CERN COURIER

NO. 5 VOL. 13 MAY 1973

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 3000 people and, in addition, there are about 900 Fellows and Visiting Scientists. Twelve European countries contribute, in proportion to their net national income, to the CERN Laboratory I budget, which totals 382.9 million Swiss francs in 1973.

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 hundreds of 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 1973 is 188 million Swiss francs and the staff will total about 370 people by the end of the year.

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Cover photograph: Unusual shot inside a threshold Cherenkov counter where multiple reflexions are obtained from the internal surfaces. The surfaces are plane, spherical and parabolic mirrors. The counter is conventional in conception but was technically difficult to construct because of its dimensions and the asymmetric geometry of its three cells. It was built in the West Workshop at CERN and is being used to identify kaons in an Orsay experiment at the proton synchrotron studying 'exotic exchanges'. (CERN 177.10.72)

CERN News

The Erste Bürgermeister of Heidelberg, Dr. K. Korz, speaking at the ceremony at CERN on 10 May when the Agreement establishing a European molecular biology Laboratory was signed. The Laboratory will be built at Heidelberg. On his right in the photograph (from left to right) are W. Jentschke (Director General of CERN Laboratory I), H. Voirier (President of the European Molecular Biology Conference), R. Keller (Director of the International Organization Board of the Swiss Federal Policy Department), J.C. Kendrew (Director General designate of the new Laboratory), R.K. Appleyard (Executive Secretary of EMBO) and M. Delauche (Secretary of EMBC).

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European Molecular Biology Laboratory

On 10 May an Agreement was signed at CERN setting up a new European Laboratory. It will be concerned with research in molecular biology and will be located at Heidelberg in the Federal Republic of Germany.

The Laboratory has been under discussion for several years. It is intended to provide a centre where top-class instrumentation for this type of research could be developed but more importantly to provide a centre where top-class scientists from the various disciplines involved in the study of molecular biology could work together. CERN, besides being the venue for many of the debates concerning the Laboratory, has been used as a model in establishing the principles as to how a European research centre should work. It is intended that the Heidelberg Laboratory will have visiting scientists coming from the Member States. The Laboratory itself is intended to have quite a small complement of 'permanent' scientific staff but will offer sophisticated equipment and a multi-disciplinary environment.

The CERN Convention has been used as a model in drawing up the Agreement on the Laboratory. The Agreement lays down the broad lines of control for the Member States while retaining sufficient flexibility to be able to adapt to the future evolution of the research. The Member States exercise their overall control via a Council of delegates, as at CERN, while the running of the Laboratory is assigned to a Director General. The Director General designate is J.C. Kendrew who has been Project Leader in the studies leading to the establishment of the Laboratory. Professor Kendrew received the Nobel Prize in 1962 for his research on protein structure.

Ten countries have signed the Agreement—Austria, Denmark, Federal Republic of Germany, France, Israel, Italy, the Netherlands, Sweden, Switzerland and the United Kingdom. Greece, Norway and Spain have participated in the discussions but are unable to join at the present time.

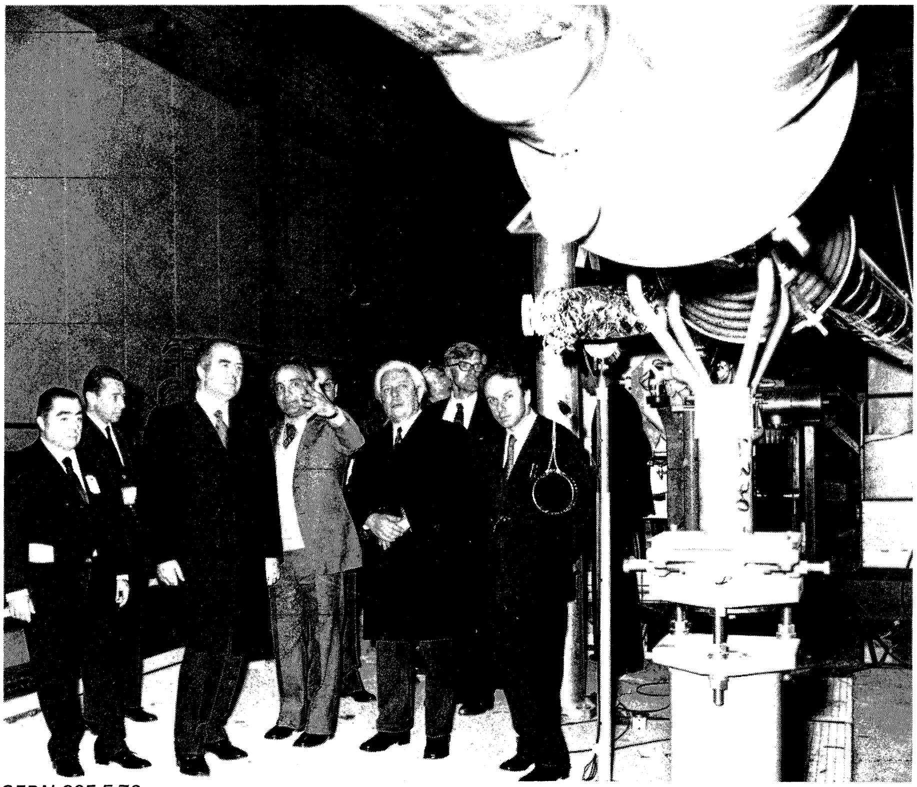
The participating countries have agreed to support the Laboratory for a minimum of seven years during which time the capital expenditure is expected to be 11 million accounting units at 1972 prices (an accounting unit is about $ 1). This sum includes expenditure at the two research facilities at DESY in Hamburg (using synchrotron radiation) and at Laue-Langevin in Grenoble (using neutron beams). Operating costs are expected to grow to 4.2 million accounting units per year.

The Federal Republic of Germany has contributed considerably towards the setting up of the Laboratory. In addition to making available the site, the German government is making a gift of 12 million marks (which reduces the capital expenditure required from the Member States to 7.7 million accounting units over seven years). Heidelberg is helping to provide temporary accommodation so that the project can get off to a fast start.

ECFA Working Group on tripartite relations

The European Committee for Future Accelerators (ECFA) has for some time been discussing the relationships between CERN, the national high energy physics Laboratories and the Universities in the CERN Member States. ECFA is a natural forum for

On 21 May, His Excellency P.L. Romita (Italian Minister of Scientific and Technological Research) visited CERN. He is photographed here (third from the left) touring the Intersecting Storage Rings. On his left is A. Zichichi giving an explanation of the machine and on the left of Professor Zichichi is C. Villi, the President of the Italian National Institute for Nuclear Physics.



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such discussions since all three parties are represented. The concern is to sustain and improve the existing relationships as the European situation of high energy physics evolves.

CERN has been built up to be the strong centre of high energy physics in Europe. With the proton synchrotron, the intersecting storage rings and the SPS it is, and will continue to be, the place where a very high proportion of the total research is done. The national Laboratories compliment the CERN facilities, for example in providing electron accelerators and storage rings. They also provide several centres where highly developed technical skills exist, which sustain the national accelerators and help national teams to equip themselves for experiments at CERN. This latter role may increase in importance as the scale of experiments at the big machines continues to grow. The Universities are by far the biggest source of the physicists carrying out research at high energies and are a major mechanism for feeding the produce of the research, in terms of increased knowledge of the nature of matter, into European science.

How these three elements of the high energy physics scene mesh together is obviously of great importance in achieving efficient research. It is also clear that the relationships could change gradually in line with the evolution of the research. For example, to pick out again the feature mentioned above, the scale of experiments at the SPS (both in the sizes and complexities of the equipment and in the possible volumes of data) has repercussions in the ways that Universities, national Laboratories and CERN will collaborate most efficiently together.

Other topics which have been discussed have included the problems of sustaining the national Laboratories, in a financial climate where budgets are not growing as in the past and where CERN is taking an increasing proportion, and the problems of short term visitors coming from the Universities to CERN to participate in experiments. In addition the discussions have not been entirely introspective. The relationship between the high energy physics community and the outside world — ranging from other scientists to the general public — is recognized as needing attention.

To examine these topics in more detail, a Working Group under the Chairmanship of J.C. Gunn has been set up by ECFA. It consists of representatives of each of the three camps and will meet for the first time on 15 June.

Reintegration into home countries

A study of the situation regarding the reintegration of CERN personnel into the social systems of their home countries has been under way for several years. There are reintegration problems essentially concerned with health, old-age, disability and unemployment insurance.

In December 1970, the first bilateral agreement was signed by CERN and a Member State. This social security agreement was between France and the Organization and came into force on 13 April 1971. It was the result of a CERN initiative with regard to each of its Member States asking for measures to be taken to facilitate the reintegration of former CERN officials and their families into national health insurance schemes and, in a more general way, into the national social security systems.

It is a very difficult task to organize a social security system in an international organization, since the national systems in the Member States differ widely from one another — in

The octopus in the photograph is used for the calibration of the pressure gauges of the ISR. It is part of a system which makes it possible to calibrate at very low pressures (from 10^{-6} to 10^{-12} torr). The large aperture is connected to a cryopump and on the opposite side gases (such as hydrogen or nitrogen) are introduced in a controlled way. The pressure gauges are connected to the eight side arms. With two of these devices on the same pump, sixteen gauges can be set up for calibration at the same time.

fact they are sometimes diametrically opposed. In CERN's case, there is a further difficulty in that the Organization extends into two countries, France and Switzerland. Its insurance schemes have to be aligned with the requirements of French and Swiss law.

In February 1970, the CERN Finance Committee decided to set up a working group to study the problems. The group assembled information concerning the difficulties involved in the reintegration into national systems encountered by people leaving the Organization and by surviving members of the families of CERN staff who died. A detailed questionnaire was sent to representatives of the Member States concerning health insurance.

The analysis of the replies proved complex. Nevertheless, it emerged that, with regard to health insurance for instance, the Member States fell into two categories: those providing health insurance benefits as soon as the person resides in the country itself and those making such benefits subject to the person's working (or receiving unemployment benefit or national pension). Reintegration presents no difficulties in the former case. In the latter, however, the question is not so much one of reintegration into the health insurance scheme but rather of reintegration into the economic life of the country.

A limited step forward was achieved at the end of 1970 when a new health insurance contract was concluded between CERN and Austria Versicherungsverein AG. In particular, this agreement states: 'Where a member of the personnel ... ceases to be employed at CERN for any reason ... the Insurers shall continue to insure him ... for a period of twelve months ... provided that the insured person ... so requests'. The same applies to the members of his family. A further provision is that: 'On the death of the insured person, the Insurers shall continue to insure the members of the family of the deceased on the same conditions ...'. Finally: 'After this period of twelve months, the Insurers undertake to guarantee the transfer of the persons ... at their request to an insurance scheme giving them similar rights to those to which they would have been entitled had they joined the said scheme on the date of their coverage by the provisions of the ... Agreement.'

By 'members of the personnel' is meant staff members, supernumeraries, fellows and research associates provided that they hold a full-time contract for a duration longer than three months, and vacation students, for whom reduced cover is provided.

National groups (one group for each Member State), to concern themselves with these problems, have been set up within the CERN Social Affairs Committee. Their mandate is to examine the provisions in national regulations which would need amendment, in order to facilitate the reintegration of CERN employees, and to report back to the Social Affairs Committee. Further information can be obtained from T. Davies.

At the end of March 1973, these groups presented the following situation report:

Austria: Government signature to an agreement is awaited;

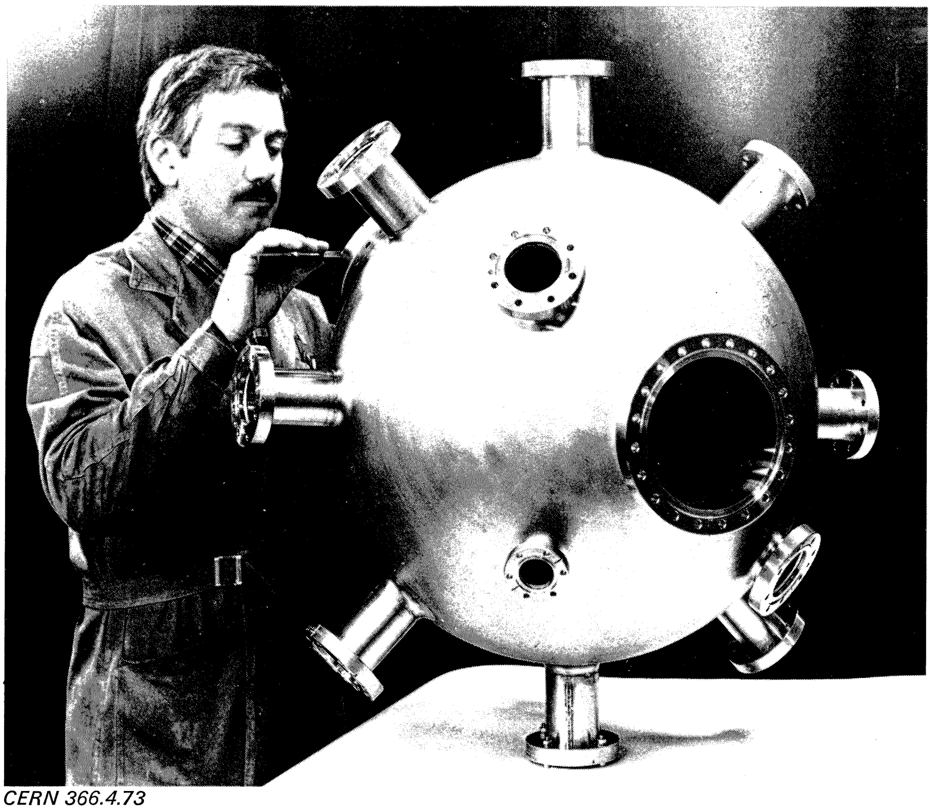
Belgium: A letter suggesting that negotiations be opened has been sent to the Government;

Denmark: The group sees no need for a special agreement;

France: An agreement was signed in December 1970;

Germany: An answer to certain questions is awaited and for the moment the possible date for opening negotiations is unknown;

Greece: The Government intends to issue a decree which would grant Greek nationals the right to contribute



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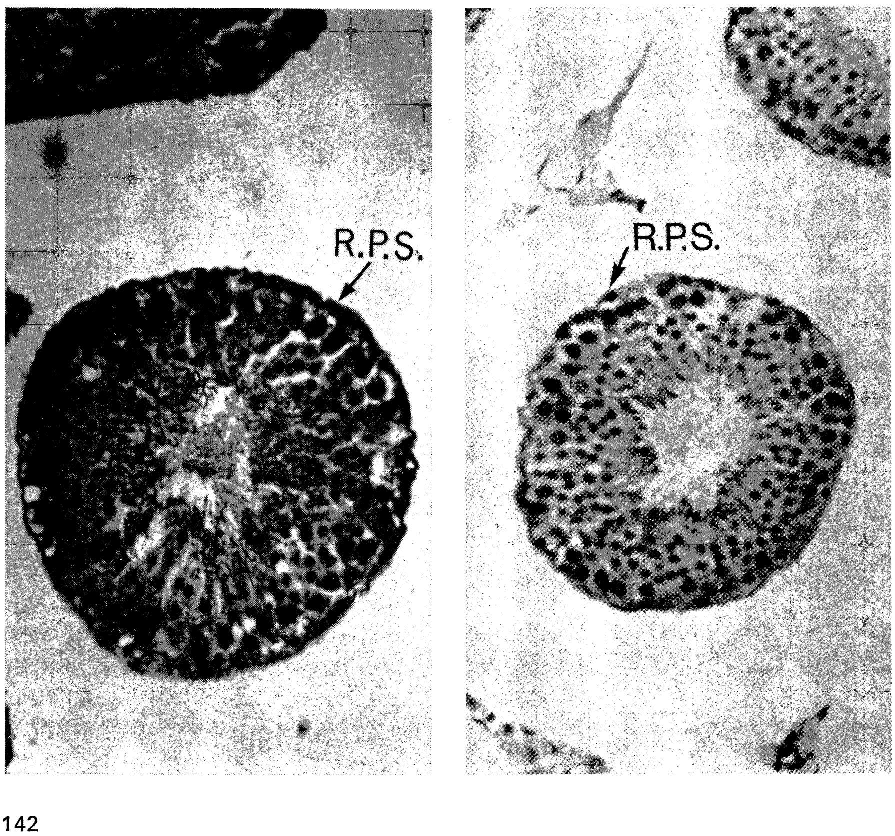

Cross-section of seminiferous tubules in mouse testicle (enlarged 1 000 times): on the left is the sample, on the right the result after irradiation by 5 rad of stopped negative pions. The arrow (RPS) indicates a type of germinative cell (spermatocytes in preleptotene stage). Cell survival may be determined by counting the number of spermatocytes missing in the animals irradiated. These experiments are being performed by the CERN Health Physics Group.

voluntarily to the national social security system;
Italy: A first exchange of views has taken place between representatives of CERN and the Ministry of Labour and Social Security and the National Social Security Institute. Italian nationals may make voluntary contributions to the system if they follow the administrative procedure. Detailed discussions will begin again during the summer;
Netherlands: By and large, the group sees no need for a special agreement except for one problem with respect to Dutch nationals over the age of 59 which is still being examined;
Norway: The group sees no need for a special agreement;
Sweden: The Government is to be approached to open discussions on certain problems;
Switzerland: The problem relates to the methods of integration into the 'AVS' system and membership of health insurance schemes after leaving CERN and contact has been made with the Federal authorities;
United Kingdom: On the whole, very few difficulties arise apart from the problem of the purchase of years of membership — a letter on this subject has been sent to the British Government.

Of Mice and Men

At the end of March, sixty mice were irradiated at the synchro-cyclotron in the course of an experimental programme studying radiation effects on mice and plants (Vicia faba bean roots) being carried out by the CERN Health Physics Group.

Radiation protection experts are interested in the biological effects of high energy radiation. It is known that the energy lost through ionization as radiation passes through matter remains virtually constant at high energies but special phenomena, produced by spallation, appear beyond a certain radiation energy threshold. These phenomena, which can be observed at high energy accelerators, may cause very large amounts of energy to be deposited in an abnormal way in small volumes of living tissue.

About twenty years ago all data concerning the biological effects of high energy particles were virtually extrapolations of what had been observed at lower energies. It has therefore been necessary to carry out a programme of experiments to check the data and thus to confirm that the proposed radiation protection measures are adequate. These experiments are being carried out in collaboration with other European institutes of radiobiology.

The experiments are being carried out at the SC and not at a more powerful accelerator, such as the proton synchrotron, because the energy of the protons and even of the secondary beams (of pions for example) at the SC is sufficient to initiate the phenomena of interest. The period of irradiation and observation varies considerably: to study the formation of a cataract in a mouse's eye due to irradiation requires following the case over a few years until natural death occurs, on the other hand, to study variations induced in the growth of bean roots requires only ten to twenty days of observation. The phenomena induced in the irradiated plants or mice are compared to those occurring naturally in the same species and to those observed after exposure to more common forms of radiation such as X-rays and neutrons.

When the world's first high energy accelerators came into action, thorough precautions were not taken to combat the dangers presented by the emerging beams and by the gradual accumulation of induced radioactivity.

On 20 May the 'mole' had burrowed its way 650 m around the SPS tunnel. The photograph shows the spoil being pulled out by train; twelve wagons carry 60 tons at a time. The pipes on the right of the tunnel wall take air and water to the working face. Metal hoops are installed temporarily to hold the walls at this point in the tunnel since it is one of the sections which will be later enlarged from 4 to 6 m.

This tank is being built to dry out vacuum components for the SPS — along the walls are the supports for the heating elements. The components will be chemically cleaned and rinsed with demineralized water. Within the tank they will be heated to 150°C while under a vacuum of 1 torr. After this they will be sealed off and be ready for installation. The tank, constructed in the Main Workshop, is 7 m long and 1.5 m in diameter and is scheduled to be brought into use at the end of June.

Shielding of the machine itself was thought to be enough. To ensure that the appropriate measures were taken, when CERN's first accelerator (the SC) operated in 1957, a small radiation protection group was formed and attached to the Scientific and Technical Services Division, the predecessor of the present Data Handling Division. In 1961, as people became aware of the considerable problems in the field of radiation protection, the group was reorganized and attached to the Directorate. It now has about forty staff including visiting scientists and a few Fellows.

The main aim of the Health Physics Group is to locate radiation hazards to assess them correctly, to take necessary precautions or impose necessary restrictions and to pass on information efficiently. The group must also check that personnel radiation exposures remain within acceptable limits.

The hazards vary according to whether machines are running or shut down. In the latter case the danger comes from conventional (mainly gamma) radiation due to activation of the accelerator components by high energy particles and the radioactivity may reach very high levels locally. In this case, monitoring and personnel dosimetry do not present any basic problems though the hazards due to high intensities and unusual spectra have to be taken into account. At present 90 % of the total radiation dose received by CERN personnel is of this type.

When the machines are running the main hazards are due to high energy particles and their secondaries. This may effect not only the experimental areas but also their immediate surroundings and even the whole site. In contrast to 'conventional' radiation, the hazard is much more difficult to evaluate as no single instrument can provide a complete picture of the radiation.

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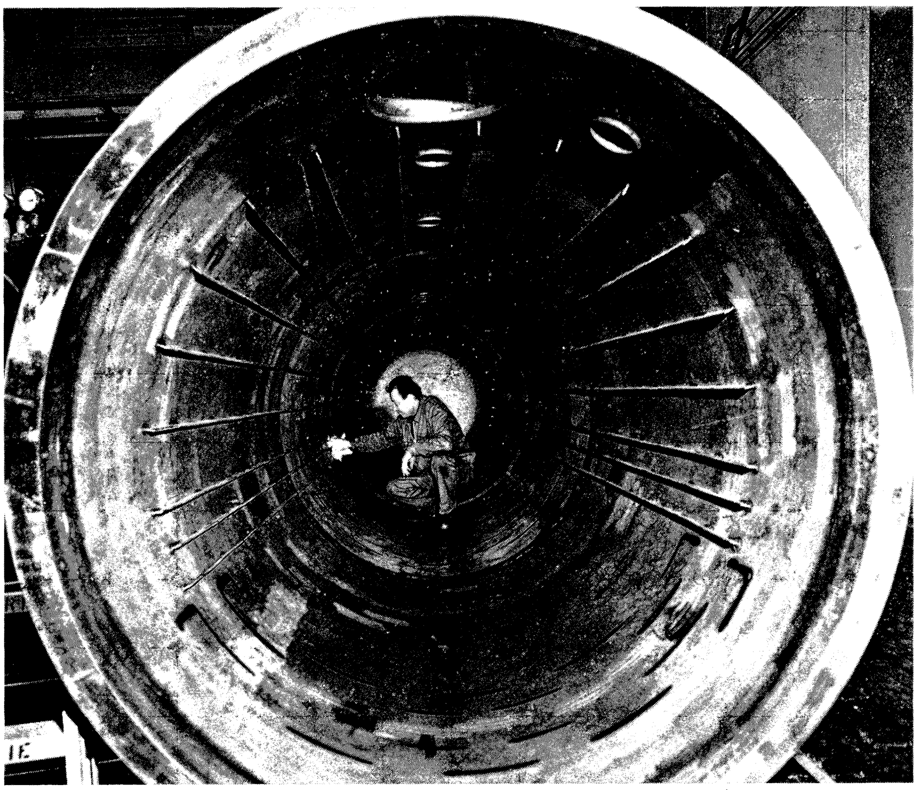

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At CERN a set of detectors is used to measure the total radiation dose: neutrons from the thermal range up to approximately 15 MeV are measured with an RIC (rem ionization chamber), particles above 20 MeV (from nuclear interactions) are measured by carbon activation, and gammas and charged particle ionization are measured by differentiation between two chambers. It is thus possible to obtain a quick plot of the radiation fields in the experimental halls, evaluate the hazards facing those working there and advise on the necessary precautions.

The Health Physics Group has established a network of monitors covering each experimental hall and the site as a whole. The monitors are of two types:

– equipment for monitoring the radiation areas, which consists of portable instruments for measuring the total dose equivalent at specific points and of a network of instruments providing readings which are continuously relayed to the Group and, if necessary, to the control rooms;

– fixed monitoring stations which continuously measure and record the radiation levels on the site. These stations can be read remotely. In addition, a denser network of integrating systems provides total dose readings which are distributed at quarterly or yearly intervals. As this network extends to the far corners of the site, the radiation level just outside the Laboratory is also evaluated.

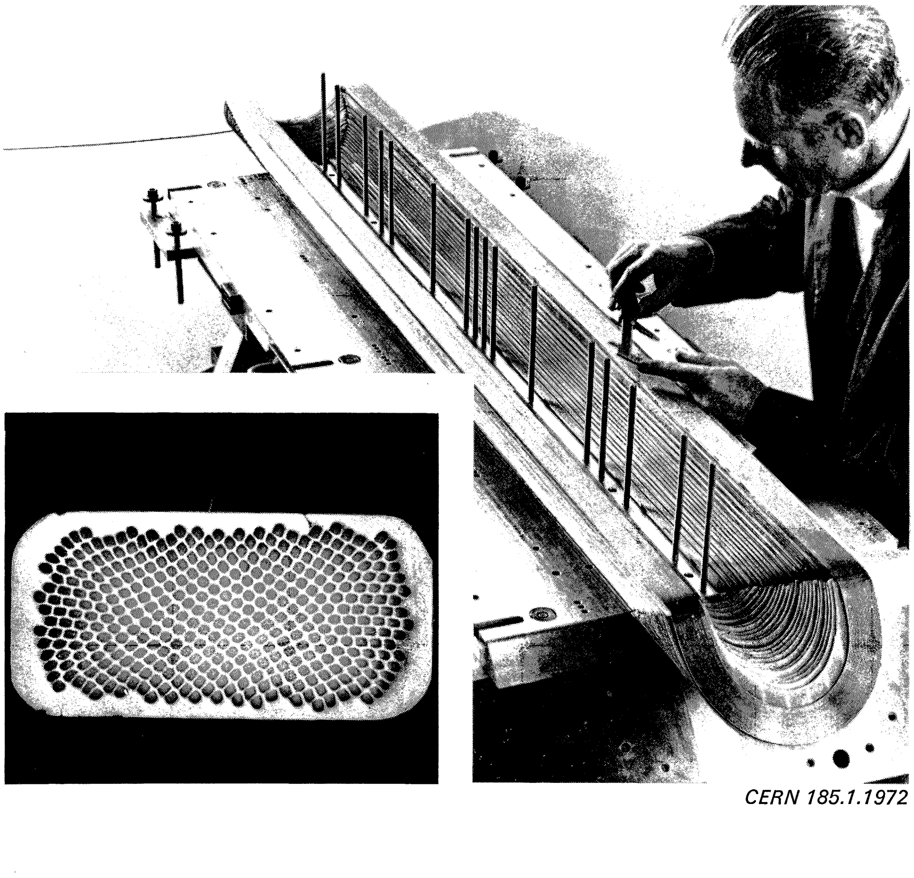
The instrumentation also includes monitors installed at critical points on the site to check gas and liquid waste. Experience has shown that the hazards due to radioactivity in gas and liquid waste are negligible but a constant watch is still kept on them. The Group also handles all the personnel dosimeters distributed to the staff (more than 5 000 per month).

On average only a few incidents which require thorough investigation are recorded each year. Cases of overexposure are few in number and, until now, low in value. During the past ten years, doses resulting from accidents have not exceeded five or six times the maximum permissible annual dose.

Superconducting bending magnet

A superconducting bending magnet has been developed for the beam-line to the large European bubble chamber, BEBC. It is now installed in its final position in beam u7, some 50 m from BEBC in the West Hall where it provides a deflection of 8°.

The project has already been discussed in vol. 10, page 228. Initially, there were plans for two identical magnets enclosed in a common cryostat, and the technical features were described by G. Kesseler, P. Lazeyras and F. Schmeissner at the Conference on Magnet Technology held in Hamburg in May 1970. Since then, there have been some changes. First of all, to give scope for possible modifications to the beam and especially to take into account the advent of the SPS, greater flexibility has been obtained by separating the two magnets and having each of them in its own cryostat. Secondly, it turned out that the bending power required for the initial operating period of BEBC would be lower than foreseen and that a single magnet would be adequate. For these reasons, only one superconducting magnet fitted in a correspondingly shorter cryostat has been built. In addition small changes in coil configuration and a slight increase in effective length reduced the nominal current and thus the current density and stored energy.



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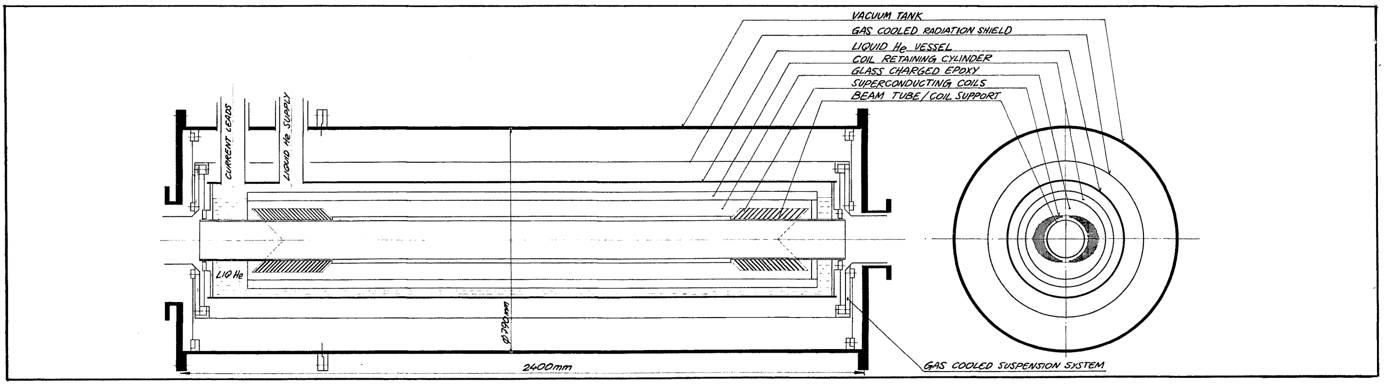
Completion of the winding of half the coil for the d.c. superconducting bending magnet now installed in the beam-line to the European bubble chamber, BEBC. Inset is a microphotograph of a cross-section of the superconductor used in constructing the magnet. The conductor is rectangular, 1.5×3 mm²; inside a copper matrix are 367 thin filaments of niobium-titanium 65 μm in diameter.

Diagram of the magnet showing how the different concentric structures come together. The coil cross-section (on the right) is close to that of two intersecting ellipses which gives a uniform field configuration in the magnet aperture. The magnet is 2.4 m long and weighs 1.5 tons.



The two coils of this first magnet are impregnated with epoxy resin and enclosed in a stainless steel cylinder which withstands the electromagnetic forces when the magnet is powered. Epoxy impregnated coils usually have poor heat conductivity and even very small quantities of heat can cause local temperature rises high enough to destroy the superconductivity in a small zone. This 'normal' zone then spreads rapidly through the coil. An impregnated coil is therefore very sensitive to internal energy dissipation. The advantages of an impregnated coil are its compactness, the good mechanical fixation of the windings and the ease of transmitting the electromagnetic forces to a simple external structure (a cylinder instead of complex clamping brackets).

Each coil was made by winding a single superconducting strip 2530 m long. A 5 m length was taken from each end of the conductor and thoroughly tested with satisfactory results.

The first tests on the magnet were made in a simple vertical cryostat. Considerable 'training' was observed as is often the case with impregnated magnets. This means that the current at which the magnet suddenly goes normal, 'quenches', increases progressively as the magnet is repeatedly charged. The explanation may be that the electromagnetic forces acting on the coil are causing small cracks in the epoxy resin, releasing sufficient heat to send the conductor normal locally.

The current passing through the magnet has reached 725 A giving a bending power of 5.6 T×m, a central field of 3.4 T and a stored energy of 370 kJ. This is adequate for the first experiments with BEBC, when a bending force of some 5 T×m is needed in the beam-line.

After the tests, the magnet was placed in its horizontal cryostat, 2.5 m long, and tested again. It performed satisfactorily together with the associated equipment which allows virtually automatic operation. Since the use of dewars is foreseen in the supply of liquid helium to the magnet it is important to know the total thermal losses. They were measured at 6.2 W with the magnet energised, corresponding to a daily liquid helium consumption of 200 litres.

Prix Francqui to Professor Macq

The Prix Francqui for 1973 has been awarded to P. Macq of the Université catholique de Louvain. This Belgian prize has a very high standing and is awarded in successive years for work in the humanities, natural sciences and medicine, and mathematical, physical and chemical sciences. Among the recipients of the prize in this last category have been L. Rosenfeld (1949) and L. Van Hove (1958).

The prize was awarded to Professor Macq particularly for his work on weak interactions. The citation praised the rigour and precision of his scientific method and recognized that he has built up in Belgian a Laboratory of international renown.

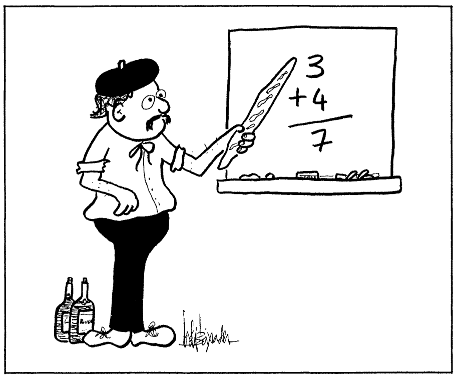
P. Macq has been involved in the experimental programme at CERN for many years. At the synchro-cyclotron he carried out a series of experiments on muon capture, pseudoscalar coupling constant and other related topics in weak interactions. At the proton synchrotron he has been in teams using polarized proton targets. He also participated in one of the first experiments on electron polarization in muon decay at Berkeley. In Belgium he leads the work on the cyclotron at the University of Louvain.

Schooling of CERN children discussed at Sèvres

At the beginning of April, a Colloquium was held at the 'Centre International d'Etudes Pédagogiques' at Sèvres, Paris, to study the pedagogical structure of a schooling system adapted to the educational needs of the children of CERN staff. This was a further step in the discussions which have been going on between the French authorities and CERN for over a year in an attempt to work out a reasonable solution to the rather unusual problems in the education of CERN children which come from the international nature and the particular personnel structure of CERN. These discussions seem worthy of widespread attention because the CERN situation probably has much in common with situations which have come, or will come, into existence in the context of the moves towards European unity.

At the Colloquium there were representatives of the French authorities, particularly from the Ministère de l'Education Nationale (Mission de Recherche Pédagogique and Mission aux Relations Internationales). Local officials were present from the Pays de Gex (the region of France surrounding CERN) and the Sous-Préfet de Gex attended part of the Colloquium. The Member States of CERN were represented by educational specialists. A large delegation came from the Lycée at Ferney-Voltaire where it is intended that the secondary section of the schooling system catering for CERN children will be developed. The teachers from the Ferney Lycée played an important part in the discussions. In addition there was a delegation from CERN itself.

The question of the education of CERN children, came to the fore in the course of the debate leading to the decision to build the SPS. The Member States who put forward sites for the new accelerator each agreed to set up an educational system to meet the needs of a 'mobile', international community should the new CERN Laboratory be in their country. When the proposal was put forward to adjoin the new machine to the existing Laboratory, creating an extension of CERN site predominantly into France, the French government accepted a commitment to provide for the educational needs of CERN children.

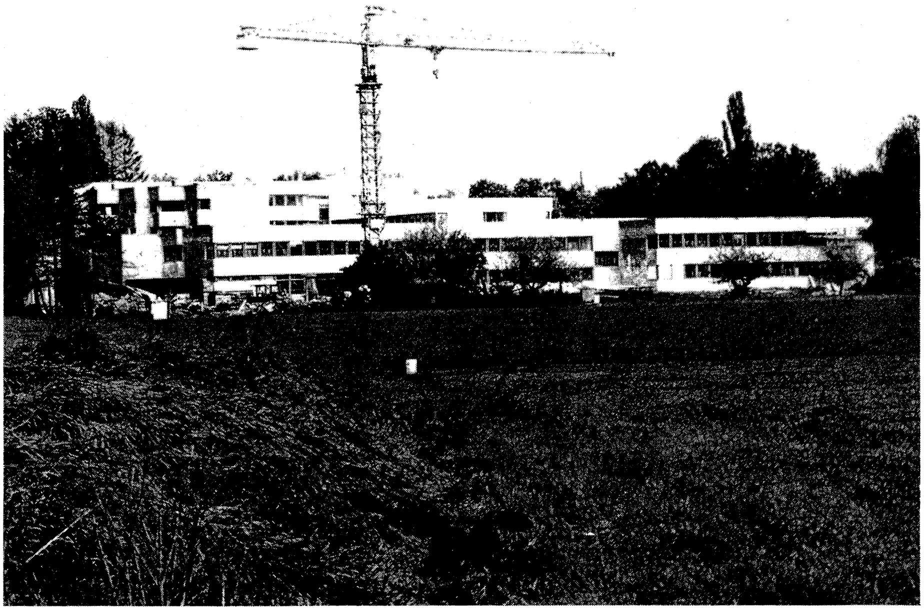


The ways in which this commitment can be implemented have been discussed between France and CERN at several meetings over the past year and the stage has been reached where the needs and the possible ways to cater for them have become clear. The Sèvres Colloquium was organized to bring in more pedagogical expertise and to involve the educational authorities of all the Member States with the aim of arriving at an outline of the desirable pedagogical structure of the school.

At first sight the prospect of evolving a schooling system which is appropriate for the CERN population looks very daunting. The population includes twelve nationalities speaking nine languages. It involves children spread across the whole spectrum of schooling ages and with the usual spectrum of individual abilities. It includes children of parents visiting CERN for a short duration, of parents on short contracts but who may stay indefinitely, and of parents who in all probability will stay at CERN throughout the schooling years of their children. Children arrive from a variety of national educational systems where there are many divergencies from country to country in level and approach. On departure, children need to be reintegrated into their national system.

At the present time, in the neighbourhood of CERN, only a few national groups can find teaching which is in any way adapted to cater for this situation. Schooling has therefore been recognized as a problem for a long time and has led to recruitment difficulties and to problems for many CERN families.

In 1967 a very thorough survey was carried out among CERN staff (see CERN COURIER vol. 8, page 187) to determine what they regarded as the priorities in the education of their children. There was wide agreement on the main concerns. Without entering into detail, they called for a teaching system which would minimize the difficulties encountered in transferring from one country to another (concentration on a solid grounding and on training for individual work, mastery of languages, etc...) and which would at the same time maximize the benefits which can be obtained from schooling in an international environment (integration into the local community rather than



The Lycée at Ferney-Voltaire where the secondary section of the schooling system adapted to the needs of CERN children will be located. The school already houses children of the region and will obviously continue to ensure that the normal qualifications of the French education system are available to them.

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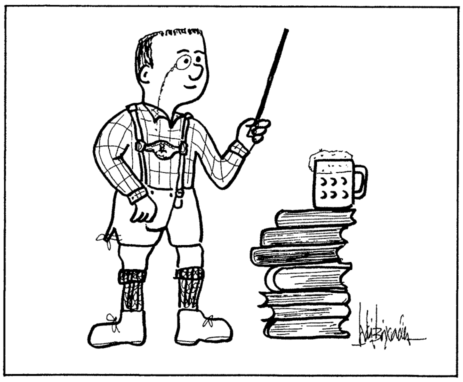
separation into national groups, acquisition of internationally recognized certificates, etc...). These priorities, emerging from the survey of the staff, have been the guidelines used by CERN in the discussions with the French authorities.

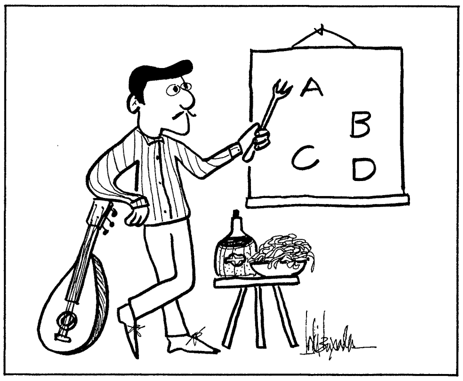
From these discussions, the following structure has emerged for the proposed schooling system which would be accessible to the children of CERN staff: The common core of the teaching would be in French and following a French programme. Connected to this common core would be teaching given by teachers coming, it is hoped, from almost all the other Member States. They would look after the language and national culture of each country for children from that country and help in the initial integration of their nationals into the common French core as children arrive and in the preparation for transfer back to national systems as children leave.



It is recognized as being extremely important (and in line with the desire of CERN parents for integration rather than separation) that the French children from the region should be able to acquire the same qualifications and absorb the essential features of French education as they could elsewhere in France so that they would in no way be handicapped in their future careers within France by virtue of attending the schools. Far from being a drawback, internationalization of the schools should greatly enrich the education available to local French children and open many opportunities to them (languages is an obvious example) which would otherwise not be there.

The traditional French educational system, like any other specifically national system, tends to be fixed in its form and methods and to lack the flexibility which is required to meet the diverse needs expressed above. However, within France, as in almost all the Member States at present, there are a considerable number of upheavals taking place in the traditional system. Experience has been gained concerning new pedagogical techniques, new teaching programmes, new attitudes (such things as modern math, teaching of languages at a very early age, revision of teaching of French, team teaching, integrated day, individual study, new science programmes, etc.). Not many have been applied within the region close to CERN but experience does exist within the French system. It was obviously desirable to incorporate into the programme to be followed in the schools accessible to CERN children, those new pedagogical developments which are in line with the international aims of the schools.

The colloquium at Sèvres tried to put some flesh onto this skeleton plan — common core consisting of a modern French programme complemented by teaching supplied by teachers from the Member States. Three working groups were set up to study: 1) Primary education; 2) Secondary education — languages, cultural subjects; 3) Secondary education — sciences, mathematics. Each group emerged with a series of recommendations from which we will attempt to extract the main points.

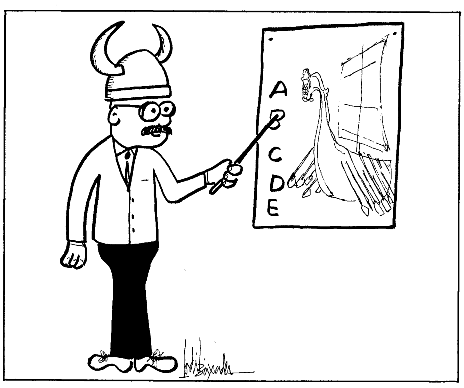


1. Primary education. It is proposed that CERN children attend local schools except for one morning and one afternoon per week when non-French children would come together at one or two schools for national language teaching.

Very young children absorb another language easily and it is proposed to immerse them immediately in the French class appropriate to their age. For children of six years old and above, those who can read and write their own language would again be immersed in the French class without need for special initiation courses. Those who cannot read and write their own language should have the possibility to acquire this ability before being fed into the normal classes for the bulk of the teaching.

The schools would obviously be very rich on the languages side and the local French children would have an excellent environment in which to make early acquaintance with other languages. Finally on leaving the school a child should be provided with a 'dossier scolaire' to help his reintegration into his home country.

Obviously these measures will require practical steps. An important one concerns a reduction in the standard class size because more individual teaching would definitely be essential and is not possible in large classes. Teachers would be needed from the Member States to provide the national language teaching. The means of transporting and accommodating children for the morning and afternoon of national language teaching would have to be worked out.



2. Secondary: Languages and arts. It is envisaged to absorb all children of secondary school age in the Lycée at Ferney-Voltaire. For children arriving (at no matter what time in the school year) an intensive initiation in French would be necessary to enable them to follow the programme. This is foreseen as involving six weeks during which the children will be taught French for half the schooling week. Additional French language teaching would continue for newcomers during their first year.

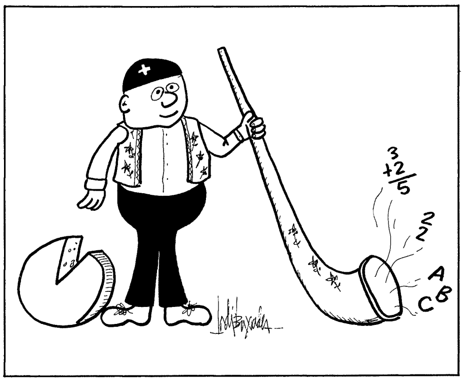
The national language, particularly in written form (since it is probably conveyed orally in the home), and national culture could be taught for up to six hours per week. The teachers from the Member States will also pay particular attention to the initiation of their children in the French programmes and, on departure, help in preparing them again for their national programmes.

The teaching of languages would take place in a particularly rich environment. History and geography should be presented in a more international way following programmes worked out by the French staff together with their colleagues from the other countries. Artistic activities and sports would be catered for.

As discussed above, the Lycée should absorb many of the new pedagogical techniques and be very flexible so as to adapt the French programme as best possible to the international environment.

In addition to the teachers from the Member States, a very valuable contribution from other countries would be to help build up a multilingual documentation centre. This again could result in an exceptional educational aid both for the local French children and for the children from other countries.

The availability of a 'dossier scolaire' for each pupil would aid reintegration (as with the Primary children). The school will obviously prepare children for the normal French examinations (B.E.P.C. and the Baccalauréat français) but should also prepare children for the International Baccalaureate which, at least for an initial trial period, is a qualification accepted for University entrance in virtually all the CERN Member States. The provision of courses leading to both the Baccalauréat français and the International Baccalaureate is not considered to be a problem.



Secondary: Mathematics and sciences. Many of the themes covered above in describing the proposed structure for the Languages and Arts teaching in the school carry over also into Mathematics and sciences.

There are considerable differences amongst the Member States in the teaching of mathematics, both in techniques and in the teaching sequence for specific age groups. Nevertheless it is believed that, with the help of teachers from the national units for the initiation of children, for help with specialized vocabulary and generally for assistance to the French staff, the problems can be overcome.

In the sciences, however, major problems exist in the differences in alignment between the different national programmes. It is recognized that the normal French programme is in need of reorganization. This has already been studied by a French Commission led by A. Lagarrigue and new methods are being tested, for example at Grenoble. An optional programme should be implemented from the start of secondary education incorporating biology, physics chemistry and mathematics in a unified way.

Around the Laboratories

To help prepare the science programme, it is proposed that a colloquium be held of experts from France and from the other Member States. A similar meeting on the mathematics programme could take place at the same time.

As proposed for the arts programmes, it should be possible to prepare for the International Baccalaureate as well as for French qualifications.

These recommendations from the three Working Groups at Sèvres have been conveyed to the French authorities, who have also been asked to make known their time-table for implementing the schooling system in the Pays de Gex to cater for CERN children. The representatives of the Member States conveyed the recommendations from the Colloquium to their respective authorities.

It is expected that the system will be launched, at least at the secondary level, in September of this year. It is likely to take several years to evolve detailed programmes incorporating all that the Working Groups proposed and actual experience in the schools will help to adapt the programmes more precisely to the needs.

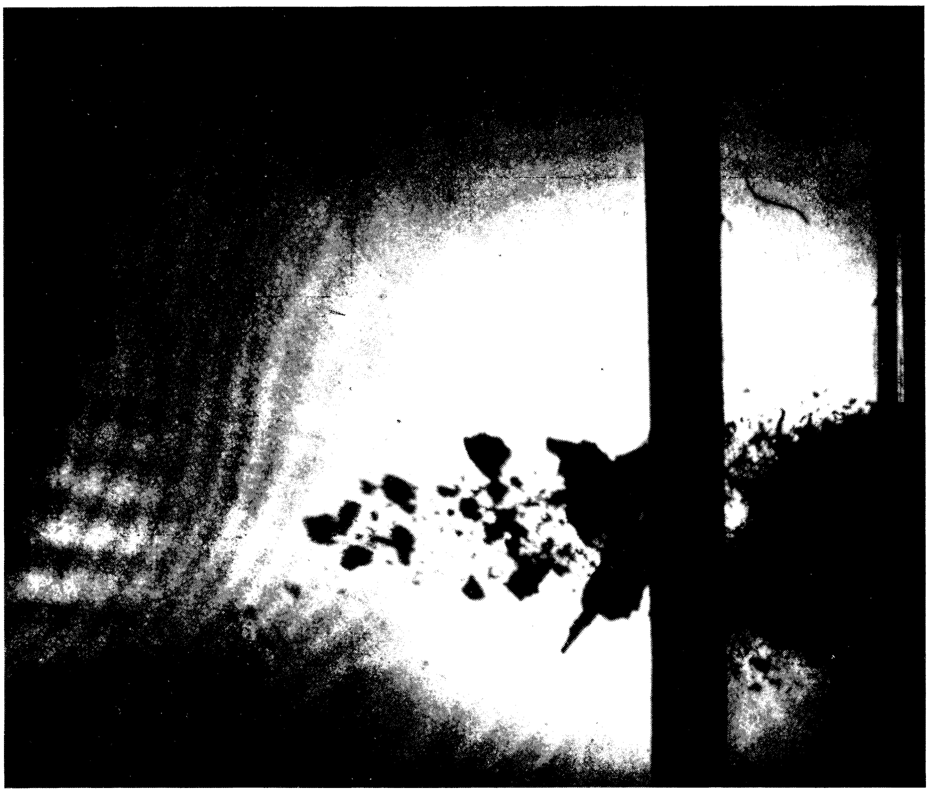
Several Member States have already indicated that they are prepared to send teachers for the start of the school year in September. Thus as from September a new type of school will open, albeit on a modest scale initially, which could make important contributions to the development of European education.

BERKELEY
New tunnelling effect with electrons

When listing applications of accelerators in the report of the USA Conference in the April issue (page 105) we mentioned the novel idea of using electron beams to cut through rock. The technique has been investigated by R.T. Avery, T.L. Brekke, I. Finnie and D. Keefe with help from many Berkeley staff and the financial support of the National Science Foundation as part of their 'Research Applied to National Needs' programme.

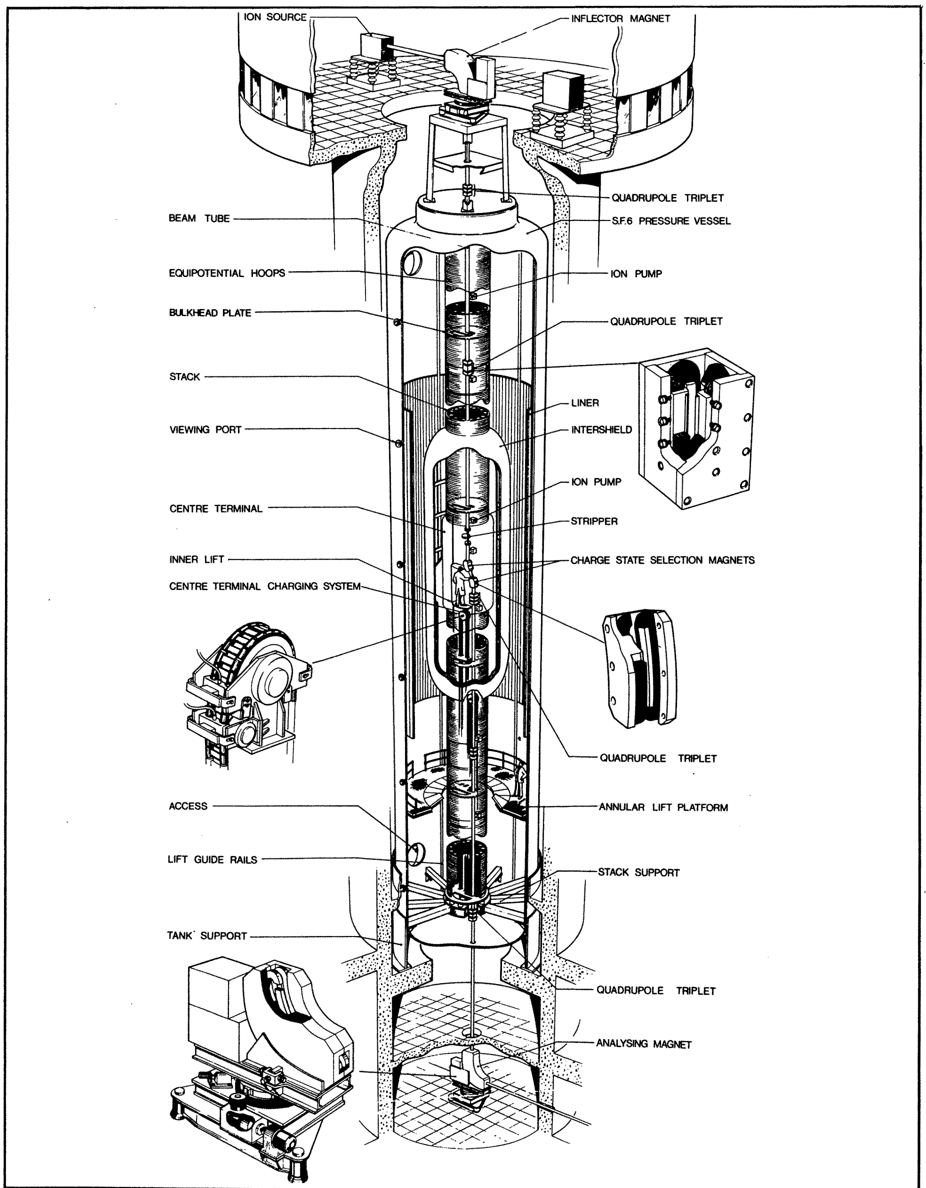
It was during the design of the injector for electron ring accelerator research at LRL (see, for example, vol. 11, page 108) that it was realized that intense electron beams could cause considerable mechanical damage to materials that crossed their path. This potential was studiously avoided in the ERA injector but some experiments began to investigate the effects on rock with a view to application particularly in underground tunnelling. For many reasons — such as the preservation of the surface environment, additional safety, or avoiding an already crowded surface environment — tunnels, storage areas, etc., cut underground are preferable. However, the associated costs are often prohibitively high and it was thought worthwhile looking into the idea of using electron beams which could prove a cheaper or more appropriate way of cutting through rock.

The phenomenon involved is known as 'shock spalling'. It is not the same phenomenon as that proposed previously using electron beams or lasers to cut through rock by melting or vaporising the rock surface, which requires much greater amounts of energy to achieve the same purpose. Shock spalling occurs when intense



High speed photography records pieces of granite being exploded away from a 1 cm slab (the dark vertical bar running across the photograph) which has been bombarded with a single intense burst of electrons for 50 ns. The electron burst created a pressure in the granite which not only disintegrated the right side of the rock where the electrons entered but also travelled through the slab and fractured the left side also. (Photo LBL)

Drawing of the tandem Van de Graaff proposed as a nuclear structure facility to be built at the Daresbury Laboratory. The machine is designed to operate at a central terminal voltage of 20 MV, initially, with scope for increasing the voltage to 30 MV. The machine would be vertically mounted with a variety of ion sources available at the top and the possibility of distributing particles to experiments over a 210° sector at the bottom.



stresses are introduced in the rock by locally depositing energy in pulses lasting less than a microsecond. Comparatively modest amounts of energy can initiate stress waves exceeding the tensile strength of the rock and resulting in 'mini-explosions' breaking off flakes of rock. The stress waves can travel through the rock and can cause further shock spalling at an interior surface. Such a double effect is shown in the photograph.

Experiments were carried out with electron beams with characteristics such as — 50 ns pulse length, 1 400 A per cm^2 current density, average energy around 1 MeV, beam diameter of a few centimetres. One pulse of this type can cut out about 1.6 cm^3 leaving a crater about a millimetre deep. Shock spalling was observed for a wide variety of rocks. Wet rocks (such as often encountered in tunnelling) showed more spalling than dry rocks.

Some preliminary information was gathered on energy thresholds, etc... Independently, J.H. Shea of Physics International Co. has also studied rock spalling and arrived at similar data.

Much more research into the phenomenon is needed before an optimum system can be specified and before the economics of using electron accelerators for tunnelling can be sensibly estimated. Also, accelerator technology would need to be pushed further to provide streams of short electron pulses with MeV energies and intensities in the tens of kiloampere region. The first results however have been sufficiently encouraging for the research to continue.

DARESBURY Nuclear Structure Facility

Two years ago a design study for a large tandem Van de Graaff accelerator, to be used for nuclear structure research, began at the Daresbury Laboratory. After eighteen months of work, a design report was prepared which now has the backing of the UK Science Research Council and is before the Treasury for financial approval.

The study was carried out with the strong support of the nuclear physics community in the UK and in collaboration with establishments of the Atomic Energy Authority (Aldermaston, Harwell and Risley) and with the Universities of Birmingham, Liverpool, Manchester, Reading and Salford.

The accelerator has been designed to operate at 20 MV initially with the possibility of subsequently stepping this up to provide a wide variety of beams from protons to the heaviest

A test rig for a 'laddertron', the new charging technique for use in Van de Graaffs, developed by Daresbury and Reading University. The origin of the name can be seen in the form of the continuous loop which conveys the charge. Bars of metal conductor carrying the charge form the rungs of the ladder linked by insulators.

(Photo Daresbury)

ions. The major features of the design are as follows:

The machine will be mounted vertically, which simplifies many mechanical problems and enables the accelerated beams to be fanned out to experiments over a wide angle by bending them into the horizontal plane with a 90° magnet. In the horizontal plane, a 210° sector is being left available for experiments but not all of it is intended to be used initially. Scope has also been left for the addition of a further acceleration stage (using a cyclotron or superconducting linac) if it is desired later.

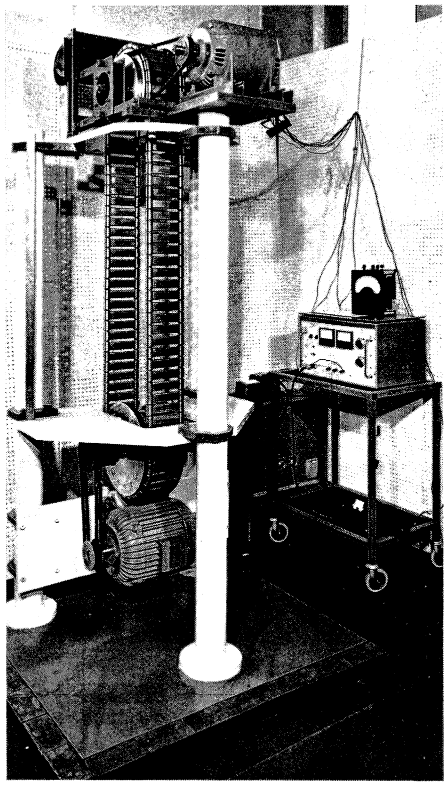
A similar right angular magnetic bend at the top of the machine will make it possible to sprinkle ion-sources in a circle around the top of the accelerator tower. It will also be possible to provide polarized or bunched beams. This injection region is held at earth potential. The 'tandem' acceleration proceeds, as usual, by accelerating negative ions from the injector to a central terminal held at a positive high voltage (20 MV or above) where electrons are pulled off by gas or foil strippers. The positive ions thus produced are further accelerated away from the terminal to earth potential at the bottom of the machine.

The accelerator will operate inside a pressure tank which is cylindrical with domed ends, filled with sulphur hexafluoride at a pressure of better than 10^{-7} torr. The tank height is 45 m with an inner diameter of 4 m. Inside it is the accelerator 'stack' consisting of two active lengths of 13.4 m each side of the central terminal which is 4.5 m long. There are 'dead sections' added along the stacks where beam shaping magnets are located.

On the way to laying down these design parameters, a considerable amount of research proved necessary particularly in order to be confident of withstanding voltages up to 30 MV. The design team found that Van de Graaff construction has not, up to now, had the backing of very thorough development programmes which are customary in the world of accelerators for high energy physics. It was therefore necessary to do some careful work with high voltages. This was carried out at a 6 MV tandem machine at Aldermaston and at Daresbury.

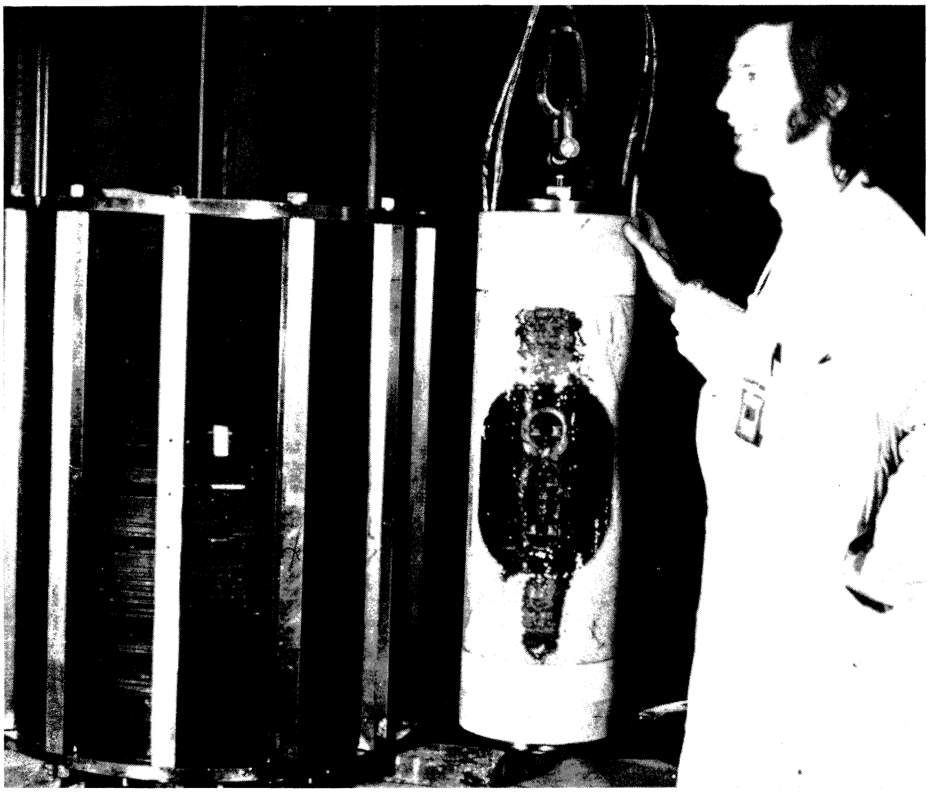
Several advances have already emerged from this work, the most important being a new method of charging the central terminal. This is normally done in Van de Graaff machines by spraying charge onto an insulating fabric belt which moves in a continuous loop carrying charge up to the terminal where it is picked off. The limitations of the belt method are that uneveness of the belt leads to variation in the charging current and hence instability in the central terminal voltage and the energy of the emerging beam. Also the belts wear, causing dust in the machine and possibly degrading the clean high voltage conditions. Daresbury and Reading have developed a new charging technique which is known as the 'laddertron'.

The name comes from the configuration of a series of conductor bars, like the rungs of a ladder, linked at each end by insulating beads. Joints between the conductors and insulators make it possible to have a continuous loop moving at high speed over pulleys. Charge is induced on to each conductor when passing a plate at high potential — a reverse process pulls the charge off at the central terminal. A current as high as 550 μA has been carried on a laddertron prototype, moving at a speed of 15 m per s, built for a 1 MV Van de Graaff at Reading. This laddertron was constructed of aluminium and stainless steel conductors with glass filled nylon for insulators.



Other developments have emerged from the study of such things as field shaping and surge phenomena in voltage breakdown. New structure designs have evolved using field shaping to reduce the field gradient in the critical region around the cathode insulator junction. A new type of annular spark gap will ensure very fast triggering to protect the structure if fast voltage surges occur in fault conditions. A theoretical analysis of these problems was carried out using an equipotential field plotting programme on a computer and experimental checks have given satisfactory results.

On the engineering side, a process has been worked out for bonding metal and ceramic together efficiently to give vacuum-tight joints. Alumina and titanium can thus be used to build up an acceleration tube completely free of organic materials. Organic vapours are one of the major



The coils of the MOBY magnet prior to their assembly inside an iron yoke. MOBY reached 5 T during its first tests and is now being pushed towards the design figure of 6 T which is the highest dipole field level aimed for in the magnet development programmes of the GESSS collaboration.

(Photo Saclay)

sources of breakdown problems and the new bonding technique applied to the NSF should help considerably towards achieving voltages in excess of 20 MV.

It is intended that the NSF should be built at the Daresbury Laboratory. The latest state of play is that the Department of the Environment has announced the holding of a 'public enquiry' which will examine various aspects of the impact of such a project on the Daresbury region. The date when this enquiry will be held has not yet been fixed but the nuclear physics community is hoping that it will be very soon so as to retain the momentum towards the realization of what would be one of the world's most advanced facilities for this type of research.

SACLAY First tests on MOBY magnet

The progress towards the possible construction of a high energy synchrotron using superconducting magnets was reviewed in the April issue (pages 117-118). In Europe this work is being carried out by a collaboration of the Karlsruhe, Rutherford and Saclay Laboratories known as GESSS (Group for European Superconducting Synchrotron Studies). Each Laboratory has a development programme to build pulsed dipole magnets suitable for a high energy machine and the construction techniques are sufficiently different in the three centres to enable several possible solutions to be compared.

Saclay are aiming for the highest magnetic field level in a dipole known as MOBY. This magnet has been completed and the first tests have begun. Its major parameters are — length 0.5 m, aperture 10 cm diameter, design peak field 6 T at a current of 1.5 kA with a rise time of around 10 s, coils wound from 24 strand braid each incorporating 1 000 filaments of niobium-titanium superconductor 10 μm in diameter embedded in a copper matrix, coil cooling by copper heat drains protruding into the surrounding helium bath, iron core close around the coil.

In the first tests a field of 5 T was achieved within the magnet aperture after a period of 'training' (successive improvement towards peak performance as the magnet is taken through cycles of normal and superconducting states). This field level was reached after about one hundred transitions to normal state — during the transitions the coil temperature never climbed above 50 K.

The peak field level was still rising which indicated that further training could achieve the design field but it was decided to halt the performance at 5 T so as to carry a series of measurements on the field quality. Most of the measurements were done with MOBY operated with d.c. current rather than pulsed. They revealed that the sextupole and decapole components of the field were close to the anticipated levels. Remanent field had a 0.65 mT dipole component and a 0.45 mT sextupole component over half the aperture which is also close to prediction. When the magnet was pulsed, the losses in the coil were as calculated but losses in the surrounding iron yoke were lower than calculated.

A more precise series of measurements on MOBY is now under way. Correction elements will be brought into action and the peak field will be pushed towards the design figure.

While on the subject of superconducting magnets we should correct confusion concerning cm/mm/radius/diameter which crept into the article in the April issue. In considering aperture requirements for a superconducting conversion of the SPS, low energy injection (10 GeV) would require an aperture of around *5 cm radius*, high energy injection (200 GeV) could reduce this to around *4 cm radius*. This was highly garbled on page 117 of last month.

KARLSRUHE En route to a superconducting r.f. separator

A superconducting r.f. separator is under construction at Karlsruhe for use at the SPS in the beam-line to the Omega spectrometer. Tests on a section of the first 3 m deflector have given results close to the desired parameters.

A twenty-cell section for a 3 m long niobium superconducting deflector. The section is reinforced by niobium bars and has an overall length of 60 cm so that it can be accommodated in the Karlsruhe high temperature, high vacuum furnace for annealing. The first tests on the section have given very encouraging results.

(Photo Karlsruhe)

The separator will be operated at 2 855 MHz (S-band) and will consist of niobium deflectors each about 3 m long. It is intended to reach deflection fields of at least 2 MV per m which implies peak magnetic fields at the surfaces inside the cavities of 310 gauss. To steer clear of thermal breakdown, a quality factor (Q) of at least 5×10^8 is needed which limits the power absorbed inside a deflector to about 15 W.

The separator will be installed in a beam-line with a distance of 90 m between the cavities and will make it possible to separate kaons and anti-protons in the range 10 to 30 GeV/c. The estimated gain in the intensity of the desired particles is of the order of ten compared to an unseparated beam.

In superconducting r.f. separators, low losses should make it possible to achieve very long pulse lengths such as are needed for counter experiments. However, there are two main limitations to be overcome:

i) According to the BCS theory of superconductivity, surface resistance, which is directly linked to the r.f. losses inside the deflectors, should decrease exponentially in the temperature range of interest (less than 2 K). The decrease is always limited at some temperature by the onset of a residual resistance because of the quality of the superconducting surfaces. This is still poorly understood.

ii) The deflection fields which can be achieved are limited by breakdown which is linked to the peak magnetic or electric fields reached somewhere on the cavity walls.

Lead and niobium are the most promising superconducting materials because of their comparatively high critical temperature and magnetic fields (for lead these are 7.2 K and 750 gauss and for niobium 9.25 K and 1 900 gauss). Lead has been successfully pursued particularly at Rutherford (see vol. 11, page 136) but Karlsruhe concentrated on niobium which has greater potentialities.

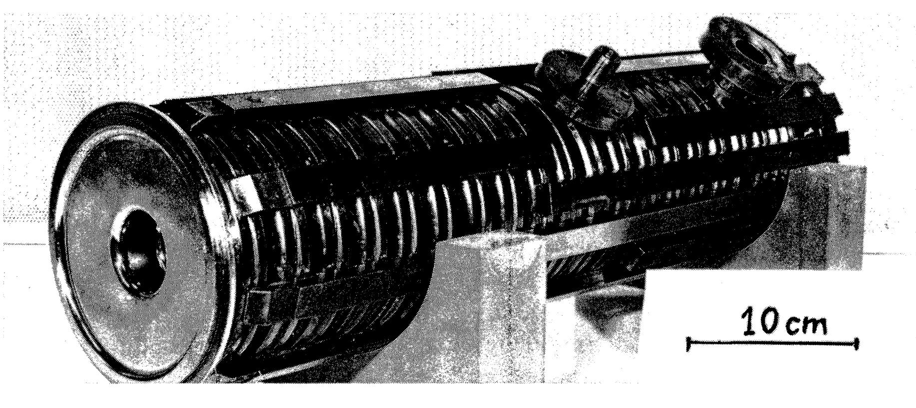
To tackle the difficulties of fabrication, welding and surface treatment of complicated structures, several test-deflectors and a twenty-cell section, intended for the first deflector, were constructed in close collaboration with Siemens. The cells are machined out of solid niobium and joined together by electron beam welding. Since all the electromagnetic processes, at the frequencies used, occur in a surface layer of the superconducting material which is only 500 angstroms thick and since the r.f. losses have to be about 10^5 times smaller than for copper, extremely clean, smooth surfaces are needed. This involves elaborate surface treatment.

At Karlsruhe the best results have been obtained by applying the following multi-stage process twice: removal of about 50 μm of niobium by electropolishing, anodizing with a layer of niobium oxide about 500 angstroms thick, firing in an ultra-high vacuum furnace for 24 hours at 1850°C and about 10^{-9} torr.

The results obtained on some test deflectors and the twenty-cell section are listed in the Table. The required Q values and peak magnetic fields have been largely reached.

Once a deflector reaches high field levels, these are not reduced by subsequent cooling cycles under vacuum or by careful exposure to dust free air and/or methanol. These results encouraged the construction of a full 3 m deflector which will be assembled out of five sections. The first section (60 cm long, 20 cells) was tested at the end of April and immediately gave a field of 350 gauss, corresponding to a deflection field of 2.3 MV per m. The Q value is still low by a factor of two but experience indicates that further surface treatment should improve this.

Superconducting deflector results from Karlsruhe	Quality factor Q	Peak magnetic field (gauss)	Peak deflecting field (MV per m)
4 cell test deflector	4.3×10^9	500	3.2
8 cell test deflector	0.5×10^9	425	2.7
12 cell test deflector	0.58×10^9	250	1.6
20 cell section	0.235×10^9	350	2.3



Tests on single and combined sections of the first deflector will continue. Furthermore, a research programme to improve surface quality and to develop more sophisticated deflector structures is under way aiming for field levels higher than 4 MV per m. This should push the separation limit in the r.f. beam to Omega up to 40 GeV/c. If higher frequencies were used (C-band), the limit could climb to 50 GeV/c.

The work has been carried out at Karlsruhe by W. Bauer, G. Dammertz, M. Grundner, H. Lengeler, and E. Rathgeber.

Work on superconducting r.f. cavities at Karlsruhe does not stop with the separator work. There is also a development programme on superconducting linear accelerators (see vol. 12, page 133), such as could be used for the acceleration of protons or of heavy ions, which could result in short accelerators with long duty cycles.

This work was reported at the USA Accelerator Conference by M. Kuntze. Related work is under way at Stanford, Argonne and Cal. Tech. Helix structures have been studied for the acceleration of low velocity particles and, at Karlsruhe, a maximum accelerating gradient of 2.8 MV per m, corresponding to a 700 gauss magnetic field, with a Q of 2×10^9, has been obtained in a niobium helix structure operating at 90 MHz. This followed the same surface treatment technique as mentioned above.

Two 0.5 m sections, each consisting of five half wave-length helices, have been built following a design developed in collaboration with Francfort University. Protons were injected at 750 kV into one section from a Cockcroft-Walton pre-injector which can give a continuous beam current of 1.3 mA. A bunched beam of 400 μA can be fed to the first superconducting helix section and protons are successfully accelerated. Effort is now being concentrated on bringing the two separate superconducting sections into action simultaneously.

LOS ALAMOS
Positive and negative at the same time

The 800 MeV meson physics facility, LAMPF, at Los Alamos has added another notch to its count of 'firsts'. At the beginning of April both positive and negative particles were accelerated along the linear accelerator at the same time.

From the early days of working on the project, the requirement of simultaneous acceleration of both varieties of charged particle was fed into the design. This is possible in linear accelerators because the accelerating fields along the machine swing from one direction to the opposite direction at very high frequency. It results in tiny fractions of time for which particular sections of the machine establish the right conditions for accelerating positives followed by tiny fractions of time with the right conditions for accelerating negatives.

LAMPF is therefore provided with two ion sources — one providing protons and the other providing negative hydrogen ions in which the hydrogen molecule has broken up to leave an extra electron tacked onto a hydrogen atom. (In addition, there will later be another ion source to provide polarized protons.)

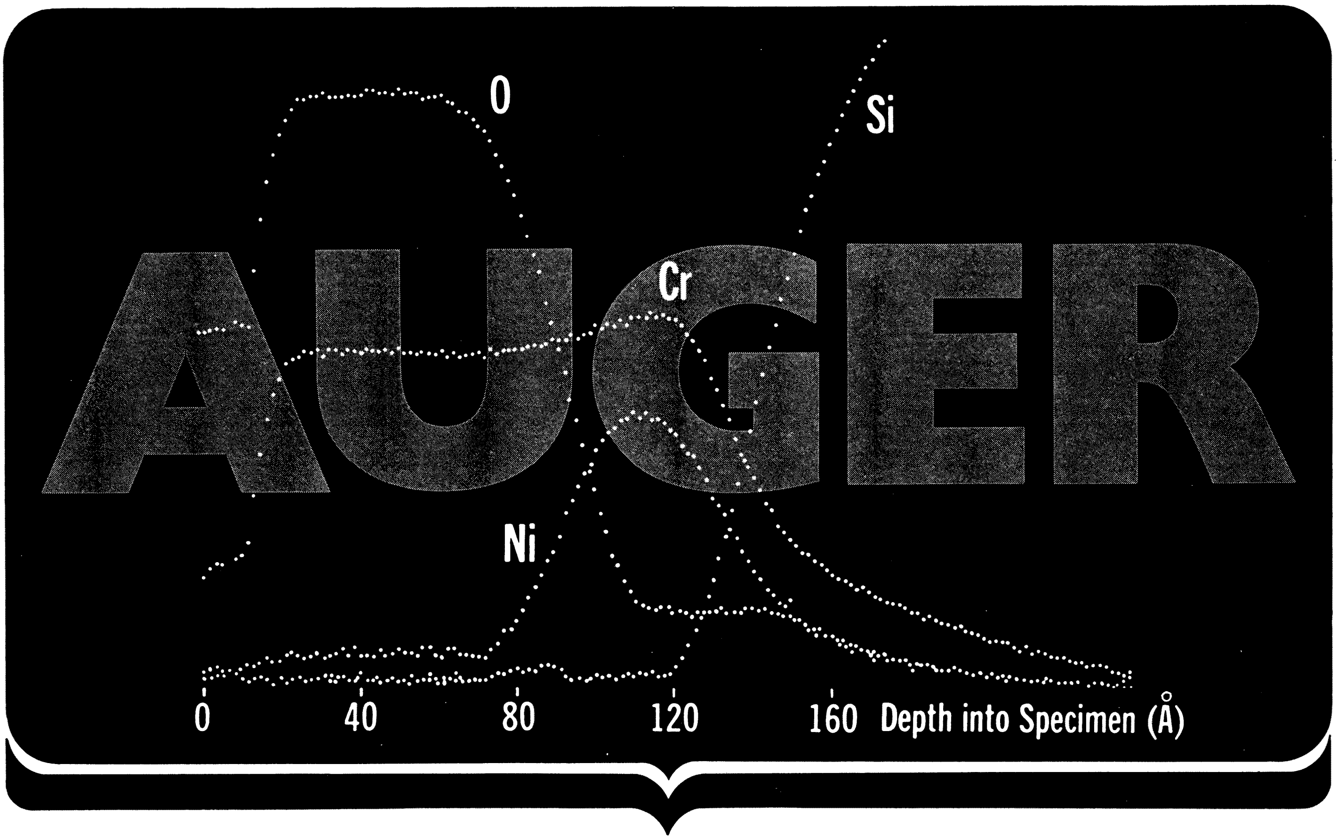
The first simultaneous acceleration was of 200 μA of protons travelling along the accelerator interlaced with 100 μA of negative ions. The particles were taken to energies in excess of 100 MeV which is also the highest energy yet achieved for negative hydrogen ions. Using the accelerator in this way increases its potential in feeding the experimental programme while adding comparatively little to the cost. Further machine developments will aim to increase the intensities of the simultaneous beams and to take them to the peak energy of 800 MeV.

LIVERMORE
Still no quarks

A careful search for quarks in high energy cosmic rays has been carried out by a team from the Lawrence Livermore Laboratory. In over 200 000 photographs of cosmic ray showers there was no sign of the type of track which could be assigned to a low ionizing particle such as the hypothetical fractionally-charged quark.

The search was prompted by the results from the Sydney team (see vol. 9, page 309) who seemed to have evidence of quarks. From 60 000 high energy cosmic ray tracks they claimed five possible quarks. The photographs were taken in cloud chambers and this technique was also used in the Livermore experiment carried out by A. F. Clark, H.F. Finn, N.E. Hansen and D.E. Smith.

Improved methods of scanning the cloud chamber photographs, both visually and by computer, were developed. About four hundred candidate quark tracks were picked out but none withstood detailed examination. The team fix the probability of finding fractionally charged particles in cosmic rays as less than 1 in 10^{10} per cm^2.

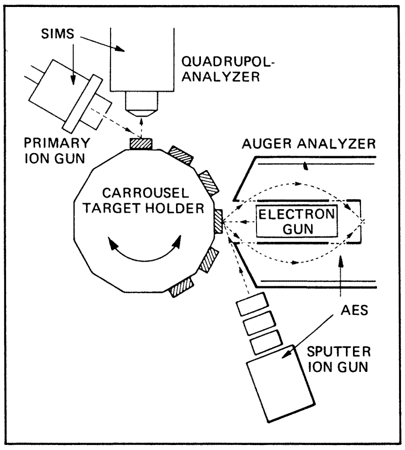


Auger-Electron Spectroscopy (AES) for automatic Thin Film Analysis

Select the chemical elements which interest you, put the ion gun into operation and leave the apparatus to operate automatically. Within a short time it will give you the concentration of the selected elements in relation to the distance from the original specimen surface.

The above example shows a chrome-nickel film on a silicon substrate. The dissimilar distribution of the chrome and nickel can distinctly be recognised. BALZERS co-operate with Physical Electronics Industries Inc. (PHI), USA in the construction of instruments for profile measurements of this nature and surface investigation.

In addition to Auger-Electron Spectroscopy (AES), BALZERS Secondary Ion Mass Spectrometry (SIMS) can also be carried out in these instruments, which means that a number of specimens can be investigated with both methods in only one plant, without interrupting the vacuum. Simultaneously with the specimen manipulator, the cylindrical Auger analyzers and the SIMS equipment, the following BALZERS/PHI-additional components can also be mounted on the vacuum chamber: ion guns (for etching the specimen in AES), electron source for grazing incidence bombardment (AES for insulators), fracture attachment (for breaking open the specimen in UHV), electron bombardment heater (by electron bombardment), microscope (for observing the specimen surface in AES). If you are interested we shall be pleased to send you full details.



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MODEL 5175

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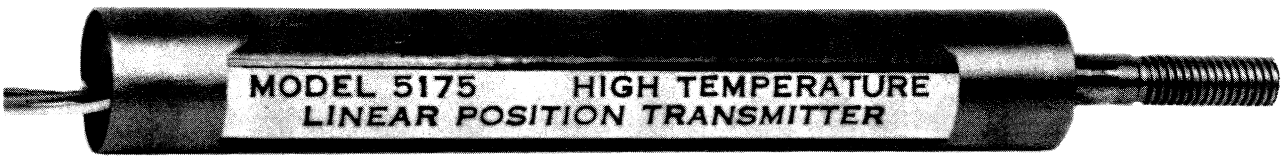
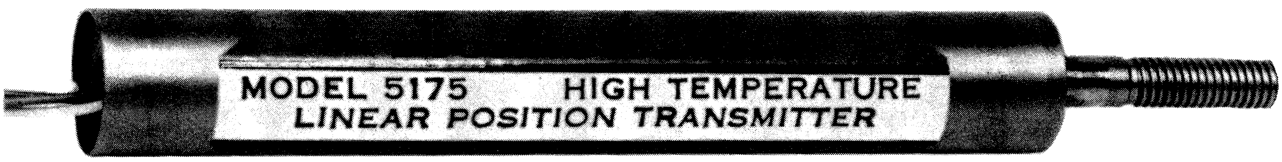
PRODUCT DESCRIPTION

Measures linear position up to **6"** and will provide an equivalent output signal proportional to change in position. Transducer wiper is positioned along a precision electrical element thus allowing the input voltage to be divided as a function of the mechanical input.



FEATURES

- High Level Output Signal
- +260°C Operating Capability
- Stainless Steel Construction
- Continuous Shaft Rotation
- Sand, Dust and Fungus Protection

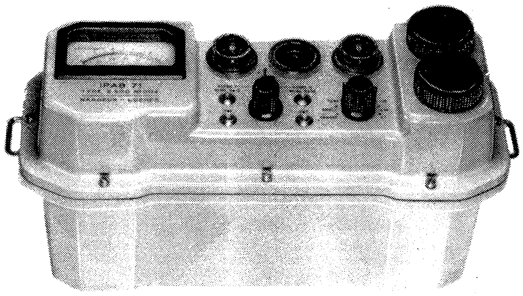


PRINCIPLE OF OPERATION

The transducer contacts are positioned along a precision electrical element which varies the resistance. Excited by either an AC or DC input voltage, mechanical backlash is eliminated by a positive connection between the shaft and contact assembly.

Bourns (Schweiz) A.G., Baarerstrasse 8 6301 Zug
Tel. 042 23 22 42 Telex 78722

RADIO PROTECTION



POLYRADIAMETRE PORTATIF

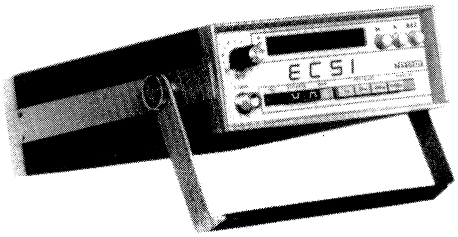
IPAB 71 Réf. 500

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

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Usine : 37600 Loches - FRANCE

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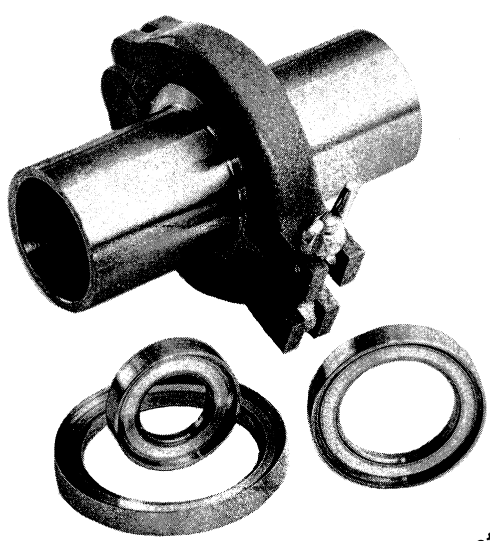
All metal indium seals for small flange connections



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.

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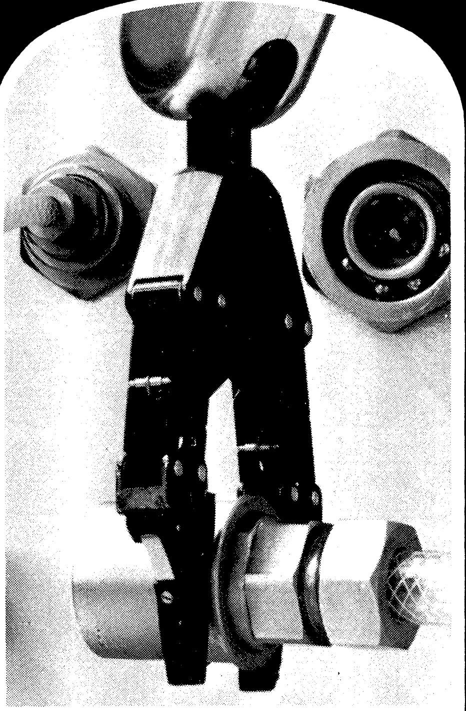

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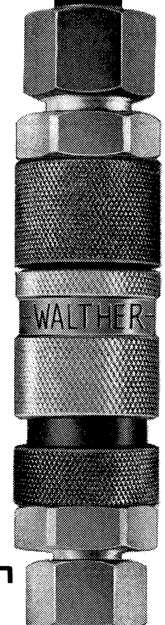

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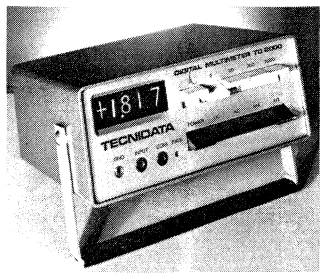

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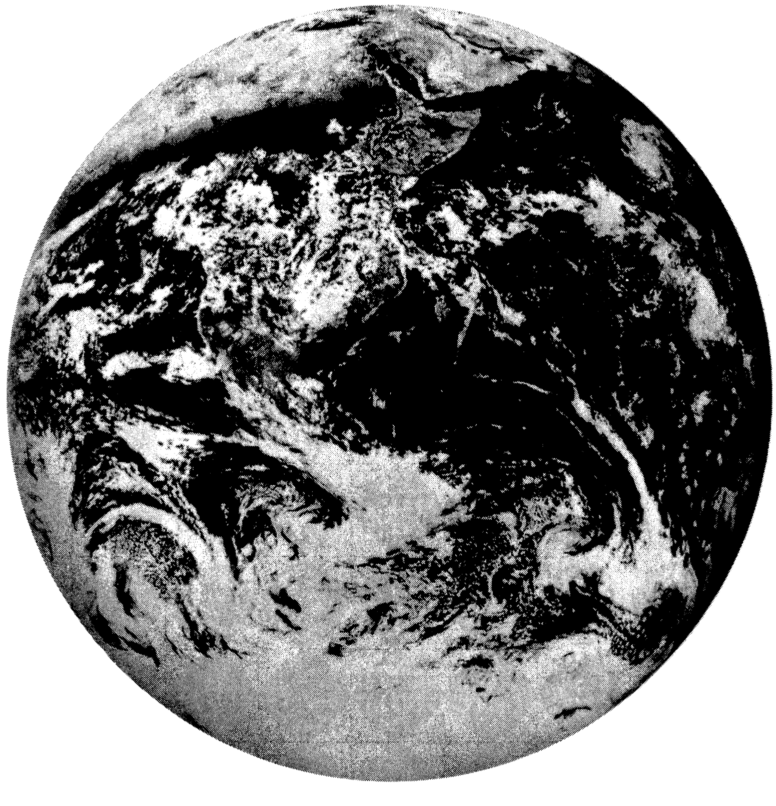

Quand on donne l'heure avec une précision d'une seconde sur 30000 ans... on a vraiment une longueur d'avance dans la fabrication des calculateurs scientifiques.

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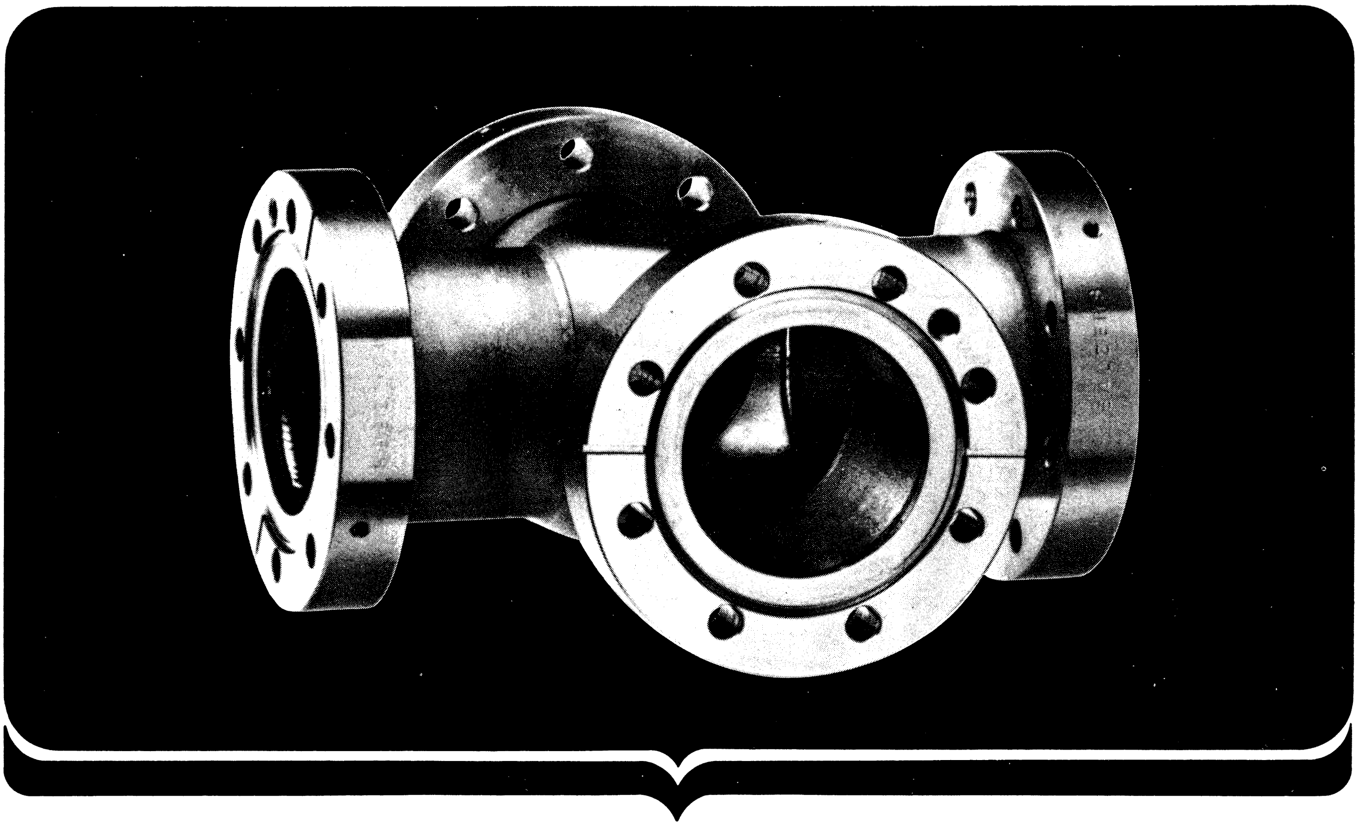

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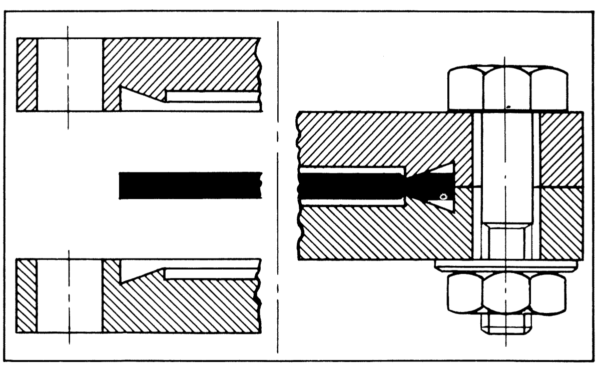

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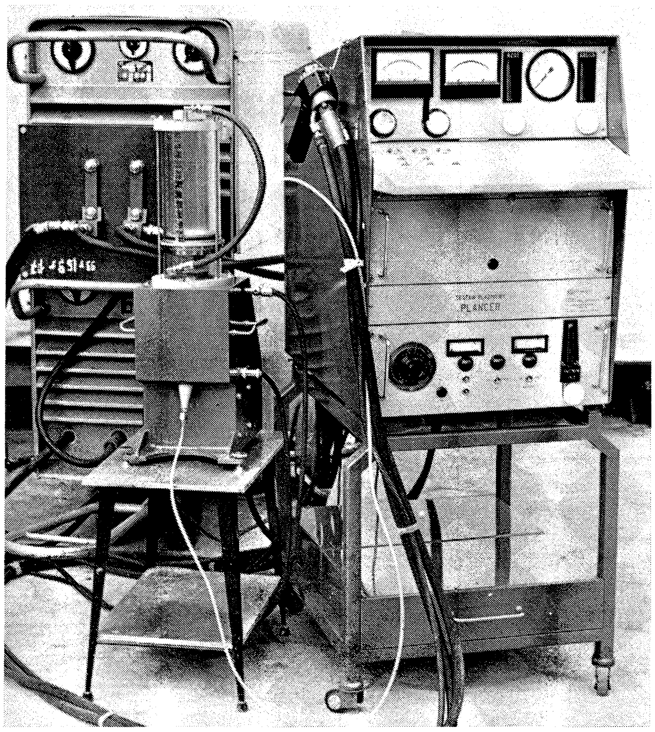

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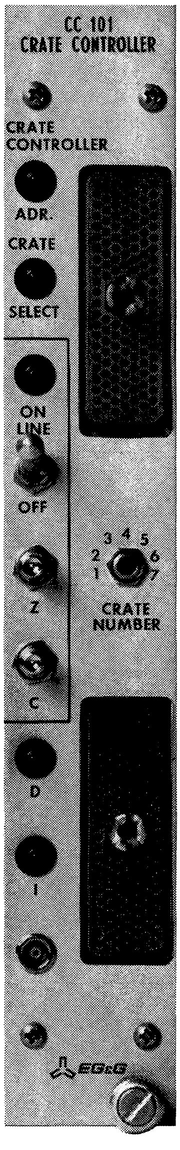
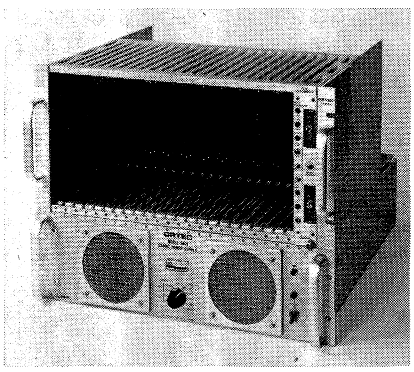


Here's why you should buy it from EG&G/Ortec.

If you want one of the new Type A-1 CAMAC crate controllers, you'll be pleased to know that one is in production right now in Oak Ridge. Our new CC101 crate controller has been designed to conform to the most recent Type A-1 specifications of EUR-4600.

True, you can get by with one of the older Type A controllers other manufacturers are selling. But it won't have an X (function accepted bus) line or LED indicators to monitor the constantly changing branch demand L (look-at-me) status, crate select, and crate controller addressed.



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So as long as you have to purchase a crate controller or two, it makes dollars and sense to get our CC101.

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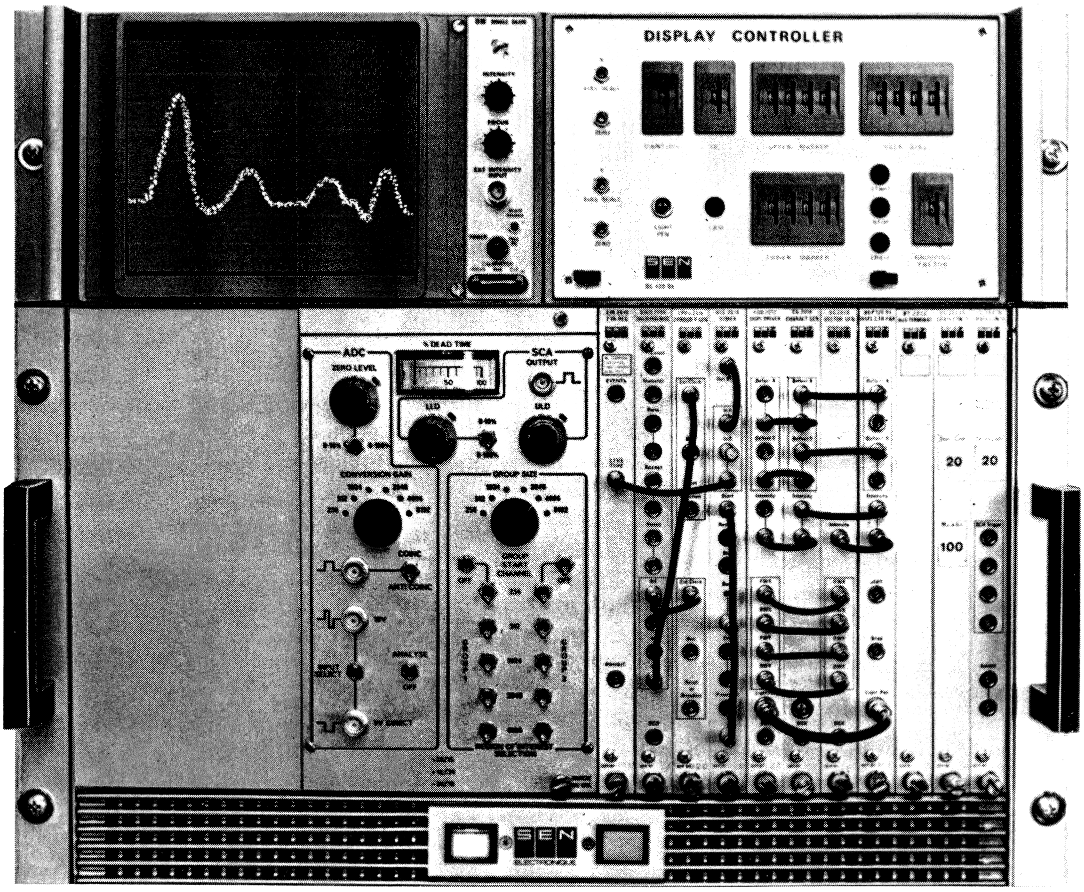

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* *The current range of SEN CAMAC consists of 37 different modules.*

For further information contact:

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