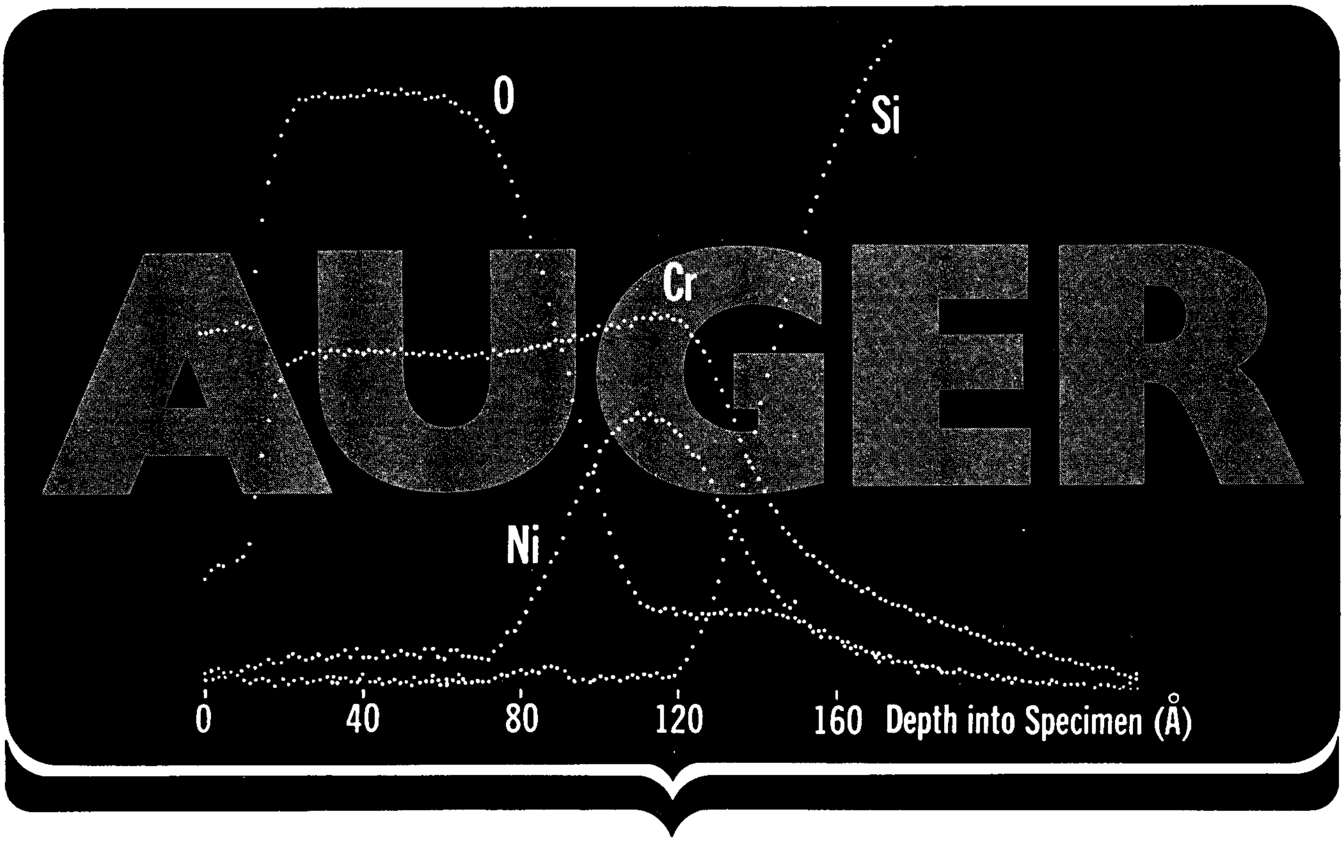
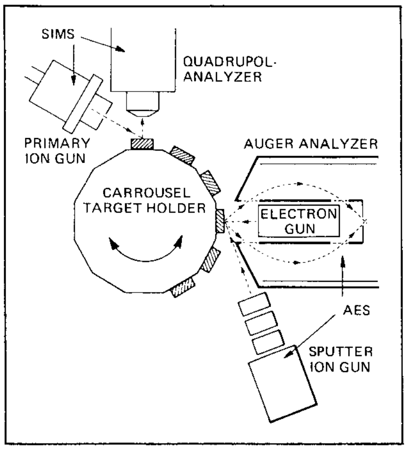

O
Si
AUGER
Cr
Ni
0
40
80
120
160
Depth into Specimen (Å)


SIMS
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PRIMARY ION GUN
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CARROUSEL TARGET HOLDER
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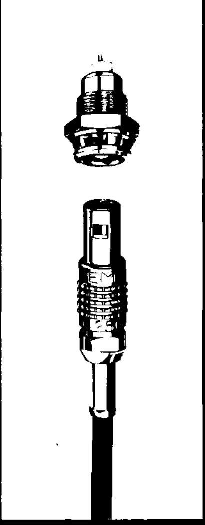
SPUTTER ION GUN

LEMO SELF-LOCKING CONNECTORS FORM A SOLID BOND.

IMPOSSIBLE FOR THEM TO DISCONNECT ON THEIR OWN.



Our production programme

Connectors, unipole (1÷150 A). Connectors, coaxial (50-60-75-100Ω). Connectors, biaxial and triaxal. Connectors, high voltage (2-5-8-10-15-30 KV.DC). Connectors, multi-coaxial, multiple contacts, multiple high voltage. Connectors, combined, high and low voltage. Connectors, combined, coaxial and signal. Connectors, combined special. Connectors, for thermo-couples. Adaptors to connectors type: BNC-UHF-C-N-CONHEX-PET-Suhner-G. Radio, etc.

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The Branch Terminator Type 1592

saves almost 40% of previous termination costs

- Only 1 Crate station needed = $^1/_{25}$ of the total crate cost is used
- Built-in Branch cable saves ⅓ of the Terminator cost

Also from the same design team:

Branch Driver/Interfaces

for HP2100, –14, –15, –16
Varian 620I, L, F & 73

- Modular construction
- Optional auto-address scanning
- Optional DMA operation

borer

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Hochleistungsblitzsysteme für 10 kWs Blitz für Blasenkammern, Photolyse, Fluoreszenzanregung, Photo-Stimulation und optische Pumpsysteme.

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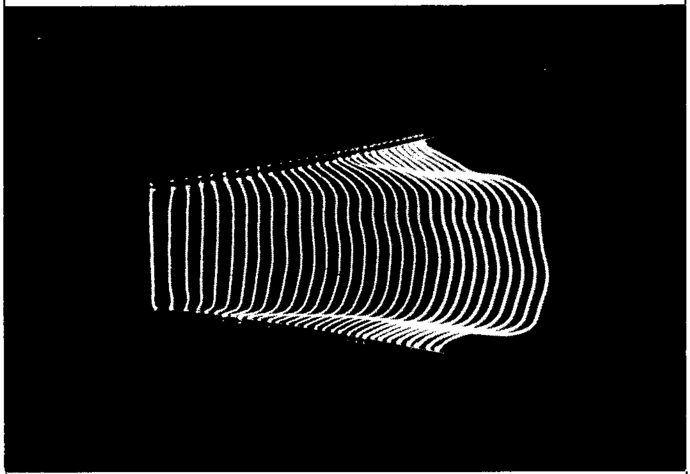

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