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Contents

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The cover photograph this month is a departure from the usual kind, since it is only remotely connected with experiments in sub-nuclear physics and was not even taken on the CERN site. Although the shape of CERN is ever-changing, this particular piece of ground breaking, performed by Mr. G. H. Hampton, Directorate Member for Administration, took place on 26 April at Grand-Saconnex and marked the beginning of work on the first block of flats to be erected for the CERN Staff Insurance Scheme. Standing behind Mr. Hampton is Mr. M. Disch, one of the administrators of the Scheme, and on the far left of the group of spectators is Mr. C. Tièche, Leader of CERN's Finance Division, who is its Manager.

This action towards the alleviation of the housing problem in Geneva, an account of which is given on pp. 85-86 of this issue, is but one aspect of the interrelation of CERN and its neighbouring communities. Some of the others were discussed at a meeting earlier this year, also in Grand-Saconnex, which is reported on pp. 87-89.

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The European Organization for Nuclear Research, more commonly known as **CERN** (from the initials of the French title of the original body, 'Le Conseil européen pour la Recherche nucléaire', formed by an Agreement dated 15 February 1952), was created when the Convention establishing the permanent Organization came into force on 29 September 1954.

In this Convention, the aims of the Organization are defined as follows:

> **'The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto. The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available.'**

Conceived as a co-operative enterprise in order to regain for Europe a first-rank position in fundamental nuclear science, CERN is now one of the world's leading laboratories in this field. It acts as a European centre and co-ordinator of research, theoretical and experimental, in the field of **high-energy physics,** often known as **sub-nuclear physics** or the **physics of fundamental particles.**

High-energy physics is that front of science which aims directly at the most fundamental questions of the basic laws governing the structure of matter and the universe. It is not directed towards specific applications — in particular, it plays no part in the development of the practical uses of nuclear energy — though it plays an important role in the education of the new generation of scientists. Only the future can show what use may be made of the knowledge now being gained.

The laboratory occupies an area of 41 hA (100 acres) at Meyrin, Canton of Geneva, Switzerland, next to the frontier with France. A similar area on adjacent French territory is expected to be taken over shortly.

Its main experimental equipment consists of two large particle accelerators:

— a 600-MeV synchro-cyclotron,
— a 28 000-MeV (or 28-GeV) proton synchrotron,

the latter being one of the two most powerful in the world.

The CERN staff totals some 2100 people.

In addition to the scientists on the staff, there are about 300 Fellows and Visiting Scientists, who stay at CERN, either individually or as members of visiting teams, for periods ranging from two months to two years. Although these Fellows and Visitors come mainly from universities and research institutes in the CERN Member States, they also include scientists from other countries.

Thirteen Member States contribute to the cost of the Organization, in proportion to their net national income:

Austria (1.95%)	Italy (10.78%)
Belgium (3.83%)	Netherlands (3.92%)
Denmark (2.07%)	Norway (1.47%)
Federal Republic of Germany (22.74%)	Spain (2.18%)
France (18.57%)	Sweden (4.23%)
Greece (0.60%)	Switzerland (3.19%)
	United Kingdom (24.47%)

Poland, Turkey and Yugoslavia have the status of Observers.

The budget for 1965 amounts to 128 760 000 Swiss francs (= $29 800 000), calling for contributions from Member States totalling 126 400 000 Swiss francs (= $29 300 000).

A supplementary programme, financed by twelve states, covers design work on two possible future European projects in high-energy physics — intersecting storage rings for the 28-GeV accelerator at Meyrin and a 300-GeV accelerator to be built elsewhere ●

Last month at CERN

PS operation and experiments

Since the experiments at the proton synchrotron in the second half of March were reported in the last issue of *CERN COURIER*, more information has become available on the **target programming** during that period, which included the first application of a new technique based on that of the now commonly used 'servo-target'. The aim was to intercept about 10 % of the beam on target no. 1, at a momentum of 17 GeV/c rather than the full 20.9 GeV/c required for the bubble-chamber targets. This was to provide secondary particles for various electronics experiments operating 'parasitically' at the same time as the bubble chambers, and the requirement was for a long pulse on the target at constant intensity. Whilst the protons were still being accelerated, therefore, a perturbation was introduced into the orbit so that some of the protons struck the target instead of only passing near to it. The electrical signal from the counter that monitors the secondary particles emitted from the target was then compared automatically with a rectangular pulse* proportional to the intensity of the circulating proton beam, and the difference signal was fed to the radial beam control, which governs the position of the beam inside the acceleration tube. In this way a rectangular target pulse was obtained, with a duration of 150 milliseconds, whilst the main proton beam was making some 70 000 revolutions around the ring.

Then, in each acceleration cycle, at 20 GeV/c one of the 20 bunches in the proton beam was ejected from the machine, by means of the fast ejection system in the South target area, to provide particles for tests on the enlarged CERN heavy-liquid bubble chamber. The rest of the beam then circulated at constant energy round the accelerator for 60 milliseconds (during the 'flat top' of the magnetic field) before being divided between targets 10 and 60 to produce secondary beams for the 81-cm chamber in the North hall and the 2-m chamber in the East bubble-chamber building, respectively.

It is also of some interest to note that the average **proton beam intensity** over the whole operating fortnight was 88.3×10^{10} protons per pulse, whilst for one of the eight-hour shifts it was 98.2×10^{10} protons per pulse.

During this period also, those members of the operations and maintenance section of the **PS Radio-frequency Group** who were accommodated in the North experimental hall and Laboratory 8 moved into an annexe to the PS central building in the middle of the ring. This has liberated the whole of the North hall for the installation of physics experiments and, incidentally, enabled all the section to be collected together in one place.

In the 2 ½ weeks running before the Easter shut-down (weeks 14,15 and 16 of the PS schedule) the emphasis was again on bubble-chamber experiments, although, as usual, a number of counter experiments continued to take data or perform calibration tests during this time and three days were devoted wholly to an important emulsion experiment.

In the East area, the **152-cm British National Hydrogen Bubble Chamber** collected another 151 000 photographs of 10 GeV/c negative kaons. This was an experiment using the o_2 beam line including the recently developed

* Electrical signal rising sharply to its full value, remaining constant for a certain time (the pulse length) and then falling sharply to zero again.

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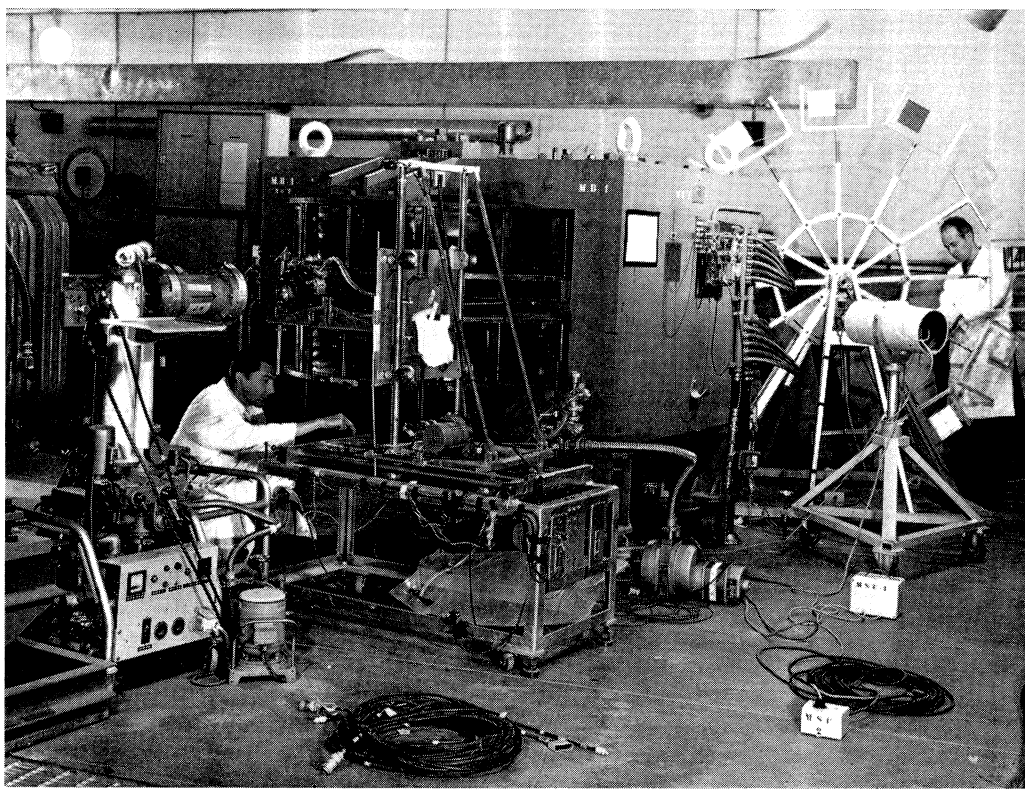


This photograph shows P. Skarek (left), **of CERN's MSC Division, and W. Hirt, of the Eidgenössische Technische Hochschule, Zürich, working on the apparatus used in the Propion experiment that was recently completed at CERN's 600-MeV synchro-cyclotron. The wheel in the background holds various target materials which can be switched into the beam as desired. In front of the wheel can be seen the television camera with whose aid the beam alignment is checked from the control room.**

radiofrequency separators *, and the fact that nothing particularly remarkable happened during the run is perhaps an indication of how rapidly new techniques become assimilated into routine operations. The films, showing an average of four kaons per picture, are being divided among institutes in Aachen, Berlin (East), CERN, London (Imperial College) and Vienna for measurement and analysis of the tracks.

The **81-cm Saclay/Ecole Polytechnique bubble chamber** was used for runs with negative kaons of momentum 800-1200 MeV/c (50 000 photographs in week 15) and positive kaons of 800 MeV/c (70 000 photographs in week 16). This was its last run in the **k_4 beam** of the North hall, and the beam line was afterwards dismantled.

The **experiment with nuclear emulsions** involved the exposure in the k_4 beam of the largest single stack of emulsion ever used, having a volume of 20 litres and a weight of 80 kg, costing about 100 000 Swiss francs. About three million negative kaons were stopped in the stack and it is expected that the subsequent search and analysis will lead to an increase of five to ten times in the number of examples of rare types of hyperfragment. Scanning and evaluation of the stack, after separation into its component pellicles, will occupy groups in Berlin (East), Brussels, Dublin, London and Warsaw during the next two or three years.

A number of **short experiments** were also carried out with the modified $c_{8\alpha}$ beam (see *CERN COURIER*, vol. 5, p. 51, April 1965). One of these was an exposure, to 20.8 GeV/c protons, of nuclear emulsions in a 180-kilogauss magnetic field, the protons coming from target no. 60 during the 2-microsecond burst for the o_2 beam, but only on every tenth pulse of the synchrotron. After this experiment, the protons provided by the same beam line were directed into the 2-litre pressure-stabilized heavy-liquid bubble chamber from Fribourg, with 50 to 1000 particles per burst entering the chamber, which was operated at low sensitivity. About 20 000 useful pictures were obtained, and these will be examined to test the possibility of measuring multiply-charged or highly ionizing particles such as deuterons, tritons and helium ions, produced by the interaction of the protons in a target inside the chamber. For one 3-hour period, target no. 61 was flipped on every 40th pulse, giving protons also to the $c_{8\alpha}$ beam for further studies of nuclear-emulsion sensitivity at liquid-hydrogen temperatures.

The SC in April

Except for the Easter holiday, the synchro-cyclotron was operated regularly throughout April for a number of physics experiments.

One of these, on which the accelerator runs were completed during the month, was the so-called **'Propion' experiment,** conducted by a team of physicists from CERN, the Universities of California, Geneva and Grenoble, and E.T.H. Zürich. This was to study the production of pions in the interaction of 600-MeV protons with various nuclei, with the dual aim of giving a better understanding of the pion-production processes in complex nuclei and of providing a better assessment of the various methods of producing pion beams with the accelerator. Momentum distributions and time-of-flight distributions of the pions and other interaction products from the targets were measured at production angles ranging from 0° to 50° and the data obtained are now being evaluated. The equipment for the detection and identification of the outgoing particles was constructed in the Nuclear Physics Laboratory of the University of Geneva.

Another experiment, started during this month, was intended to provide information about the **structure of the lithium-6 nucleus.** Carried out by a visiting group from Trieste, this experiment measures the correlation between the protons and neutrons produced in the disintegration of the lithium-6 after capture of a negative pion.

2400 people at CERN

During April the number of Staff members at CERN passed the figure of 1700 and on 9 May stood at 1717 with an additional 379 supernumeraries (auxiliary and laboratory workers). At the same time there were 70 CERN Fellows, 13 paid and 76 unpaid Visitors from Member States, 14 paid and 36 unpaid Visitors from other countries, 87 members of visiting teams and 6 students, making an overall total of 2398. Of the eleven Divisions at CERN, Site and Buildings was the largest with 405 Staff Members and 108 auxiliaries, whilst the Theoretical Studies Division was the smallest, having only 16 Staff Members together with 46 Fellows and Visitors ●

* CERN COURIER, vol. 5, pp. 35-37, March 1965.

NIMROD EXPERIMENTS AT CERN

As mentioned in last month's CERN COURIER, the breakdown of the British accelerator Nimrod has interrupted the experimental high-energy physics programme of the Rutherford Laboratory until September at least. However, some of the experiments can be done elsewhere, and arrangements have now been made to carry out three of them at CERN.

Two of them are bubble-chamber exposures, one involving positive kaons stopped in the CERN heavy-liquid bubble chamber, the other negative pions of momentum 2.2 GeV/c in the CERN 2-m hydrogen bubble chamber. Photographs from the K^+ experiment will be analysed by groups in Berkeley (U.S.A.), Wisconsin (U.S.A.) and University College, London, whilst those from the π^- run are for a group at Saclay. The latter experiment, in fact, was originally scheduled for the Saclay hydrogen bubble chamber at present at Nimrod.

The third experiment is one proposed by a group at Nimrod to search for a possible decay of the K^0_2 meson into two neutral pions — so far only the decay into two charged pions has been detected. At CERN, some of the spark chambers previously used in the neutrino experiment will be incorporated in the detection equipment and some of the physicists from the former neutrino spark-chamber group will also take part in the experiment.

CORRECTION

An error of identity unfortunately found its way into the English edition of the April issue. In the caption to the cover photograph the name should read **Gilbert Vuffray** and not **Lucien Vuffray** as printed.

CERN Staff Insurance Scheme invests in housing

Since its foundation in 1956, the Staff Insurance Scheme at CERN, which provides mainly for retirement pensions and related payments, has been primarily concerned with the accumulation of capital, and it has not been possible to follow any long-term investment policy.

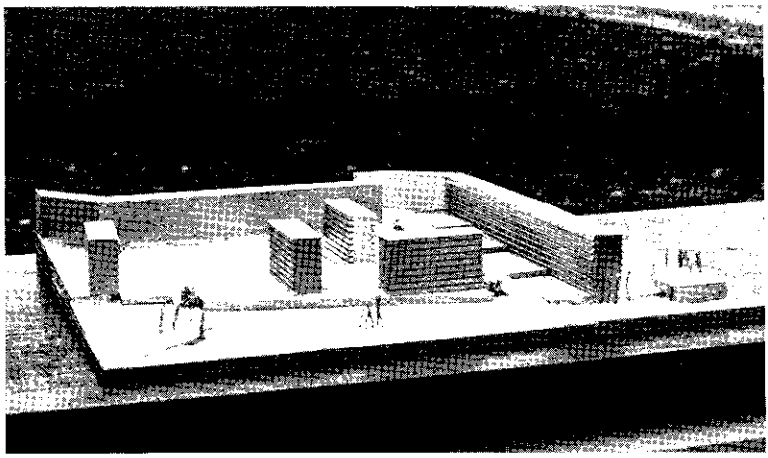
With the growth of the fund, however, such a policy has become practicable and for the last two years the Management Board has been working on one that would take into consideration both the particular character of the Scheme and the international status of the Organization. At the same time, in spite of much new building, the shortage of housing in Geneva continues to be a problem that closely affects the CERN staff. Since investment in property forms one of the means by which capital can be safeguarded against the risk of inflation, the purchase or construction of blocks of flats was seen to provide a solution of advantage both to the Insurance Scheme and to the inhabitants of Geneva. Several million Swiss francs are therefore now being devoted to this purpose.

This news was made generally known at a ground-breaking ceremony on Monday 26 April, on the site of the first block of flats to be erected by the Scheme, not far from CERN, in Grand-Saconnex. The ceremony, attended by many Cantonal and local government officials, representatives of financial and insurance bodies, the architects, and members of the press, as well as people from CERN, was opened by Mr. G. H. Hampton, CERN's Directorate Member for Administration and chairman of the Management Board of the Scheme. After welcoming the guests, he pointed out that this project, although relatively modest, was a symbol of the desire among those at CERN to become more integrated into the life of the community in which they lived.

Mr. C. Tièche, Leader of the Finance Division in CERN and, as such, Manager of the Staff Insurance Scheme, then gave some details first of CERN's contributions to the easing of the housing shortage in Geneva and afterwards of the project that they had come to see started.

Out of the 2300 people currently at CERN, only about 1100 in fact require accommodation in rented flats in the Canton of Geneva. Of the others, many live in France, others in the neighbouring Canton of Vaud, or in houses (either their own or rented), furnished rooms or hotels.

As to CERN's contributions towards the housing of these 1100, in the past few years 4 million francs have been subscribed by the Insurance Scheme to loans raised by the Canton and Town of Geneva and by the 'Caisse hypothécaire' (mortgage fund). Recently, two sets of flats, 60 in all, have been bought in Meyrin, half of them being already occupied by CERN employees. Also in Meyrin, agreement in principle has been reached on the loan of 3 million francs to the local authorities to help construct new flats to be let at moderate rents. Work on the first stage of this scheme ('la fondation HLM, Nouveau Meyrin'), providing 130 dwellings, will begin soon.



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This model of the complete project was exhibited at the ground-breaking ceremony. On the right, the long straight block is the one on which work was being started, with a possible future extension angled at the rear. The three other blocks to be built by the CERN Staff Insurance Fund are in the centre. The remaining buildings will be under other ownership.

Turning to the project at Grand-Saconnex, Mr. Tièche revealed that this had been under study for a number of years, on a co-operative basis, but the general shortage of funds for house building had stood in the way until the CERN Insurance Scheme decided to take on the whole project itself. Eventually there would be 400 flats available, arranged in one long block and three smaller ones. The long block, containing 260 flats was the one now being started. Half the total cost of 24 million francs was being provided by the Insurance Scheme and the rest by loans acquired outside the Canton. Thus the construction of these flats would have no effect on the total credits available in Geneva for housing. The average rent of the flats would be about 1100 francs per room per year.

After giving some details of the design of the buildings and the interior arrangement of the flats, Mr. Tièche pointed out that here again there was no intention of reserving the whole of the block for CERN staff. Finally, he paid tribute to the various authorities, public services, finance houses and insurance societies, for their help, without which such a project could not have been envisaged.

Mr. Hampton then proceeded with the formal opening of the site, remarking that it was fortunate that Mr. Jenny, the architect, had arranged for a fleet of bulldozers to take over from the pickaxe he was using.

After this, Mr. P. Zumbach spoke on behalf of the CERN Joint Housing Committee, of which he is chairman.

Referring to the social importance of proper housing, and its particular role in family life, he remarked that the latter took on a special meaning at CERN, where the average age was 34½ and more than 200 births were registered each year. He then went on to stress the fact that it was a deliberate policy of the Housing Committee, in all its schemes, to reserve a large part of the available accommodation for families who belonged neither to CERN nor to other international organizations. This was not only of value at the social level but also reflected a concern for the financial problems of those communities that accepted international employees into their midst.

Mr. Zumbach then took the opportunity to recall that the population of CERN was very far from being that envisaged by the general public. Most of their number were average wage-earners, who were just as much affected by the housing shortage as anyone else was. They were also worried by increasing rents, and that was another reason why the efforts of the Housing Committee were extended in a number of directions, including the possibility of co-operative house-building schemes both in France and Switzerland. The number of people interested in the latter was also an indication of the desire of many people at CERN to become established in the neighbourhood.

After mentioning also the fact that CERN had now furnished some thirty flats for the use of newly arrived staff and the numerous Fellows and Visitors who stayed for short periods at CERN, Mr. Zumbach allowed himself a personal comment. As a citizen of Geneva, he said, he had come to know CERN about a year ago and had been struck not so much by its scientific standing, which was well-known, but by the dynamic collaboration there of men and women from thirteen different European countries. This was an experience, he thought, that should be communicated to others outside, and appropriate housing conditions could help to bring this about.

The last speaker was Mr. F. Peyrot, Head of the Department of Public Works in the Canton of Geneva. Thanking the organizers on behalf of the guests, he welcomed the occasion as an indication of CERN's continuing help towards the solution of Geneva's housing problems, and mentioned specifically two points which he found of special importance. The first of these was practical – the fact that this new project was being financed wholly independently of the normal funds available in Geneva for such purposes; the second was more psychological – the intention that even in the flats and houses built with their own funds, the CERN staff would be living among other inhabitants of the region and not in a closed community of their own ●

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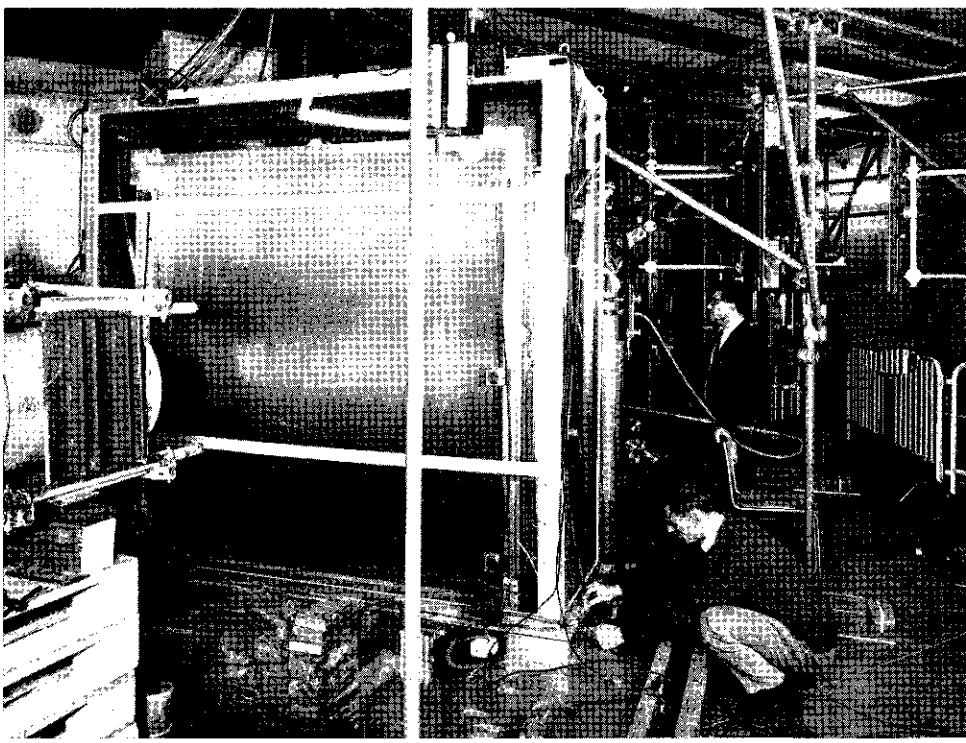

Several times in recent issues of CERN COURIER, **reference has been made to the experiment of the 'CERN/Ivry group', running in the a_γ beam in the North hall of the proton synchrotron. This experiment, carried out in fact by a joint group of physicists from CERN and the 'Centre national de la recherche scientifique', Paris, was to investigate the distribution of pions and kaons elastically scattered at large angles, especially in the backward direction, from protons in a liquid-hydrogen target. Apart from its value in providing new data on the strong interactions at very short distances, the experiment was also of interest because it involved the first use of a large transparent spark chamber in which the sparks are photographed through the electrodes instead of from the sides.**

Part of the experimental arrangement is seen in this photograph, in which the largest item is the gas-tight box, 5 m³ in volume, containing the five transparent spark-chamber elements one behind the other. Each element has an area of 1.9 m x 1.9 m, with its two electrodes of stainless-steel wire mesh, the wires being 0.05 mm in diameter spaced 0.5 mm each way. There is thus very little material to disturb the trajectory of any particle and, in addition, over 80 % of the light from a spark is transmitted through the mesh, so that a single camera can photograph the sparks in all five elements. Moreover, the position of the camera is not important and the tracks can be easily 'reconstructed' from the photographs. Another innovation is that the gas (a helium/neon mixture) in the chamber enclosure is recirculated through a purifier, in which water vapour and air are trapped by a 'molecular' filter and zirconium metal (see Nuclear Instruments and Methods, **vol. 29 (of 1964), pp. 319-321). This improves the performance of the spark chamber and gives an efficiency of 100 %. Also new is the method of illuminating the fiducial marks on the chambers (the small crosses on a circular background) – by means of light pipes leading from flash tubes outside. The detection equipment included six conventional spark chambers as well, and some of the mirrors of the associated optical system can be seen on the right of the mesh chamber. Also in the picture are L. Mazzone** (standing), **of MPS Division, and P. Anzoli, of NP Division.**

The mesh spark chambers, which were developed by a group led by L. Goldzahl and extensively tested at the synchro-cyclotron before being incorporated into the present experiment, have been described in Nuclear Instruments and Methods, **vol. 26 (1964), pp. 137-140. They were based on a CERN design, which was the subject of the report** CERN 61-25. **More recent CERN reports have dealt with the illumination system for the fiducial marks** (CERN 65-13) **and the method for reconstructing the particle trajectory from measurements on the photographs of the sparks** (CERN 65-15).

The international civil servant and today's world

The title is that of the eighth annual meeting of the Foyer John Knox, held on 25 February 1965 in this international student centre at Grand-Saconnex, on the outskirts of Geneva. The speakers were Dr. Willem Visser't Hooft, Secretary General of the World Council of Churches, and Professor Jacques Freymond, Director of the 'Institut universitaire des Hautes Etudes internationales' (Institute of Advanced International Studies) of the University of Geneva. At the time, the United Nations Organization was in the midst of a crisis, even now unresolved, arising from the dispute over payment for its military operations. In Geneva there was an added feeling of tension resulting from the campaign, ultimately defeated by popular vote, against the setting up of a 'Fondation des immeubles pour les organisations internationales' (FIPOI), to build new offices and conference halls for renting to the international organizations. Although the talks had been prepared at an earlier stage, both they and the discussion that followed showed how much the speakers and the audience were preoccupied with the problems that confront those who work in the international field.

We in CERN, a European organization rather than an international one, and scientific rather than political, do not perhaps suffer to the same extent from the problems evoked by Dr. Visser't Hooft and Prof. Freymond. Nevertheless, much of what they had to say has some relevence and we are glad to print here a summary of the speeches and the discussion, kindly provided by the wife of one of CERN's physicist-engineers.

Speaking, in French, before an audience of about 250, including citizens of Geneva and both Swiss and foreign staff of international organizations, Dr. W. Visser't Hooft underlined the fact that in the prevailing tension between a section of the 'Genevois' and the international institutions the former should remember that these institutions had not been imposed on Geneva. In fact it was as a result of the pressing demands on President Woodrow Wilson by the Swiss Confedcration and such Geneva personalities as William Rappard and Guillaume Fatio that the league of Nations came to be established there.

On the part of the 'internationals', the crisis served as a reminder that the existence of the international organizations was by no means guaranteed and that their future was thus constantly menaced. They are in a class of their own, he went on, outside the traditional national framework yet too early for the truly international society which is still to come. Some regard them as prophets of the future world society, others only as profiteers. Very few understand their real problems.

One of these problems is that arising from the uprooting of the individual from his surroundings. This is a frequent occurrence of our times, but the problem is accentuated in the case of the international employee because he finds himself in a society of similarly uprooted people with widely different origins. In such a situation there is a danger that he will be quickly lost when faced with the difficulty of making contact with people of other races, backgrounds and cultures, and turn in on himself or his own national circle.

Another fundamental problem is that of his relations with the country of his birth. The United Nations Charter underlines the absolute necessity for the international civil servant to be completely independent of his own country. Yet, even neglecting the sub-conscious influence of early environment, this is impossible, since the official depends on his own government, or other national organization, for his future. Again, the essence of an international organization is that it should not support any particular ideology. Any attempt on the part of the international civil servant to be independent thus leaves him in a sort of vacuum, with nothing to replace the natural ties with his own land.

A third problem arises from the fact that in his professional actions the international official must never adopt any particular ideological, religious or political viewpoint. He thus quickly risks becoming an uncommitted person.

How can these difficulties be overcome? Basically, the international official must have a deep conviction that the world needs good technicians in the field of international relations, in the same sense that it needs good farmers or good engineers, and that they are especially important since they must create something new.

For the accomplishment of his task, the official needs to be equipped intellectually — an enquiring mind, knowledge of other languages —, but he must also believe in friendship between people of different upbringing, nationality and race.

An example of this is given by his relations with the citizens of Geneva, where, contrary to common belief, a passive 'co-existence' often leads to an increase of tension. There is fault on both sides, and efforts at reconciliation should be made by both, without first asking what 'the others' have done.

In the end, to counteract this political, ideological, religious and cultural profusion, the fact that his profession has no well-defined professional code, and the lack of a coherent social environment, the international official must rely on his own deep convictions. This is the real cure for someone who has been uprooted. He cannot expect to have a quiet life, because the world is continuously menaced by ideological or nationalistic explosions, but he has no right to run away, engaged as he is in the great struggle between the forces of construction and destruction. This kind of conviction was the secret of Dag Hammarskjöld, the supreme example of everything that an international official should be: "For someone whose job so obviously mirrors man's extraordinary possibilities and responsibilities, there is no excuse if he loses

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Although the campaign in Geneva preceding the referendum on the creation of the FIPOI was in general taken very seriously, it was still possible to find some grounds for humour, as in this juxtaposition of posters seen in the city. FIPOI – Fondation des immeubles pour les organisations internationales – is a company owned jointly by the Canton of Geneva and the Swiss Confederation, set up specifically to provide rented accommodation for the international organizations in Geneva. Although approved by all the political parties and many other bodies, the proposal to create the Foundation was opposed by a group of citizens in the Canton who raised sufficient support for the measure to be submitted to public referendum. In the subsequent debate it was clear that the opposition to the FIPOI was much more a protest against the presence and probable growth in Geneva of the international organizations themselves, even if the ill-feeling over 'privileges' and other matters was not always soundly based on the facts. At the same time, however, many influential voices were raised in the defence of the organizations and there was clearly a good understanding of the prominent part they play in the life of Geneva. After a 36% poll (comparatively high for this kind of vote) the proposal to set up the Foundation was supported by 31 813 against 25 804.

his sense of 'having been called'. So long as he keeps that, everything he can do has a meaning, nothing a price".

Preparing the international civil servant for his task

Prof. Jacques Freymond, dealing with the more specifically political international organizations, stressed the fact that the qualifications required for taking up public office of this kind were not very different from those needed for other careers.

However, if training was desired, of what should it consist? It was better to dismiss immediately the idea of a course of study specifically linked to the activities of the international official. Whilst providing useful information, such instruction, for students with no general background or developed method of study, would produce good servants rather than independent personalities capable of adapting to new problems and ever-changing circumstances.

In fact there is no reason why the training of the future international official should differ from that given to university students intended for public service or a similar profession. The task of the university is to show the student *how* to build, to give him the tools

The Foyer John Knox is an international residential student centre in Geneva, founded in 1954 by the Presbyterian Church of the U.S.A. in collaboration with the National Protestant Church of Geneva. To supplement its basic purpose as a centre of oecumenical and international student activities, the attempt was made with this eighth annual meeting to present the Foyer as a meeting place for those who work for the international organizations in Geneva. Following the success of this meeting, a smaller group met a month later to discuss the possibility of further action. As a result, the last Tuesday in each month has been set aside for meetings at the Foyer and it is hoped to set up study groups to go more deeply into the various problems confronting the international community in Geneva. At the meeting on 27 April, Mr. Philippe Maury, of the World Council of Churches, presented much material for the succeeding discussion in a talk entitled 'International responsibility and national responsibility'.

of intellectual independence. In other words, a method — and a sense of its rigorous application. However, if practically any university discipline would be satisfactory, a particular combination (law, history, economics, social science, political science) can provide a more direct preparation for the future international official's task of 'multilateral diplomacy'. This instruction would be similar to that given to the diplomat, who needs to acquire from his specialist university studies a method of approach that can be applied to other fields as well as a general education and habit of thought that facilitates the synthesis of ideas.

The study of economics, national law and national history must serve as the basis for the same studies on an international scale. Only those students who are well versed in their own subjects and capable of working by themselves can hope to profit from special courses aimed at giving a quick survey of the work of the international organizations. Such courses are most useful when given in the form of seminars — discussions between teachers and students — at which certain problems are presented and thoroughly investigated, bringing out the general approach and the techniques to be applied and forcing the student to assess the situation, organize his research and evolve working hypotheses.

The student of present-day international relations has to learn not to set himself up as the champion of a cause but to act in the same way as a historian, seeking to understand and explain. He must be capable of a scientific detachment from the reality in which we are all involved. Furthermore, it is essential that the same criteria of 'The highest qualities of work, competence and integrity' (article 101, U.N.O. Charter) be applied to all candidates wherever they may come from. To reduce the requirements for a candidate from one of the 'under-developed' countries, for example, could lead only to permanent friction later on, nourished by feelings of superiority and inferiority arising from different levels of attainment.

Finally, the candidate for a post in an international organization must know how to balance his relationship with the organization, on the one hand, and his government, on the other. The Charter requires absolute independence with respect to ideologies or national interests and Dag Hammarskjöld pushed this loyalty as far as envisaging the adoption of a policy, beyond that of neutrality, which could oppose the U.N. to some State or group of States. The international organizations, however, have no influence except through

BOOKS

The strange story of the quantum, by Banesh Hoffmann (Harmondsworth, Penguin Books Ltd., 1965; 4s. 6d.), tells in a lively, readable way the story of the rise of the quantum theory, from its first unseen stirrings in the photoelectric experiments of Hertz in 1887 to its final acceptance as a basic philosophy of science some fifty years later.

Unlike most 'popular science' books, this one does not set out primarily to explain one of the current topics, such as nuclear fission and its uses, but selects instead a history of ideas. As the story is unfolded, explanations take their place in it, and understanding of the ideas — their basic nature if not their intimate detail — comes to the reader in much the same sequence as it came to the physicists at the time.

Also unusual is the fact that this book is written with an emphasis on people, allied to a personification of the various theories involved, which brings the whole thing to life. As with a good detective story, one is led from page to page, anxious to know what will happen next. At the same time, because the author is a mathematician and one-time collaborator of Einstein and Infeld, the story has a ring of authenticity about it. The approach may shock some of the more serious students of the subject, but it will attract many people who would otherwise regard such things as quantum mechanics as being far too mysterious to warrant their attention.

One advantage of a book written in this historical fashion is that it does not get out of date quite so easily as those that attempt to explain the latest technological advances. This one was written originally in 1947 and revised in 1959, yet it does not give the impression of being dated. True it ends in the 'turmoil' of parity non-conservation and remarks that isotopic spin 'seems destined to play a significant role in future developments', there are no muon neutrinos, resonances, SU_3 or inexplicable K^0_2 decays, but these are only new discoveries in the field in which quantum mechanics is valid; they have not changed its fundamental nature, at least not yet.

The style, and viewpoint of the book are well illustrated by the following extracts, taken from the introductory preface:

'The story of the quantum is the story of a confused and groping search for knowledge... illumined by flashes of insight, aided by accidents and guesses and enlivened by coincidences such as one would expect to find only in fiction.

'It is a story of turbulent revolution; of the undermining of a complacent physics that had long ruled a limited domain, of a subsequent interregnum predestined for destruction by its own inherent contradictions, and of the tempestuous emergence of a much chastened régime — Quantum Mechanics.'...

'The magnificent rise of the quantum to a dominant position in science and philosophy is a story of drama and high adventure often well-nigh incredible. It is a chaotic tale, but amid the apparent chaos one gradually discerns a splendid architecture, each discovery, however seemingly irrelevant or nonsensical, falling cunningly into its appointed place till the whole intricate jigsaw is revealed as one of the major discoveries of the human mind.'

This drama of discovery is told in a Prologue, two Acts (divided by an Intermezzo) and an Epilogue, with a Post-

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their member States. This is why their officials are subject to a constant tension, in trying to decide whether to accept the ideology of the State to which they belong, or a more or less agreed division of power between rival groups (which would render the organization ineffective) or whether to work for a closer cohesion in the organization and a consequent gain in its authority.

The international official's links with his country of origin are important, because they keep him in touch with everyday reality and assist his thoughts and discussions on the choice available in practice between the interests of the many and of the few.

In a world where nationalism still prospers, the international organizations lead a hard life, but they remain one of the only means of reconciling divergent views. In the end it is not the training of the international official that is of greatest importance, but his sense of vocation, which must feed the hope of peace inherent in the organizations themselves.

Contributions to the discussion

These two interesting talks were followed by a sustained discussion, under the chairmanship of Mr. Pierre Zumbach. The rather strained relations existing at the time with a section of the local population were referred to by Prof. A. Babel, President of 'La Commission de la Genève internationale', who was nevertheless confident that the people of Geneva would adopt a more positive view of their connexions with the 'internationals' and thus produce a lasting improvement. On the same theme, it was suggested that international employees should join Swiss professional associations, or local sports clubs, or interest themselves in church affairs or other activities in Geneva. A point put very strongly was that it was absolutely essential to learn French. There was also a proposal for a public debate between 'Genevois' and 'Internationals', covering all the points at issue.

The healthy growth of the international organizations was also a subject of discussion. Whilst it was certainly necessary to eliminate any 'Parkinsonian' increase, there was a risk that the ceiling at present imposed on the non-governmental organizations would seriously hinder their work in some cases.

All in all, an intensely stimulating evening that deserved to be followed up.

Ursula Reich

script added for the second American edition of 1959 (of which the English edition is a reprint).

On the first page of the Prologue we see Heinrich Hertz at work on the first experiments to detect radio signals, with no thought of wireless telegraphy but just to prove the correctness of Maxwell's electromagnetic equations. And because he was more interested in the phenemonen itself than its practical utilization he noticed a small effect that was destined to overturn the whole structure of physics. How this first came about is told in the five chapters of Act 1; the 'violet catastrophe', the invention of the energy quantum. Einstein's explanation of the photoelectric effect and the beginnings of the 'wave or particle' controversy, the rise of Niels Bohr's atomic theory and its final collapse as a ruin of contradictions (a fact that will come as a surprise to many readers, and possibly writers, who still believe that the atom really is just a miniature solar system).

After the Intermezzo, which warns of things to come, the next seven chapters, forming Act 2, show how the chaos of the late nineteen twenties gradually resolved itself into a usable theory. Here we find the story of the idea and the experimental proof that electrons were waves as well as particles, the growth of matrix mechanics, the wave equation of Schroedinger and the fundamental formulation of quantum electrodynamics by Dirac, Heisenberg's indeterminancy principle and the abandonment of causality, culminating in a new outlook of physics so different from that of half a century earlier and exemplified by the statement of Dirac that 'the only object of theoretical physics is to calculate results that can be compared with experiment and it is quite unnecessary that any satisfying description of the whole course of the phenomena should be given'.

In the Epilogue we read of the successes of the quantum theory in describing the early experimental results on the physics of the atomic nucleus rather than of the atom as a whole, the discovery of the positron (the first 'antimatter' particle), the neutron, artificial radioactivity, the idea of the neutrino, exchange forces and mesons, fission — and the sudden realization that all this disinterested, fundamental research, 'science for its own sake', had enormous practical applications.

The Postscript carries the story of the fundamental research further forward into the field of sub-nuclear physics; starting with Powell's discovery of the pion, and stopping for a moment with the shell model of the nucleus, it deals with such things as the fundamental 'infinities' of the wave equations, the Lamb shift and 'virtual' particles, renormalization, Feynman diagrams, strange particles, the overthrow of parity conservation in weak interactions, and ends perhaps on an appropriate topic in view of current events — the postulate of CP invariance!

Anyone who doubts whether the happenings of this 'drama' are as important as they are said to be has only to tot up the number of characters who have been rewarded with the Nobel Prize — no less than thirty-seven of them are named, not counting those who appear in the Postscript prior to their award.

Those familiar with the work of CERN and similar high-energy-physics laboratories will also discover many parallels between the events of today and those of the quantum story. There is the same feeling of uncertainty with present theories, the sense of impending discoveries, the theoretical successes (omega minus) and disappointments (intermediate boson); present day physicists have taken over the 'group' algebras of the previous century in the way that the quantum theorists adapted the older mathematics of matrices and the work of Hamilton, for example; and so on.

But Hoffmann's book has an interest for everyone. With some 220 pages of text, in 'pocket' format, it is incredibly good value for money, and for those who wish to use it also for reference it is particularly well indexed.

A. G. H.

New perspectives in physics, by Louis de Broglie (Edinburgh and London, Oliver and Boyd, 1962; 30s.), is a collection of essays by a notable contributor to the field of modern physics who, incidentally, can also be said to have had two major influences on the life of CERN. The first was in 1924, when he produced his theory showing that a moving particle was associated with the propagation of a wave, and thus set physicists off on the whole development of wave mechanics without which high-energy physics would not exist; the second was in 1949, when he proposed to the European Cultural Conference the creation of a regional research organization, and thereby set in motion the events that led to the formation of CERN.

The book tells us quite a lot about the principles of wave mechanics, but much more about de Broglie, though this may not necessarily have been the author's intention. It is thus of interest not only to the student of physics, but also to the student of physicists (using 'student' in its broadest sense). Again, although it cannot be compared directly to Banesh Hoffmann's book (reviewed above), it forms an interesting commentary on the latter, from two points of view. Firstly, it shows that the rather light-hearted 'wars' between theories, and theorists, portrayed by Hoffmann were in many cases deep psychological struggles, in the search for both truth and self respect; secondly, it highlights in a very personal way the fact that there are some weaknesses in the foundations on which the edifice of quantum mechanics has been built.

For de Broglie himself has become a rebel against the 'establishment'. After agreeing with the accepted notions of wave mechanics for nearly 25 years he reverted to his own earlier interpretation of the theory, which he has struggled to develop ever since. Two thirds of this book are devoted to the story of this change of heart, its meaning for physics and its meaning for himself.

It is not a continuous account. Each chapter is the text of a paper or lecture dealing with the history and philosophy of science, written in the period 1950 to 1956. They have all presumably been published elsewhere but it is one criticism of this book that very little, if any, information is given to enable the originals to be traced. Since each paper is self-contained and covers much the same subject matter as a number of others, there is a considerable amount of repetition of the main points. However, this does not spoil the interest of what the author has to say; indeed it is probably a help for those who are not very familiar with the quantum theory in any form.

The first six chapters deal with various aspects of the 'orthodox' quantum theories, including a discussion of the essential difference between 'boson' and 'fermion' waves and the theory of 'second quantization', the Lamb-Rutherford experiment on the hyperfine structure of the lines in the hydrogen spectrum, the nuclear field, and atomic particles. In dealing with the latter the author develops the idea that only particles with spin $^1/_2$ can be 'fundamental', all others being combinations, a proposition that now appears very simple beside the multitude of 'particles', 'resonances', etc. that have since been discovered and the symmetry theories (SU_3, SU_6 and so on) that have been invoked to give their classification a semblance of order. Discussions of cybernetics and crystal structure, both from the point of view of quantum theory and wave mechanics, ends this first section, written before 1951.

In the next four chapters, which provide perhaps the main point of the book, de Broglie describes, in varying ways, his changing attitude towards wave mechanics. At first he strove to interpret it in a manner that would be in keeping with traditional physics and the idea of causality, enabling physical reality to be represented by means of precise images in space and time. By 1927 he had arrived at the idea of the 'double solution', which postulated that there should be two solutions to the wave equation of a particle; one being that which is generally supposed to be the *only* solution, the other giving a full description of the motion of the particle for all time. At the Fifth Solvay Congress in 1927, however, this theory met with little recognition in the face of the probability ideas put forward by Bohr, Heisenberg, Born, Pauli and Dirac. As a result, de Broglie dropped his own approach and lent his support to the development of the 'orthodox' theory which proceeded to dismiss causality as a nineteenth-century dream and accept complementarity as a proven fact. In 1950-51, however, after a critical review of the statistical interpretation undertaken for a course of lectures he was giving, his doubts returned, and they were reinforced by the work of Bohm and Vigier*. Since then he has worked with Vigier to find an explanation of the wave-particle dualism which would not only be consistent with the present views, and particularly the experimental results, but supply the connexion that is still missing between the theory of general relativity and that of quanta.

Their main approach has been through the theory of the double solution, one advance being the postulate that the 'u-wave', which would describe the physically real particle, obeys a non-linear equation which is identical with the linear equation of the 'ψ-wave' — the normal probability wave — outside the immediate region of the particle. In this way the ψ-wave solution would still appear to 'guide' the particle, providing a probability distribution for its appearance at any point in space and time, whilst the u-wave would actually give the trajectory of the individual particle. To take the example of the diffraction pattern produced by light passing through two slits, the ψ-waves show what the pattern will look like, the u-waves show which slit each individual particle goes through — a determination that is regarded as impossible by complementarity.

De Broglie's attitude is obviously conditioned by the fact that right from the beginning he has 'preferred to interpret the whole problem by means of intuitive physical images

* See, for example, **Quanta and reality,** reviewed in CERN COURIER, vol. 4, p. 124, September 1964.

rather than by mathematical abstractions', though of the later work he says: 'We have drawn a clear distinction between subjective and objective reality, a distinction which seems to have gone by the wayside in the usual statistical interpretation of wave mechanics'. At the same time, he recognizes that the mathematical difficulties are almost insuperable, and that we might in the end have to be content with the purely statistical view, though he nevertheless thinks that the attempt to find an alternative explanation is worth making.

To conclude this second section of the book there is a personal account of the author's meeting with Einstein, for whom he obviously had a great respect, at the Solvay Conference. The remaining pages contain comparatively light-weight pieces on 'questions of general interest' and the history of science. Although intended by the author as a 'reward for the reader's patience' they do not have the interest of the earlier papers.

The whole book has been translated from the original French by A. J. Pomerans, who has produced an English text whose style is exactly in keeping with its content. This is a volume that contains much of interest, wether one accepts de Broglie's views or not, or even if one is in no position to decide.

A. G. H.

The world nuclear directory (London, Harrap Research Publications Ltd., 2nd edition, revised and enlarged, 1963; £10 10s.) is a handsomely bound big book that covers 76 countries as well as international nuclear organizations.

Information is given concerning national atomic energy agencies, authorities, boards and commissions; other government departments including the armed services; privately sponsored research organizations; universities and colleges with research departments; professional and learned societies and trade associations; medical bodies and societies; insurance groups and companies; conferences, congresses and exhibitions; industrial firms consortia; and industrial firms. The entries are arranged in this order under each country, the book being in alphabetical order of countries. In its 541 pages, the volume also lists nuclear periodicals published throughout the world. The index of firms, institutions, organizations and periodicals that concludes the volume will certainly be appreciated by many users of the book.

No such work can possibly claim to be altogether complete and up to date and the publishers are fully aware of this, as expressed in their introduction. Conspicuous, for instance, is the absence of *Physical Review* and other publications of the American Institute of Physics, and many entries are obviously based on information supplied a year previously, as is the case for CERN and the Centre d'Etudes de l'Energie Nucléaire in Belgium. Nonetheless, the volume can be recommended as an extremely useful addition to the shelves of all libraries, offices or individuals whose activities are related with the rapidly expanding field of nuclear matters.

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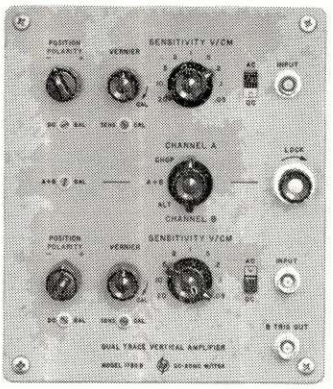

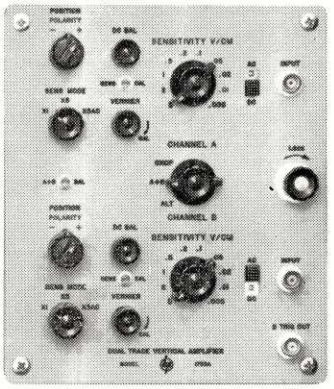

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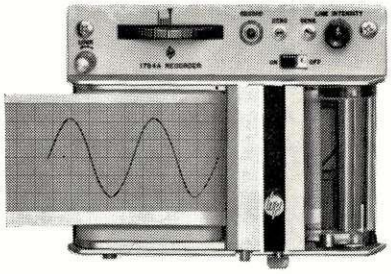

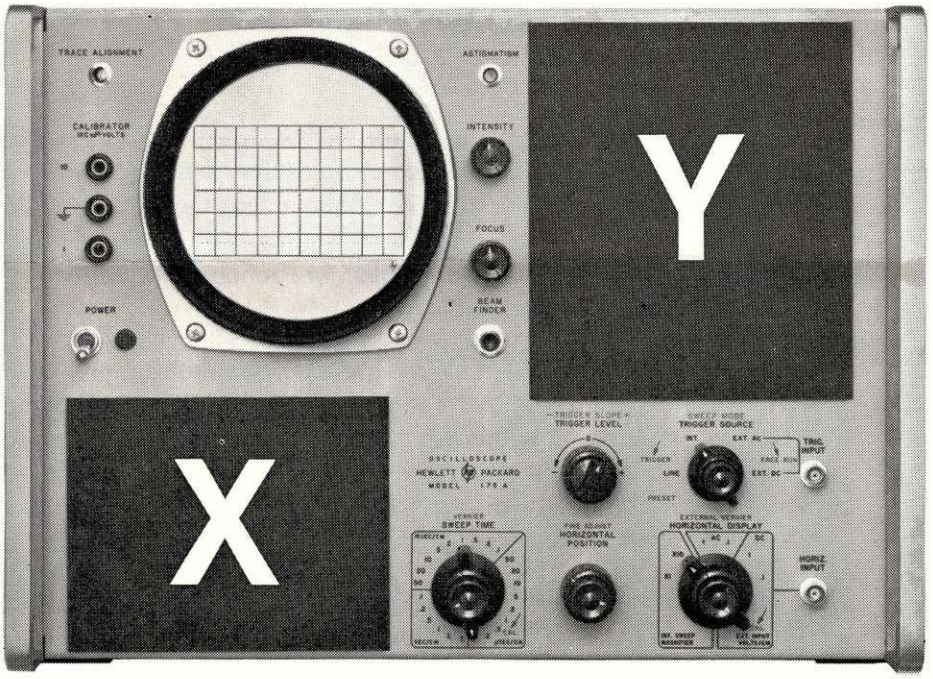

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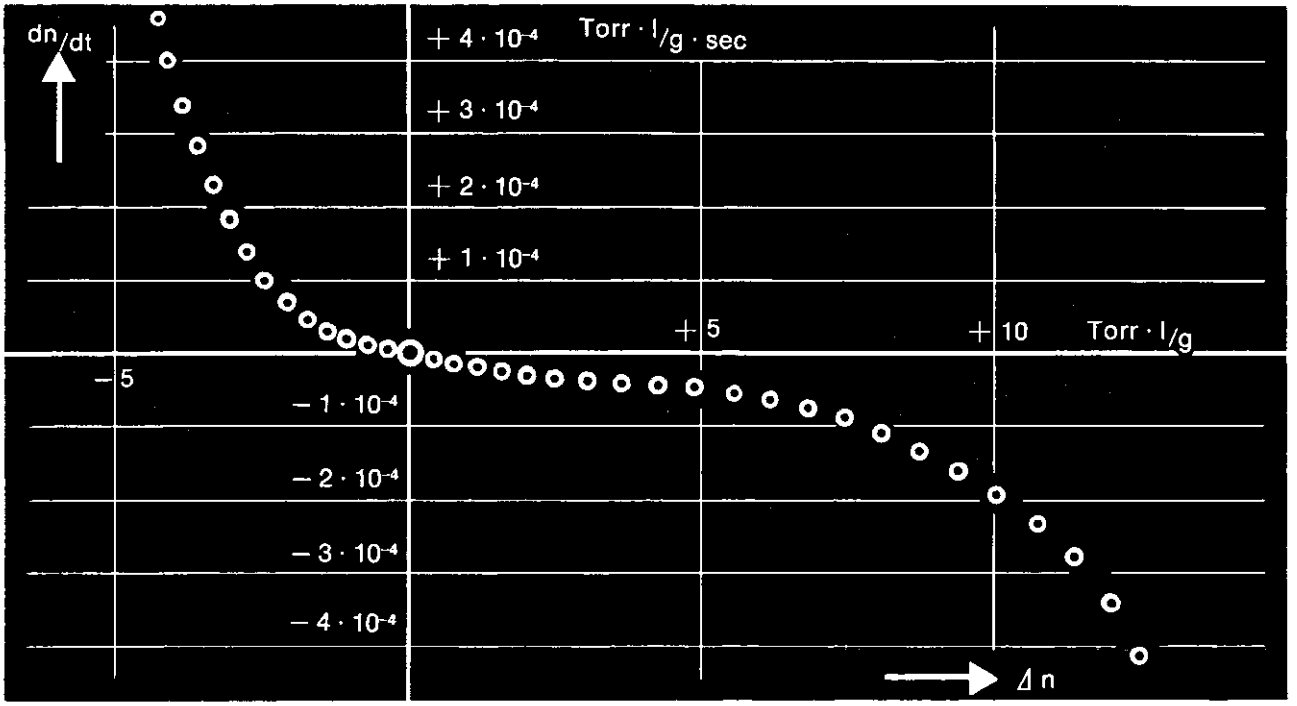

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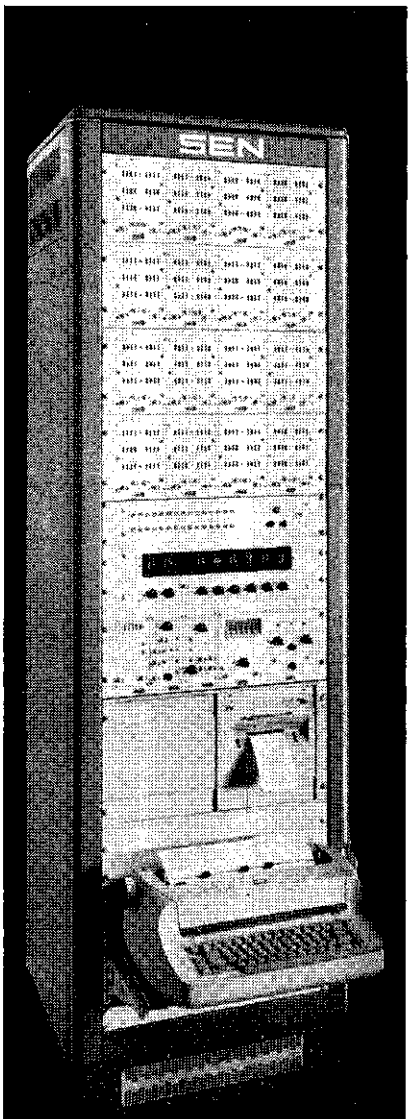

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