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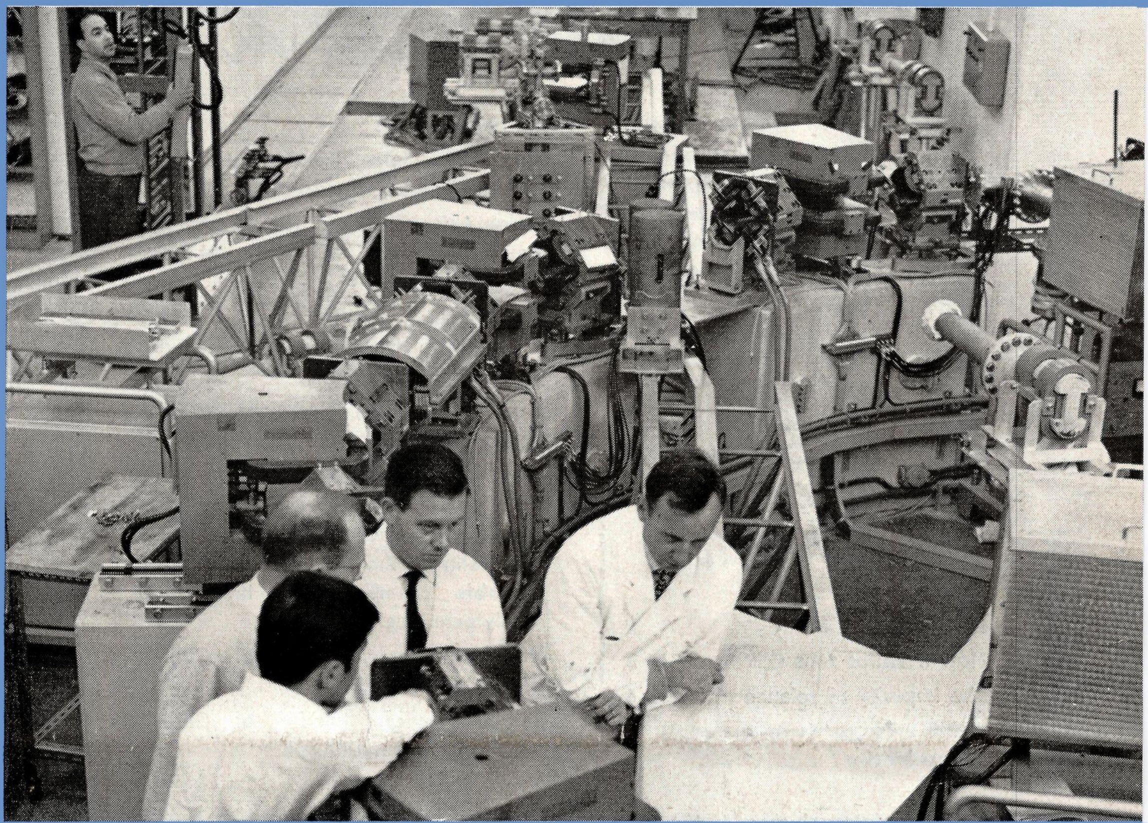
CERN COURIER



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VOL. 2

December 1962

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

The European Organization for Nuclear Research (CERN) came into being in 1954 as a co-operative enterprise among European governments in order to regain a first-rank position in nuclear science. At present it is supported by 13 Member States, with contributions according to their national revenues: Austria (1.90%), Belgium (4.07), Denmark (1.95), Federal Republic of Germany (19.15), France (20.81), Greece (0.60), Italy (9.90), Netherlands (3.77), Norway (1.58), Spain (4.21), Sweden (4.15), Switzerland (3.23), United Kingdom (24.68).
The budget for 1962 is 78 million Swiss francs.

The character and aims of the Organization are defined in its Convention 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.'

Last month at CERN

For their work on heavy mesons and hyperons the French 'Académie des sciences' has awarded the **Cognacq-Jay prize** to seven physicists who were, and in some cases still are, members of the Physics Laboratory of the 'École Polytechnique' in Paris. It is a pleasure for CERN that the most of the prizewinners are now continuing their work here, either as staff members or as visitors.

Contents

The cover photograph shows **L.** Magnani, F. Merger and B. Bruggeman, of the Accelerator Research Division, and **H.** Gentsch of the Engineering Division discussing a problem during the assembly of the 2-MeV electron storage-ring model, now nearing completion in the AR experimental hall. In the background M. Madmejahed, from Paris, operates the bridge crane.

Photo credits : Cover - CERN/PIO ; all other photographs by M. van **Gulik.**

CERN COURIER

is published monthly in English and in French. It is distributed free of charge to CERN employees, and others interested in the construction and use of particle accelerators or in the progress of nuclear physics in general.

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Editor : Alec G. Hester

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The physicists are :

Rafael Armenteros, member of CERN's Track Chamber Division,

André Astier, assistant director of the nuclear-physics laboratory at the 'Collège de France',

Jean Crussard, scientific director of the 'Saturne' division of the 'Commissariat à l'énergie atomique',

Bernard Gregory, professor at the 'École Polytechnique' and chairman of the CERN Track Chamber Committee,

André Lagarrigue, leader of the group operating the 1-m heavy-liquid bubble chamber from the 'École Polytechnique' at CERN,

Francis Muller, member of CERN's Track Chamber Division,

Charles Peyrou, Leader of CERN's Track Chamber Division.

Two 'world records' were announced from the **proton synchrotron** at the beginning of November, both achieved with the new **rri2** beam, which utilizes two of CERN's 10-m electrostatic separators, in conjunction with focusing and bending magnets, to provide particular kinds of particles separated from all others. **Kaons** of momentum **3.5 GeV/c** and **antiprotons** of **5 GeV/c** were obtained, the highest values for either particle yet reached anywhere. This beam was also used to give electrons of 600 MeV/c.

The accelerator itself was running well after its long shut-down, and during the first fortnight 215 hours were devoted to nuclear physics with only 4 V2 % lost as a result of breakdowns of one kind or another. The average **beam intensity** during this time was 4.2 X 10^{11} protons per pulse. This was in fact about the same as that obtained before the shut-down. Investigations had shown that previous measurements of beam intensity had over-estimated the values by about 15% and a **new calibration** is now in use. A similar recalibration has been carried out at the Brookhaven alternating-gradient synchrotron, and the two groups concerned have agreed on a new 'international standard' :

1 AGS proton equals 1 CPS proton.

Later in the month the average beam intensity at the PS was higher and a new peak intensity of over **5.9** X **10^{11} protons** was registered in one pulse.

On 12 October, **K. Green,** who led the team that built the AGS and is now in overall charge of this 33-GeV accelerator, arrived at CERN together with **J. Spiro** and **I. Polk.** They stayed for about a week, seeing for themselves how things were progressing here. During their visit the world's two largest accelerators were in direct contact for a while when a telephone call was made from the PS main control room to the AGS control room. This is another world 'first'.

At least part of the increased intensity of the PS beam has been obtained as a result of improvements to the 50-MeV linear accelerator **(linac),** which provides the input protons to the synchrotron itself. It is not so long since a beam of 20 mA was celebrated there with champagne, but now currents as high as **45 mA** are being obtained.

One result of the better internal beam was that the remarkable figure of 10^{8} protons per pulse was obtained for the beam **C5,** which consists of protons of nearly full energy scattered out of the accelerator at a small angle.

In the **North hall,** the reconstructed kaon beam, **k3,** was giving separated kaons of 800-MeV/c momentum, though a number of breakdowns of the 81-cm hydrogen bubble chamber prevented its use to the full. The CERN **3-m electrostatic separator** incorporated in the second stage of the beam also gave some trouble at first, but with the bubble chamber out of action the opportunity was taken to remove the separator temporarily for internal cleaning. This separator, a model rather than a finished piece of equipment, was constructed by the Nuclear Physics Appa-

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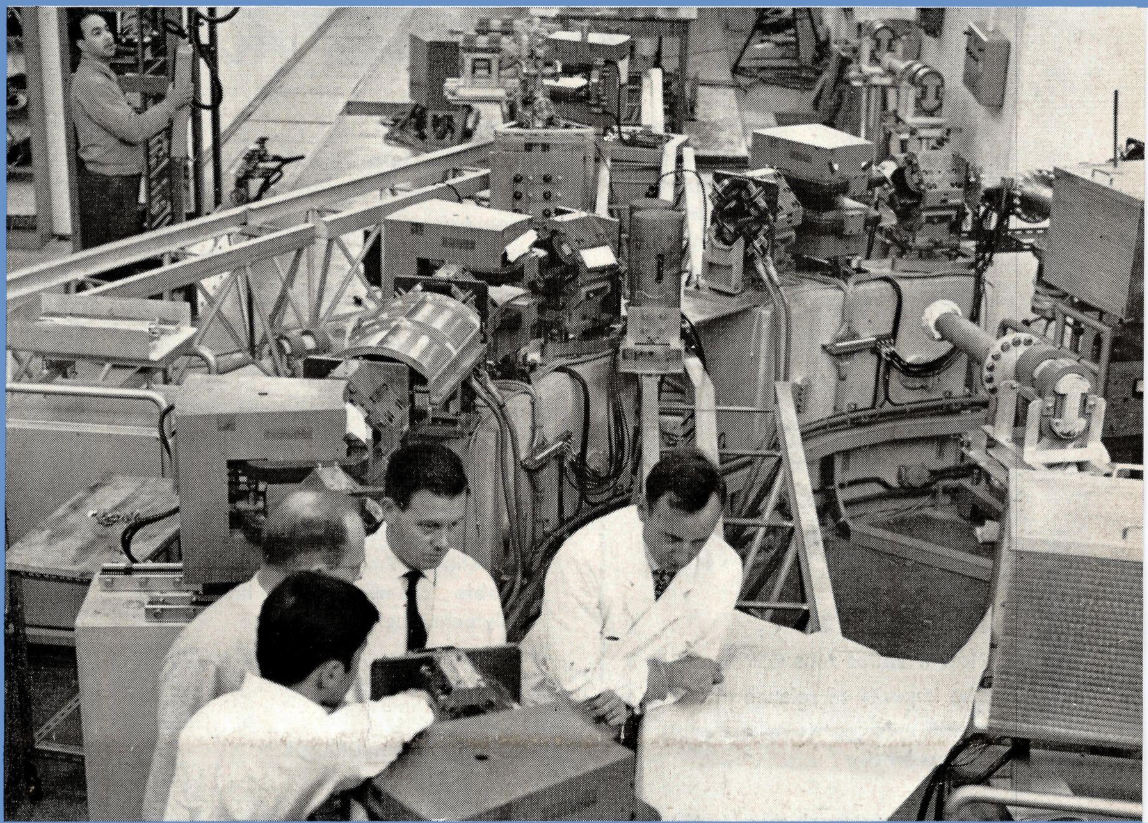
CERN COURIER



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EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

A word from the Editor

Although unfortunately too late to catch the end of the year, this twelfth issue of 1962 marks the completion of volume 2. It is hoped that every reader will have found something of interest in each issue, though it must be admitted that the highly diverse readership of CERN COURIER makes it practically impossible to satisfy all at once.

In this respect, comments, suggestions, and, in the case of CERN staff, contributions, will always be carefully considered.

All members of the CERN Public Information Department take this opportunity to wish you a Happy New Year, and every success in 1963.

ratus Division, to meet an urgent demand, in only three months, using many standard components from the larger 10-m separator tanks. It has a fixed 10-cm plate spacing, across which a potential of 500 kV was maintained after only 2 days testing. This was later raised to 550 kV when the separator was finally working in the beam. When its present task is completed, the separator will be used by the NPA Division for model studies on new types of electrodes.

Experience with the modifications made recently to the radiofrequency system of the **synchro-cyclotron** has shown that both the circulating current and, more particularly, the number of secondary particles produced on internal targets, depend critically on the conditions at the centre of the vacuum tank. Optimization of the newly installed r.f. modulation system has resulted in an increase of the internal beam to **over one microamp.,** with a corresponding increase in the intensities of the secondary-particle beams.

As from 1 November an 'emergency service' is being made available by the CERN Health Physics **film-badge service,** in case of any accidental over-exposure to radiation. Anyone suspecting such an overdose can have his film badge developed and read immediately, in*stead of having to wait until the end* of the current period.

On 27 November CERN was pleased to receive another three physicists from the **Joint Institute for Nuclear Research** in Dubna, U.S.S.R. Boris Barbachov and Atlant Vassiliev will be staying for six months, the first in the Theory Division and the second in the Accelerator Research Division. Nikolai Viriassov, who will be with the Track Chambers Division, is staying only until the end of January.

The main auditorium was filled on Friday 23 November to hear a **Tribute to Prof. Niels Bohr,** delivered by the Director-general, Prof. Weisskopf. The audience included Mr. Skak-Nielson, head of the permanent mission of Denmark in Geneva, Mr R. Helg, representing the 'Conseil d'État' of the Republic and Canton of Geneva, and members of the Institute of Physics of Geneva.

On the evening of 13 November the first of a series of **lectures on subjects of general interest** was given in the main auditorium. The lecturer, John Berger who spoke on 'Picasso, 20th Century Artist', was introduced by Prof.Weisskopf, who pointed out how necessary it was for the staff at CERN to have wide interests and praised the Staff Association for this new initiative. That his

Continued on p. 12

How a visitor sees CERN

During the summer a new photographic competition was organized jointly by the CERN Photo Club and the Public Information Department, at the request of the Director-general. With the title 'How a visitor sees CERN', the competition was open to all CERN staff, with the idea of obtaining photographs which reflect the impression that an outsider obtains when he visits CERN for the first time.

Entries were divided info four categories : 'single picture' and 'series picture sfory', each for black-and-white and for colour. Although the response was rather disappointing and two of the prizes were not awarded, the competition produced a number of good photographs. An excellent colour print showing the fall white Administration building against this summer's clear blue sky brought a prize for E. Fischer (AR Division), while the other prize went to Marinus van Gulik (MSC Division) for his observant series of black-and-white photos with some original captions. This series, which shows his young son, Han, as he fours the Laboratory, is reproduced on this and the following pages.

1. May I have a look around ?

The Impurity of Science

by **Melvin CALVIN**

Melvin Calvin, Professor of Chemistry in the University of California, has been Director of the Bio-organic Division of the Lawrence Radiation Laboratory, Berkeley, since 1946. He was born in St. Paul, Minnesota, in 1911 and obtained his B.S. degree at the Michigan College of Mines in 1931. In the course of his subsequent distinguished career in organic and physical chemistry, he has been one of the leaders in the application of radioisotopes as 'tracers'. Working closely with the late E.O. Lawrence, inventor of the cyclotron, and other physicists of the Radiation Laboratory he was able to make good use of their sfe-inch cyclotron for the production of the radioactive atoms needed for his research on photosynthesis, biodynamics and plant physiology. In 1961 he was awarded the Nobel Prize for Chemistry for his elucidation of the chemical process of photosynthesis, the assimilation of carbon dioxide by plants.

In this article, first presented in the Robbins Lectures at Pomona College, Claremont, California, on 27 February 1962, Prof. Calvin develops a theme that at first sight seems alien to those concerned with high-energy physics, but which on further reflection can be seen to be true: that there can no longer be a 'pure' science, of itself and for itself. Every branch of science reacts with others, and science as a whole affects and is affected by the humanities. As a chemist working in the field of biology, Prof. Calvin utters a warning about recent discoveries in genetics, but his message is of much wider application.

At one time or another in recent years, almost everyone has heard or read the term 'pure science' used in one context or another. This ubiquitous appearance of the word science itself in our daily lives, to the degree that all of our high-school seniors should not only have heard of science but should even have heard of the distinction implied by the adjective 'pure', is indicative of the importance that this area of human activity has come to occupy in modern society, certainly in Western society. Some of the reasons for this are obvious and some are not so obvious, and both deserve some comment.

The most obvious, and best known, reason for this widespread appearance of the word science itself is, of course, the enormous impact that this area of human knowledge has had upon the physical conditions of life itself on the planet. This is largely by virtue of the technological by-products which have resulted (and which always result) from any newly discovered truth about the nature of the world around us. Here we come to one of the first and most apparent distinctions which give rise to the adjective 'pure' as it is applied to science and, by implication, its converse, which we have come to call applied science, or technology. While the advances of technology may and frequently do lead to what we call technological unemployment, the unexpected and unpredictable developments of pure science are the prime source of the entirely new industries which constantly rejuvenate our economy.

There are those who believe that our modern science not only gives rise to technology, but historically had its origin in man's physical needs and the ways he sought to fulfill them. Perhaps this may be true on the most primitive level. Man was cold and so he sought to make himself warm by various means such as creating the fire at will which occasionally he had seen happen accidentally. But I am sure that some men wondered about the nature of fire itself even before they could use it to keep themselves warm.

There arose, with the birth of modern science some 300 or 400 years ago, a type of investigator who endeavoured to explore the nature of the world around him in observable and testable terms solely because he was curious about it. For example, Leeuwenhoek was a lens grinder, and during the course of his manipulation of the lenses he found that he could see, with their help, objects invisible to the naked eye. This led him to produce better combinations of lenses and, ultimately, to his discovery of the whole micro-world of 'animalcules'. Galileo was looking in the other direction and wondered about the nature of stars. This wonder led him not only to build his telescopes but to describe the new things he saw with them for others to see.

On the other hand, the applied arts, or technologies, were, in general, in the hands of quite a different group of men, the artisans and the engineers of the time, and so the distinction existed both in approach and in the men who did it. Daily that distinction is becoming less

2. The third machine : 'paper accelerator'.

sharply defined, largely because we have explicitly recognized the nature of technology and have realized that its greatest successes are contained in the entirely new bits of truth about the world around us which the curiosity of man uncovers primarily to satisfy his need to understand.

Today discovery and its application do go hand in hand to such an extent that the popular impression most often does not distinguish between them, and the justification for the activities of the 'pure' scientist is most frequently sought in practical, or technological, terms. This is partly true, for example, in the justification of the expenditure of public funds for such activities ; we will come back to this later.

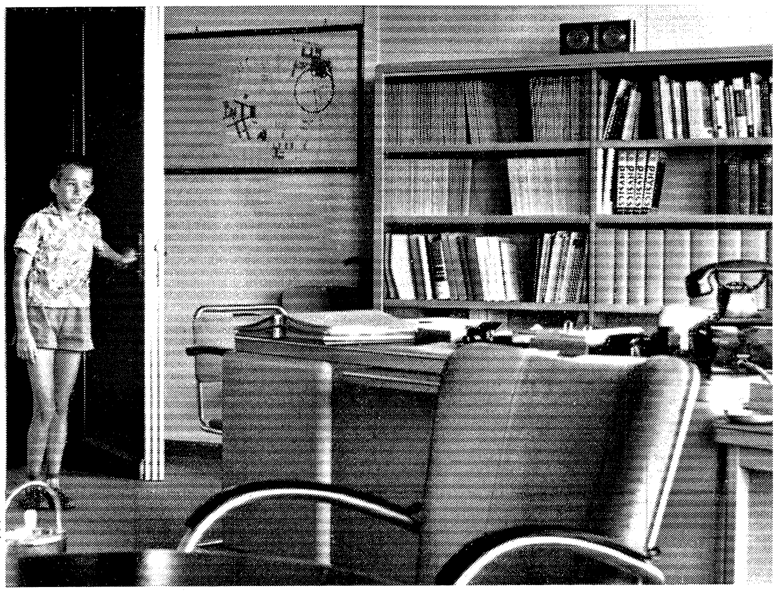
Even within the sphere of 'pure' science alone there exists today an 'impurity' and a hybridization. Therein lies its strength. In the early days of the modern period it was probably possible for a single individual to encompass all of human knowledge, not only in the sciences but in the humanities and the arts as well. The term 'Renaissance Man' has often been used to describe such persons, and the implications of it are clear. As the extent of these activities increased there appeared a specialization. First the artist, the humanist and the scientist, or natural philosopher, were separated from each other, and then during the nineteenth and early twentieth centuries science itself, and by this I mean the so-called 'pure' science, was fragmented again. This was a necessary step for the collection of the enormous amount of detailed information on many subjects which had to take place in a systematic way. Only following such a collection could the generalizations about this knowledge be made. However, this fragmentation has been carried today to such an extent that men who all place themselves in the category of 'pure scientists' very commonly cannot speak each other's language. Thus the physicist studying the nuclei of atoms and the cytologist studying the nuclei of cells are likely to have only one word in common.

In fact, I would go even further than this and point to a meeting of the American Chemical Society at which there may be some 10 000 men gathered, attending hundreds of sessions. There will be among these men, all of whom call themselves chemists (and academic chemists at that), those who, when speaking on the frontiers of their particular area of interest, are incomprehensible to each other. For example, the geometry and stereospecificity of steroid chemistry will in its terms, concepts and language be very nearly totally incomprehensible to the kineticist studying the rates of reaction of triatomic molecules at gas pressures of one millibar. Similarly, the gas kineticist has a corresponding difficulty in communicating with the steroid biochemist. And they both call themselves chemists !

This situation was already recognized fifty years ago and very beautifully described in the 1911 *Encyclopaedia Britannica* in an article under the heading 'Science' written by Sir William Cecil Dampier Wetham of Trinity College, Cambridge.

> 'In early times, when the knowledge of nature was small, little attempt was made to divide science into parts, and men of science did not specialize. Aristotle was a master of all science known in his day and wrote indifferently treatises on physics or animals. As increasing knowledge made it impossible for any one man to grasp all scientific subjects, lines of division were drawn for convenience of study and teaching. Besides the broad distinction into physical and biological science, minute subdivisions arose and at a certain stage of development much attention was given to methods of classification and much emphasis was laid on the results which were thought to have a significance beyond that of mere convenience of mankind. But we have reached the stage when the different streams of knowledge followed by the different sciences are coalescing and the artificial barriers raised by calling those sciences by different names are breaking down. Geology uses the methods and data of physics, chemistry and biology. No one can say whether sociology is properly grouped with biology or economics. Indeed it is often just where this coalescence of two subjects occurs, when some quick channel between them is opened suddenly, that the most striking advances in knowledge take place. The accumulated experience of one department of science and the special methods which have been developed to deal with its problems become suddenly available in the domain of another department, and many questions unsolved before may find answers in the new light cast upon them. Such considerations show us that science is, in reality, one, although we may agree to look at it now from one side and now from another, as we approach it from the standpoint of physics, physiology or psychology.'

> Science is impure in two ways. There is not a 'pure' science. Thus physics impinges on astronomy, on the one hand, and chemistry on biology on the other. And not only does each support its neighbours, but derives sustenance from them. The same can be said of chemistry. Biology is, perhaps, the example par excellence today of an 'impure' science.
>
> Beyond this, there is no 'pure' science itself divorced from human values. The importance of science to the humanities and the humanities to science in their complementary contribution to the variety of human life grows daily. The need for men familiar with both is imperative. We are faced today with a social decision resulting from our progress in molecular genetics at least equal to, and probably greater than that required of us twenty years ago with the maturity of nuclear power.



3. Isn't the big boss in ?

In spite of Sir William's recognition of the situation 50 years ago, things have got a lot worse before they appear to be getting better. The evidence for this is not only our own personal experience, but an additional objective statement in the form of an article, entitled 'The unification of biology', by Prof. CD. Darlington of Oxford, which appeared in January of 1962 in *The New Scientist* and from which I would like to quote his appraisal of the situation. In describing the status of science today, in contrast to what it appeared to be even as late as 100 years ago, he says :

> '. . . and an engineer, Herbert Spencer, was willing to expound every aspect of life, with an effect on his admiring readers which has not worn off today.
>
> Things do not happen quite in this way nowadays. This, we are told, is an age of specialists. The pursuit of knowledge has become a profession. The time when a man could master several sciences is past. He must now, they say, put all his efforts into one subject. And presumably, he must get all his ideas from this one subject. The world, to be sure, needs men who will follow such a rule with enthusiasm. It needs the greatest numbers of the ablest technicians. But apart from them it also needs men who will converse and think and even work in more than one science and know how to combine or connect them. Such men, I believe, are still to be found today. They have been in the past. But we cannot say that our way of life is well-fitted to help them. Why is this ?'

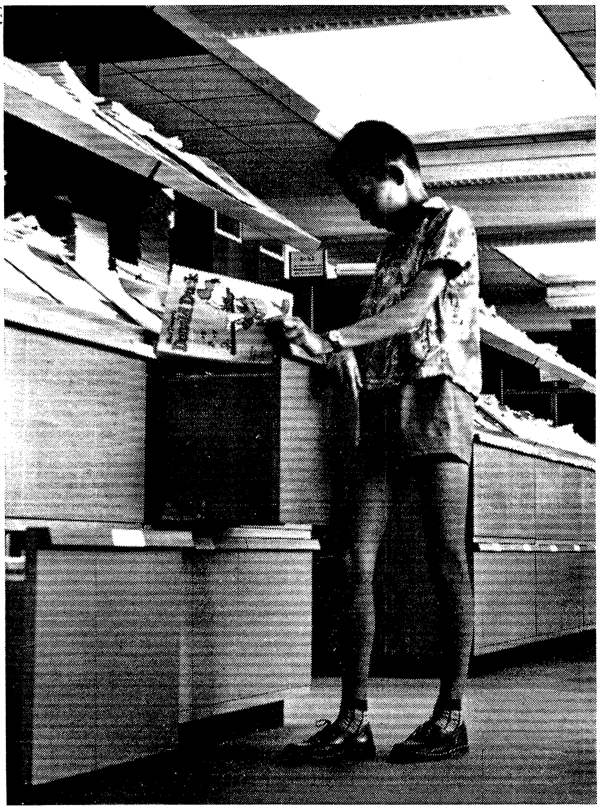
Apparently we have made very little progress in the last 50 years. In part, the reason lies in the unconscious entrenchment of vested interests in the scientific subdivisions that have grown up for purposes of convenience in the last century or two. That this separation is not an excluding accompaniment of the fine detail of the present-day scientific investigation is one of my theses. Combination and new synthesis is not only possible, but more necessary than ever before.

Perhaps a good way to illustrate the importance of the interaction of what are now called the several independent and distinct branches of 'pure' science might best begin by a brief history of the development of our knowledge of the detailed mechanism of hereditary control in biology. It had long been recognized that the character of parents was in some way transmitted to their offspring, and this at all levels of life from viruses to man. The history of mankind shows a recognition of this in its social organizations, for example, hereditary monarchies.

The knowledge that the character of a parent was transmitted to its offspring in discrete units resulted from the work of Mendel and Morgan, a botanist and a zoologist, respectively, studying intact whole plants and animals and using the most obvious kinds of structural characteristics to trace these hereditary particles from parent to offspring. For example, Mendél used the crinkliness of the skin of the peas and Morgan the colour of the eyes of his flies. That these hereditary particles had a physical reality and actually existed in the nuclei of cells was demonstrated by the cytologists. The organic chemists in analysing the nuclei of cells found in them a special material which they named nucleic acid because of its peculiar chemical characteristics, and they spent many years in determining the chemical composition of these acids and how they were put together. The physical chemists, as they learned more of the nature of giant molecules such as the nucleic acids, were able to describe something of the size and shape of these nucleic acids by using such methods as the ultracentrifuge, light scattering and viscosity measurements. The physicist examining these same materials in the dried or partly dried state using x-rays gave us still more information which culminated in a detailed proposal for the structure of the nucleic acids, some eight to ten years ago, by a team involving physicists, chemists and biologists.

Science is not only the birthplace of technology and the child of human need but also a prime progenitor of the great transformations in man's view of himself and his place in the universe which have taken place in the last half-dozen centuries and which are due for even greater transformation. Both the immediate and the long-range future of our country and of mankind is dependent upon decisions of how we use the fruits of this changing knowledge.

If mankind is to survive, the men who make these decisions must be men of broad background. As the chemist must now combine the knowledge in fields other than his own, so also must the statesman, the businessman, and the individual citizen combine basic understanding of science with the humanistic areas of knowledge. The need is pressing and immediate, for we have before us now the requirement for a decision on a course of action probably more profound and far reaching in its consequences than that which faced the statesmen of the world following the discovery of nuclear fission in 1939 and the creation of the first nuclear explosives only six years later. The 'privilege' of 'tampering with heredity' is about to be given to us.



4. You'll find every publication of importance here.

The microbiologists and virologists (who are very frequently former physicists) have gone much deeper now into the way in which the nucleic acids control more subtle hereditary characteristics in micro-organisms, for example, their dietary requirements or their virulence. This has gone so far that we must now call on the mathematician, information theorist and electrical engineer to help in the decoding of all the information contained in the hereditary tape which is the nucleic acid strand. Here you see the result of the collaboration and co-operation of practically every area of science, even overlapping into technology.

At first the progress along this route was slow and laboured, partly because of the primitive status of our knowledge and partly because of the isolation of the different men involved. More recently, progress has accelerated, and no small part of this acceleration has been due to the close physical and intellectual proximity of men who might have been, in an earlier time, isolated from each other, not only by space but by the classifications and sub-classifications of 'pure' science.

Such interdisciplinary teamwork is being recognized as an important feature of most scientific work today. One element in the success of such teams is the more or less rapid transformation of originally highly specialized ideas into more general conceptions throughout the entire scientific community. This result is probably accomplished in a number of ways. The first and most obvious is the mutual stimulation of men working together and by continuous informal discussions gradually evolving, in the group as a whole, new notions and new developments which could hardly be attached to any one individual in the group. This is in contrast to the situation which obtains in work which does not overlap very much into two or more present-day areas of science. Here, the new development may not easily be attached to a single individual.

It is my feeling, however, that the synthesis of a really new conception which involves contributions from two or more distinct disciplines of science requires some sort of union in one mind of the pertinent aspects of several disciplines. The more of the various aspects of science which this man can and does truly encompass, the more likely is a new synthesis to be achieved. In order for this to take place, it is necessary that individuals be not afraid to undertake absorption of the knowledge in areas other than the one in which they were first trained.

This education must be such as to enable the young scientist to explore deeply and well some particular area of natural phenomena. There is no substitute for this sort of concentrated activity and concentration of thought. However, it must be accompanied by the conviction that the student is free to follow, and, in fact, has the duty to follow, the exploration of any natural phenomena into whatever area the light may lead him. In this way will the creation of new horizons overlapping existing divisions of science be encouraged. Without it, we will be limited to the classification and subdivision of science developed during the nineteenth and early twentieth centuries, and our thoughts, conceptions, and even practical developments will be circumscribed by the very words and modes of expression which each scientific subdivision of today tends to use.

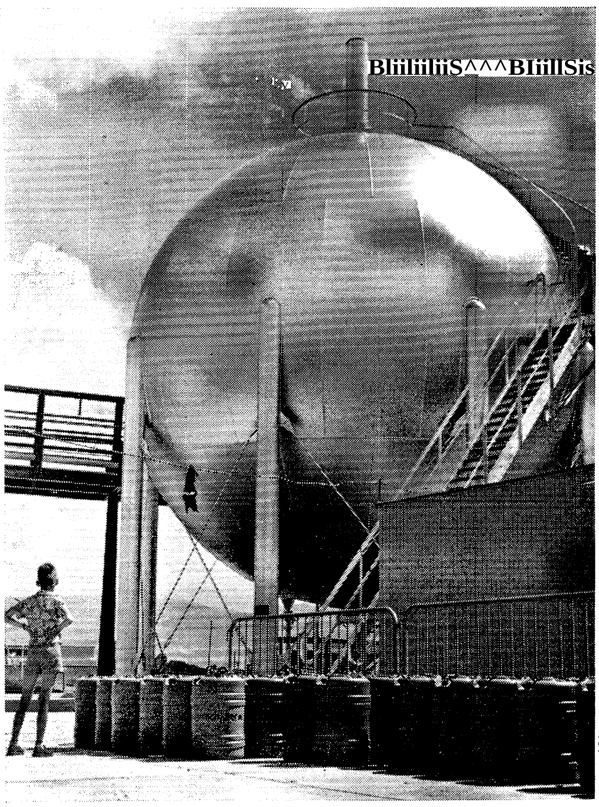
While the internal walls within the house of science are slowly crumbling, here and there, so that the individual 'purities' are fading, assistance and reconstruction in this is required. This is only part of the much larger problem of bringing back together the various larger subdivisions of human knowledge, particularly of recognizing the place of science in the intellectual activity of man.

It is here that the greater 'impurity' lies. We have been prone to think of science primarily as the birthplace of technology and the child of human need. It is not uncommon to find individuals and organizations justifying their scientific activities in terms of its application, that is, its so-called 'practical' or technological values. We find this kind of justification made on two quite different, but related, levels.

5. I wonder what he'd say if I pushed a button ?

For example, the popular writer for the newspapers and magazines, in discussing with the scientific worker the nature of his discoveries, will invariably seek to find What he calls the 'useful' application of this discovery, and by 'useful' he means : how can it be utilized to increase the physical ease of the human environment ? He is convinced that his readers, that is, the popular readers, have this uppermost in their minds and will read only those stories which contain some elements of material comfort in them. The other level, which is based on a similar conviction, is that our public legislators, from whom a very large fraction of the money to support scientific activities must now come, are moved only by the 'practical' values that they might directly see as a result of their appropriations.

In both these conceptions, the protagonists have overlooked the fact that it has been the great new truths resulting from the activities of scientists as curious human beings that have produced the great transformations which have taken place in the last half dozen centuries in man's view of himself and his place in the universe. Keppler's concern to understand the motion of the heavenly bodies led him to follow Copernicus in putting the sun in the centre of our immediate region of space. The earth then became one of the smaller bodies rotating about it, and thus man's home was finally displaced from its central position in the heavens which it had long occupied. This contributed to a profound change in man's concept of his place. Darwin's formulation of evolution in terms of natural selection again placed man in a new relation to life itself which has significantly affected all of his thinking and is still one of the central themes influencing not only the philosophers but the practical politicians as well, not to mention the scientists themselves !



6. Imagine that full of 'pop' !

I have selected only two of the most obvious and outstanding scientific truths which have had the most profound and direct influence on our daily intellectual lives. This is continuing today in many small as well as large ways. For example, our knowledge of the mechanism of brain structure and function on all levels, including the molecular, is increasing. I have no doubt that this will have a profound effect upon our present concept of what the nature of consciousness and self-consciousness really is. And this has not yet mentioned what the so-called 'practical' effect of such knowledge might be, in the form of either new machines or the manipulation of man's mind.

Perhaps the most immediate and pressing example of an iminent scientific development whose various effects on our lives can at least be imagined is the impending detailed knowledge of the molecular basis of heredity which we will soon have. In fact, we already have a good deal of it. By this I mean we already know a good deal about the way in which information concerning the construction of a living organism is handed on from generation to generation on a molecular level.

We are fairly confident that this information is in the form of a linear array of only four different molecules usually designated by the letters A,C,G,T, strung along as though they were on a tape. The whole message for a living organism will be billions of letters long, depending on the complexity of the organism. We can already take fragments of these tapes from one type of an organism and use them to transform another type. We are about to learn how to read the individual letters of these fragments for their smallest bits and pieces of information.

We will shortly be able to use pre-formed bits of this tape, suitably chosen, to control virus infection. Very likely a similar process will be involved in the control of the cellular genetic accidents which give rise to cancer. It will not be long before we will be able to repair by this means congenital metabolic accidents which at present we are helpless to treat. One can foresee the time when fragments of these information-bearing tapes (the DNA or RNA fragments) will be susceptible to laboratory synthesis.

I think it is clear that we will in the not too distant future be able to 'tamper' with the hereditary mechanism, not only for the primitive micro-organisms but for more highly developed organisms as well, and how we 'tamper' will be a matter of grave concern to us all. Both the immediate and long-range future of our country and of mankind is dependent upon decisions on the way we use the fruits of this new knowledge.

If mankind is to survive, the men who make these decisions must be men of broad background. As the chemist must now combine knowledge in other fields with that of his own, so also must the statesman, businessman and the individual citizen combine basic understanding of science with the humanistic areas of knowledge. The need is pressing and immediate, for we have before us now the requirement for a decision on a course of action probably more profound and far reaching in its consequences than that which faced the statesmen of the world following the discovery of nuclear fission in 1939 and the creation of the first nuclear explosives only six years later. The 'privilege' of 'tampering with heredity' is about to be given to us.

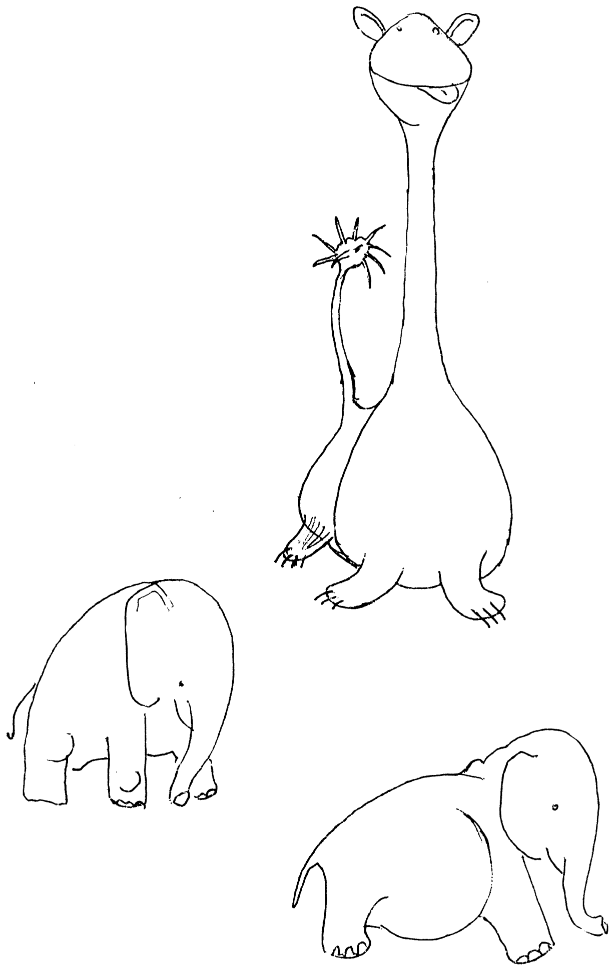
While we cannot predict at this stage the precise nature of the political and social consequences of such changes, that such changes will be profound I have no doubt, and we must be prepared for them on the broadest possible base. Along with scientific specializations, the myth has grown that only a scientist can understand science, and that only children who show promise of becoming scientists need be trained in the fundamental knowledge of science. But only consider for a moment the future of your own progency if the knowledge made available by science is written into law by legislators who have no way of understanding the implications of that which they legislate.

Only consider the dilemma of the statesmen who were forced to make the initial decisions regarding the first atomic bomb. The scientists who developed the technical information which led to the production of the bomb were forced into sociological decisions of the implication of the use of this new scientific knowledge. The statesmen, equally, were forced into basic, if elementary, understanding of the nature of this new power. The discussions of implications from both the scientific and humanitarian view have occupied world attention for the past twenty-five years.

Let us suppose, for example, that certain legislation concerning an elementary human need is under consideration. During the course of that consideration, the announcement appears that all men born in the West will henceforth have purple eyes if that legislation is enacted. What, then, would be the effect on the legislative decision of such an announcement ? Purposely, of course, the example is ludicrous, but one may extrapolate into other areas.

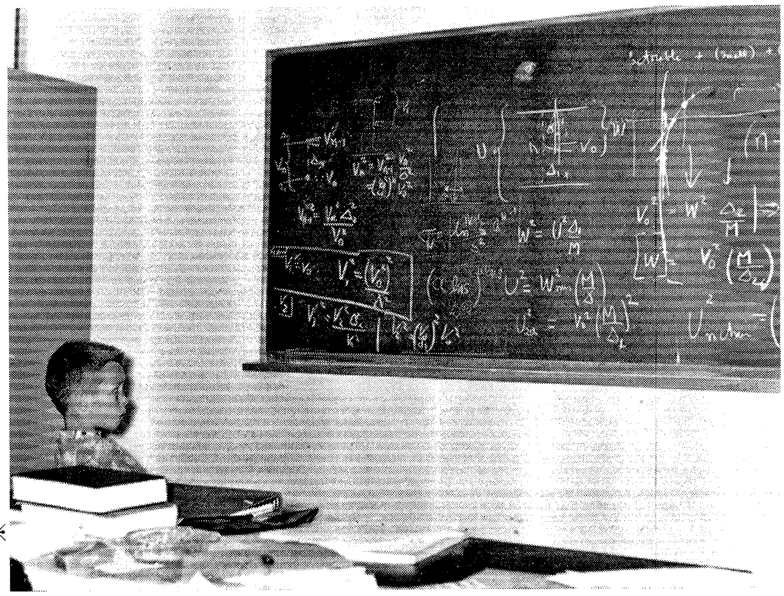
Thus, it is apparent that for the welfare of mankind, scientists must understand the basic knowledge of other fields than their own, and, in addition, must understand the world about them in terms of the humanist as well. And, conversely, the student of the humanities must understand the interrelationships of his own specialty (for example, of urban planning, with the humanitarian, or aesthetic, provisions for peace of mind and of environment) as well as the relationship of his specialty to new knowledge advanced in the area of science.

Science must be returned to its proper place as one of the essential components of a liberal education. Its position should be alongside the humanistic, aesthetic and literary arts. In the final analysis science is one of the three or four principal ways that mankind has evolved, up till now, of taking a view of the world around him •



The origin of the animal at the top is obscure ; although it bears some resemblance to a prehistoric monster, its tail is most unusual. Underneath, to the left is an elephant, obviously. A toy one, or a white one perhaps ? The significance of a three-legged (or two legged) elephant is, however, more difficult to discover.

.Where did we find them ? See p. 12.



7. I couldn't do better.

CERN Enlarges its Educational Possibilities

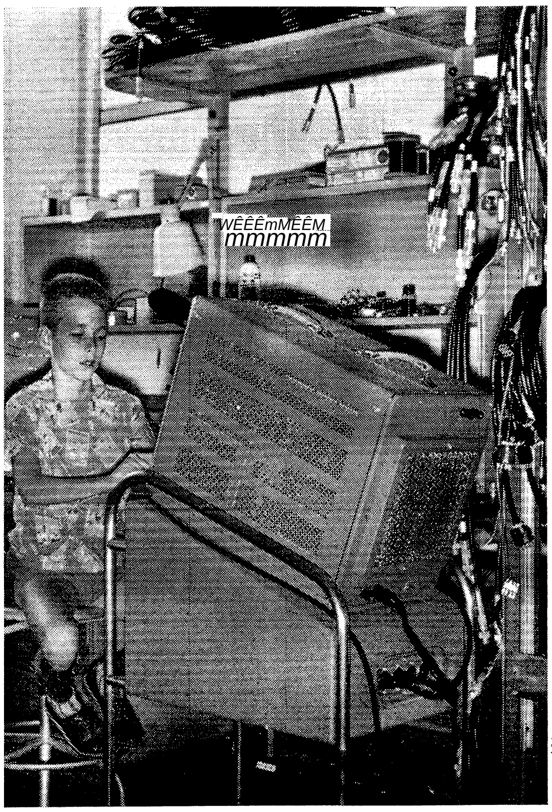
Technical Training Courses for 1962-63

On 20 November an unusual audience filled the main auditorium ; not the usual majority of scientists this time, but mostly people in overalls and laboratory coats, the technicians, machine-operators, workshop staff, laboratory assistants and others, who work with the scientists and engineers to ensure the success of the experiments carried out at CERN.

The occasion was the inauguration of the new Technical Training Courses, organized primarily for the technical staff and marking a new stage in the evolution of CERN into something rather more than just a research laboratory.

This latter aspect was brought out by Prof. Weisskopf, Director-general, who opened the meeting. After stressing that the courses, designed to improve the specialist skill required by the CERN staff, would form an essential part of their work, he went on to say that CERN is not just a place for scientific results but a centre where human beings, by working together, can enlarge their outlook and their knowledge.

The main talk ivas given by F. Griitter, Leader of the Engineering Division, and chairman of the Advisory Committee for Technical Training. What folloivs is a slightly shortened version of what he said :



8. We get a better picture at home on our old TV.

A Research Centre such as ours, which aims to be always in the forefront of scientific and technological progress, must have a highly qualified staff. However, it is not always the case that the holder of any particular post has all the qualifications and experience that are really necessary. This state of affairs can be corrected by special instruction given in the course of his work, but it is not always easy to teach him everything that he lacks ; moreover, science, and its associated techniques are progressing rapidly, particularly in our field, and we have to keep ourselves up to date all the time. There are several means at our disposal to keep us in touch with new methods : books, technical reviews, reports from other research centres and from industry ; evening classes are organized nearly everywhere, and there are many other possibilities.

All the same, there are some kinds of knowledge or special experience which cannot be easily acquired by studying the literature or by attending classes in town. That is why the Staff Association and Personnel Services initiated these supplementary training courses for the CERN personnel. A Study Group composed of T. Ball, M. Georgijevic, A. Martin, M. Pentz, E. Regenstreif and G. Ullmann was set up in September 1961 to examine CERN's requirements in the field of specialized technical training for its staff. They did some good work. Their recommendations were discussed initially by CERN's Scientific Policy Committee in March of this year, then by the Management Committee in May, and finally by the Council in June.

As a result, two new committees were set up to organize courses as quickly as possible. One of these deals with courses for the academic staff, the other for the technicians, using this word in its widest sense.

In what follows I am concerned only with the technical training programme. The Technical Training Committee consists of T. Ball, G. Brianti, G. Konried, M. Pentz, M.A. Roberts, J. Rouel, G. Ullmann, G. Vanderhaeghe and myself. Its task is to determine CERN's needs in the way of supplementary technical training, to co-ordinate CERN's activities in this field with the evening classes available in Geneva, and to arrange special courses at CERN. G. Vanderhaeghe is in charge of carrying out the programme arranged by the Committee.

Our immediate aim, as asked for by the Director-general, is to organize a number of courses this coming winter, thus putting our ideas into effect and gaining experience for the future.

Last August we sent out a circular to determine which of the ten subjects included in our preliminary programme aroused the most interest. The result of this enquiry was very heartening. In fact the number of people interested was far greater than we had hoped, and every course, except for that on ultra-high vacuum, promised to attract a reasonable number of applicants. The worst problem has been to find teachers. The fact that the courses must be given in French* has been rather inconvenient, because many of the teachers would have preferred to speak English. It goes without saying that all of them are already very occupied by their own work at CERN. In the end, we found a volunteer for each class and, as you already know, we were in a position to announce at the end of October the organization of the following courses :

- — Electrical engineering II by 0. Bayard
- — Electronics II by G. Amato and G. Kuhn
- — Vacuum techniques II by E. Fischer
- — Technology of materials by A. Achermann

In addition, two other courses, taking the form of seminars, will begin soon. These will be :

- — Selected topics in electronics, under the direction of H.I. Pizer
- — Workshop practice, under the direction of G. Konried.

We hope also to be able to start three elementary courses on Electrical engineering, Electronics and Vacuum technique next year.

There are a good many people who doubt the successful outcome of these courses ! It is true that the instructors have not got as much teaching experience as they would like, most of them are forced to speak in other than their native language, we are still short of many facilities such as demonstration material, slides, films, and so on. But I can assure you that all the instructors have gone about the preparation of their courses with considerable enthusiasm, and that they will do everything possible to ensure their success.

The Committee will not be content just with what it has started. On the contrary, the next stage will be to develop our own programme, to work with the evening classes in Geneva, and to explore other possibilities for the specialized technical training of the staff. The future programme will also contain other subjects, for example particular aspects of mathematics (covering new methods used frequently in various engineering fields), selected topics in physics, the construction and use of physics instruments, etc. But everything depends on the success of the courses that are about to begin ; I hope that those who have doubts about their success will be proved wrong. CERN as a whole has some very special possibilities to offer. At the same time, the success of our Laboratory depends not only on the quality of its research workers but also on the apparatus constructed by its technicians, and on the qualities and general experience of the technicians themselves.

* 85 % of those interested asked for the courses to be given in French.

Finally, G. Vanderhaeghe, of the Nuclear Physics Division and Executive Officer of the programme of courses, filled in some of the details. He revealed that about 250 members of the staff had enrolled for the first four courses to be arranged and it had been necessary to duplicate two of them. Some 60 more people were interested in the three elementary courses that it ivas hoped to start later. The seminars would begin probably in January and would be conducted along the same lines as those already held regularly for the academic staff, with no enrolment necessary. Dr. Vanderhaeghe stressed the usefulness of extending to these courses the habits of team work and contact between scientists and technicians acquired during research work. Remarking on the certificates that ivill be given to those who have successfully followed the courses of instruction, he pointed out that the main aim of the 'students' should be not to gain a certificate, which is unlikely to have any very great value in itself, but to improve their knowledge •

INTERNATIONALLY

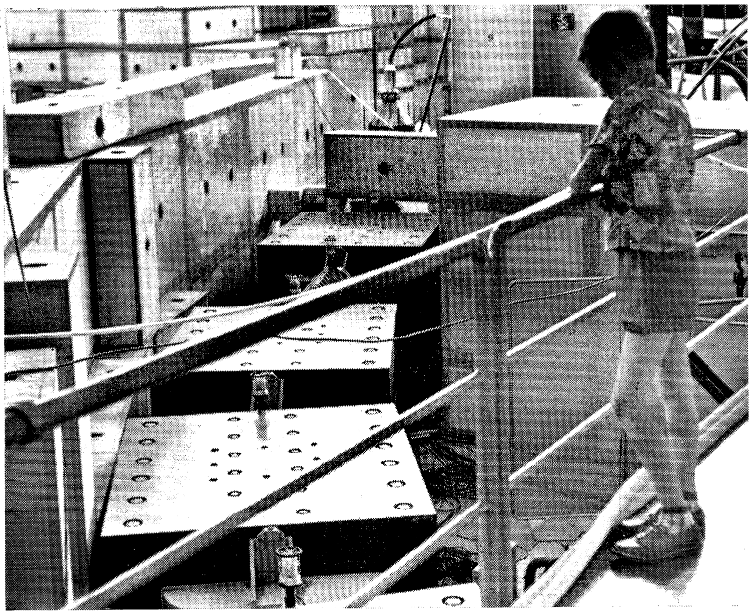
One of the papers presented at the 1962 International conference on high-energy physics was under the names of 24 people : 9 from CERN, 5 from the École Polytechnique, Paris, 3 from Imperial College, London, 3 from the University of Birmingham and 4 from the Centre d'Études nucléaires, Saclay.

S of the CERN scientists are Staff members from France (2), Germany, Spain and the United Kingdom, and the others were Visiting scientists or Fellows from Israel, Norway, Poland and the U.S.S.R.

How a visitor sees CERN

Particularly for those who don't know CERN, the locations of the photographs in this series are as follows :

1. **Main (or SB) entrance (Jean Ubertin on duty).**
2. **Part of the administration building with the bridge to the library.**
3. **The Director-general's office.**
4. **The report and periodical files in the library.**
5. **The synchro-cyclotron control room (operator Max Duval).**
6. **The hydrogen safety sphere in the East experimental area.**
7. **A theoretical physicist's office.**
8. **One of the electronics laboratories.**
9. **Part of the antiproton beam in the South experimental hall of the proton synchrotron.**



9. Where is that beam, anyway ?

IMI *M* (cont.)

sentiments were shared by many others was shown by the large audience, for which extra seats had to be provided. The lecture, which was illustrated by colour slides, was given in English with simultaneous French translation.

Disposal of electronic instruments

We hear that the electronics laboratory would like to dispose of four Hufchinson-Scarrott **pulse-height analysers** (80 channel), with nickel delay-line memory and cathode-ray-fube display, that are no longer needed. One analyser has an automatic print-out system. The three units without print-out are priced at Fr.Sw. 1000, the unit with print-out at Fr.Sw. 2500. Transport costs to be paid by the purchaser. The analysers are in working order, and circuit diagrams are available. For further information please contact the Chief Purchasing Officer, CERN, GENÈVE 23 ®

The animals on p. 9 form part of an unsigned collection of drawings, said to be the work of a former Director-general of CERN. They are believed to have been inspired by attendance at **numerous committee meetings. IVIore** than that, **we can only guess.**

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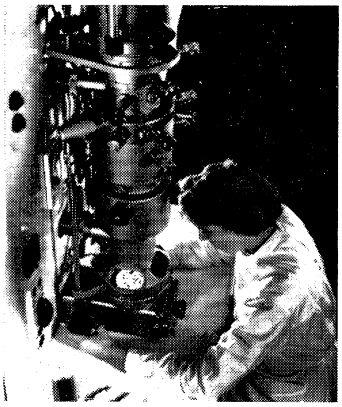

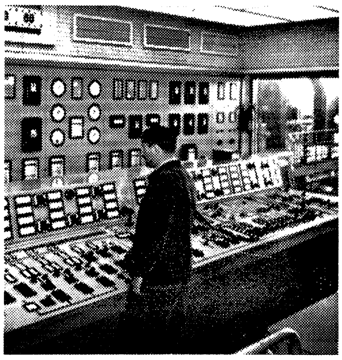

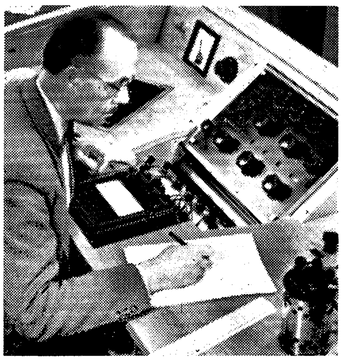

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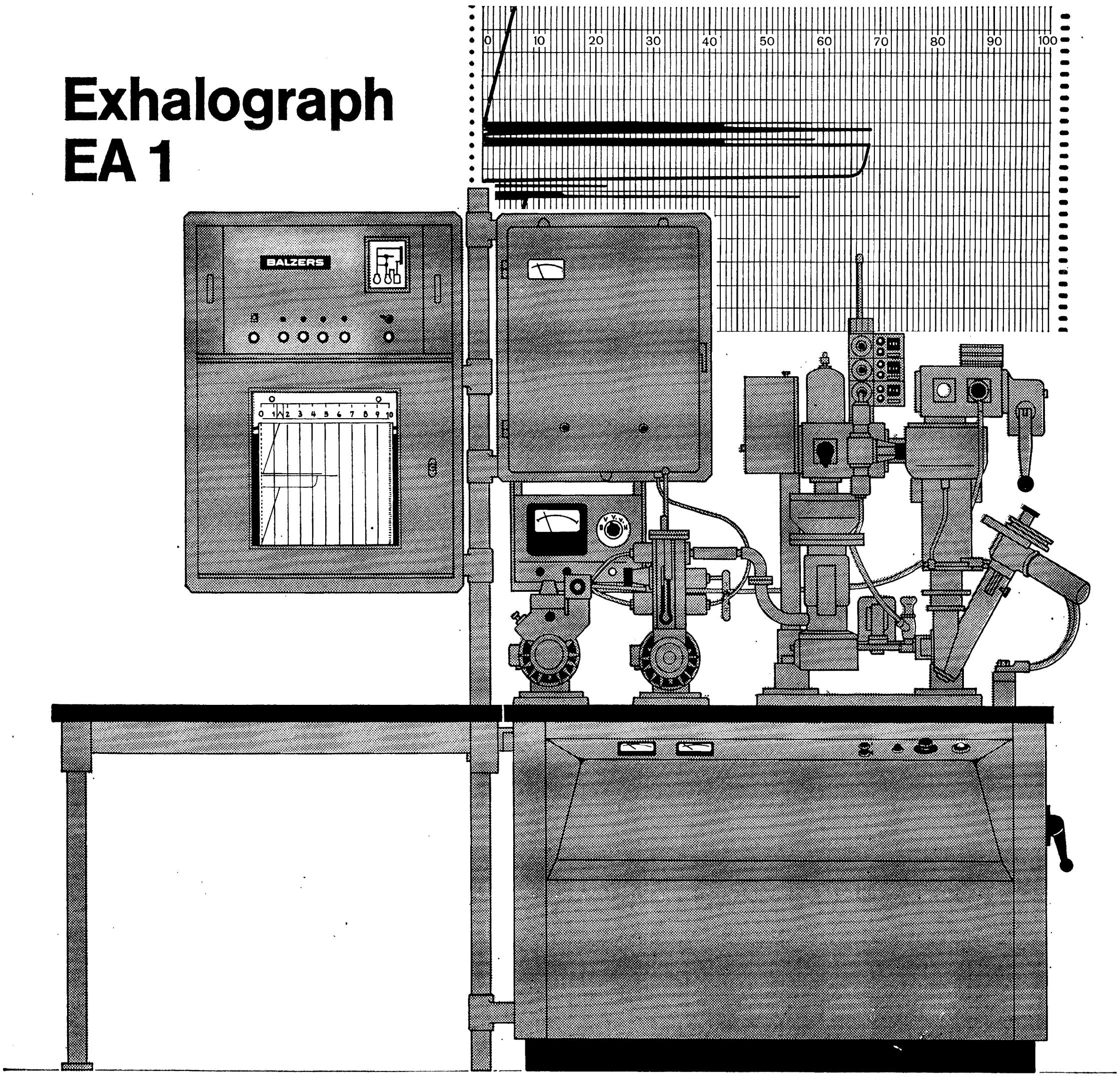

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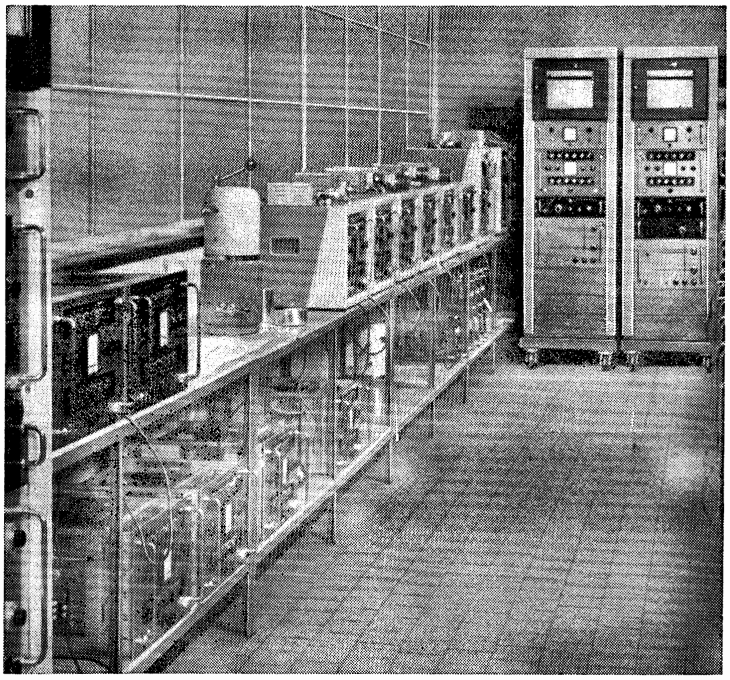

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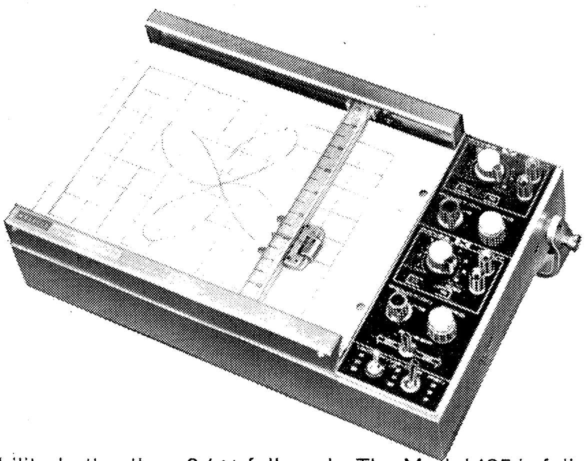

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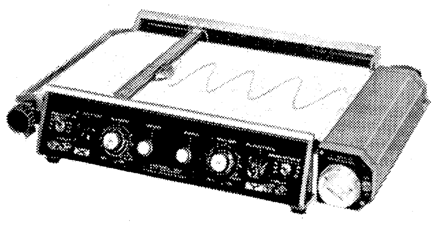

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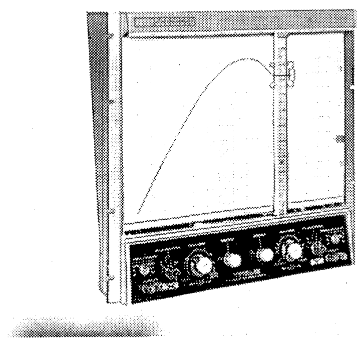

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