CERN COURIER

5

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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 14 Member States, with contributions according to their national revenues: Austria (1.87%), Belgium (4.02), Denmark (1.93), Federal Republic of Germany (18.92), France (20.57), Greece (1.12), Italy (9.78), Netherlands (3.73), Norway (1.56), Spain (4.16), Sweden (4.10), Switzerland (3.19), United Kingdom (24.40), Yugoslavia (0.65).
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

As part of the study of possible **future accelerator projects** the Accelerator Research Division arranged at the end of March and beginning of April a concentrated study of the physics possibilities of storage rings attached to the CERN proton synchrotron. Several visitors from other European and American laboratories, together with staff from various parts of CERN, participated in this study, which resulted in interesting suggestions for research that could be done and for the experimental techniques to be used with such a device.

Fritz Grütter, Leader of the Engineering Division, returned to CERN in April after a 3-month visit to the Lawrence Radiation Laboratory at Berkeley, California. This visit was in response to an invitation to participate in some preliminary studies on the problems of designing a large proton synchrotron in the energy range of several hundred giga-electronvolts.

Colin Taylor, of the proton-synchrotron Linac Group, and Dr. **Bruce Cork**, at present at CERN from the Lawrence Radiation Laboratory, Berkeley, spent a week during April at the Institute of Nuclear Research at Swierk, near Warsaw. They went at the invitation of Prof. Danysz, Director of the Institute, for consultation on the 10-MeV linear accelerator under construction there.

Two members of the CERN staff travelled to Washington for the Spring Meeting of the **American Physical Society**, held from 23-26 April. At a banquet held during the meeting, Prof. **L. Van Hove**, Director of the Theory Division, was presented with his 1962 Dannie Heineman Prize, awarded for 'his contributions to statistical mechanics and to field theory as examples of outstanding publication in the field of mathematical physics'. The preceding afternoon he gave one of the invited papers on 'A few problems in many degrees of freedom'. Dr. **G. F. von Dardel** read an invited paper, on 'Recent high-energy experiments at CERN'.

Prof. **L. Leprince-Ringuet**, Vice-president of CERN's Scientific Policy Committee, also read an invited paper on 'Strange-particle research at high energies performed at CERN by École Polytechnique and Collège de France'.

The normal **proton-synchrotron** programme, with the machine running continuously each week for nuclear physics or technical development from 15.30 on Tuesday until 23.00 on Saturday, was changed last month to minimize loss of time due to the Easter holiday. Beginning as usual on Tuesday 10 April, the run was continued through the following week-end right up to 6 o'clock on Friday morning 20 April — some 230 hours in all, including 14 hours for machine development.

Among experiments which were particularly successful during this time were those using the Saclay **81-cm hydrogen bubble chamber** and the **1-metre heavy-liquid chamber** of the Paris École Polytechnique.

The former obtained some 200 000 photographs contributing to studies of different interactions in hydrogen. Incident particles, obtained by means of the beam m_1, were positive pions or antiprotons, each of momentum 4 GeV/c, and positive or negative pions of momentum 2.7 GeV/c. The photographs are being analysed by laboratories in England, France, Germany, Italy, Sweden, and at CERN.

About 270 000 photographs were obtained with the heavy-liquid chamber, using negative kaons as incident particles, obtained by means of the beam k_1. These photographs are being analysed in England, France and Norway, as well as at CERN, particular attention being given to xi-zero particles.

The **CERN electrostatic separator** used in the beam m_1, in the South Hall (see CERN COURIER for February, p. 8), operated smoothly during these runs, with a plate separation of 14 cm and potentials between the plates of from 430 kV up to 840 kV.

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The cover photo shows that Spring has returned to CERN. Once again the restaurant terrace is a place where fresh air can be added to the discussion of high-energy physics – or anything but that – over after-lunch coffee.

Photo credits : photos by CERN/PIO, except p. 10 : G. Klemm.

CERN COURIER

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Lew KOWARSKI

Leader, Data Handling Division

Dr. Lew Kowarski, who has contributed a characteristic article to this issue of CERN COURIER, is not only one of the original staff members of CERN ; he also played a crucial part in its formation. Moreover, he can justly claim an important rôle in the development of the whole field of nuclear energy which, although not the direct concern of the Organization, is certainly a major reason for its existence.

He was born in 1907, in St. Petersburg (now Leningrad), and went to school there and at Wilno (now Vilnius). Later, he moved to Belgium, and then to France, where he entered the University of Lyons. He qualified as a chemical engineer in 1928.

For the next nine years he was technical secretary in an industrial firm, 'Le Tube d'Acier', at the same time carrying out part-time research. This was first in biochemistry, in a hospital laboratory, then in molecular physics, for which he was awarded his doctorat ès sciences under Prof. Jean Perrin, and finally in nuclear physics, acting part-time as personal secretary to Prof. Frédéric Joliot at the Collège de France.

In 1937 Dr. Kowarski received a grant from the Caisse nationale de la Recherche scientifique, enabling him to work full-time in Prof. Joliot's laboratory. It was there, in February 1939, that he, H. von Halban, and Joliot performed the crucial experiments which proved that neutrons were emitted in the fission of uranium. Six months later, the same group produced the world's first proven nuclear chain reaction, albeit a 'convergent' one, that is one not capable of maintaining itself in the absence of a driving source of neutrons.

To continue their experiments, they obtained from Norway, on the eve of its being invaded, the world's entire stock of heavy water (185 kg). When France was overrun in 1940, Halban and Kowarski brought the water to England, together with the important experimental records. Carrying on their work at Cambridge University, they produced the first strong evidence that construction of a controlled nuclear reactor would be possible. Four years later, when the first nuclear reactor outside the U.S.A. was begun in Canada, Lew Kowarski was put in charge of its design and construction.

He returned to France after the war and became scientific director of the Commissariat à l'Energie atomique when it was formed in 1946. There he was responsible for the development of pure and applied physics, and the design and construction of the first French nuclear reactors, Zoé (EL 1) in 1948, and EL 2 in 1952. From 1946 to 1948, too, he was adviser to the French delegation to the United Nations Commission on the control of atomic energy.

It was here that CERN had its beginnings, growing from the informal talks of scientists and diplomats drawn together for other purposes but seeing clearly how Europe was falling behind in the quest for fundamental knowledge. Dr. Kowarski played an important part not only in these informal discussions, but also in the formal development of the Organization after the recognition of the need by UNESCO in 1950. He has recorded the story of these years in his report 'An account of the origin and beginnings of CERN', published last year.

When the provisional Conseil Européen pour la Recherche Nucléaire (from which the name 'CERN' is derived) was set up in 1952, Dr. Kowarski became Director of the Laboratory Group, charged with planning the whole complex of site, buildings, administrative methods, finance rules, workshops, research and development in support of the two machines that were to be built, documentation and public information, etc. — right from the beginning, before even the site had been found. In 1954 the permanent Organization came into being, and he came to Geneva as Director of the division set up under the name of Scientific and Technical Services.

The tasks of this Division, intended to be run autonomously during the first period of CERN's construction, included the starting-up of such activities as the central workshop, electronics, track chambers, cryogenics, health physics, and computation. During 1957-1960 most of these activities became gradually integrated with those organized around the two machines. In 1961, following a considerable increase in the use of electronic computers and of measuring devices connected with visual detection techniques, such activities, together with the Scientific Information Service (which includes the library and the publication of CERN's scientific output) were organized as the Data Handling Division, of which Dr. Kowarski is the leader.

Since 1956 Dr. Kowarski has also been Scientific Adviser to the Director of the European Nuclear Energy Agency. In this capacity he took a leading part in the setting-up of several international enterprises (including the 'Dragon' reactor at present being built in England) and has produced several studies on new trends in atomic-energy research ●

Team Work and Individual Work in Research*

by **L. KOWARSKI**, Leader of the Data Handling Division

In the early days of nuclear physics, the well-known names were those of individual research workers — Madame Curie, Rutherford, Einstein, Bohr. Nowadays, the names are those of Laboratories — Berkeley, Brookhaven, Harwell, Saclay, CERN. Dr. Kowarski here traces the history of this development, contrasting the attitude of mind of the new research physicist with that of the old, and indicates some solutions to the metaphorical problem: how does a restaurant prepare its dishes in large quantities and on the spur of the moment, without destroying their taste ?

Starting points

Let us begin by asking : 'What is the purpose of scientific research ?' Whatever kind of research we consider, its aim always is to acquire new knowledge. But there are different kinds of new knowledge. The aim which first springs to mind is the age-old one of increasing our knowledge of natural phenomena. But there is also another aim, which calls for very much the same sort of effort, that is the aim to achieve something which requires methods or techniques that are still only partly known : for instance to produce a very hard alloy or launch a missile that will go into orbit. Research is also necessary in this case : its object, however, is no longer the knowledge of nature, but what the Americans call 'know-how'. Often, this second kind of research merges into what is called 'applied research'. Often, but not always — for the result sought is sometimes of the kind which will not by itself increase our knowledge of nature, and yet will clear the way towards such knowledge, or else will enhance our prestige. Space research does both. It can hardly be called 'applied research' and yet it aims at achieving a well-defined practical result rather than revealing a new aspect of nature.

The vast expansion of research activities during the last few decades is due mainly to the rapid growth of the second type of research, namely the kind which is more often than not 'applied'. Our knowledge of nature is also growing, but not quite so fast. Intuitively one is ready to grasp the need for putting a whole team to work when a difficult achievement is at stake, whereas it is preferable to be by oneself when it comes to putting a cunning question to nature or reflecting upon its secrets. It is, then, research for a practical purpose which tends to be done by teams, while research of the first type is more for the lone wolf. The present-day evolution, in which the acquisition of 'know-how' is expanded more quickly than the quest for pure knowledge of nature, can thus be identified to a certain extent with the trend away from individual or solitary research towards research work by teams. This identity is not perfect, for, as we shall see later, even the purest research into the secrets of nature calls for an increasing amount of team work.

It so happens that my own research activities, begun several decades ago when individual work was the rule, are now continuing at a time when team work is the order of the day. I can therefore regard the different stages of my career as illustrating, so to speak, the general trend, and some of what follows reflects my personal experience. Let us consider, then, the state of affairs in physics, and especially nuclear physics, a few years before the last war. We find there such greatly renowned names as Mme Curie and Rutherford, Einstein and Bohr. Apart from a few exceptions, they are all lone workers or else leaders who tower above their colleagues to such an extent that they cannot be regarded as members of a team. As a first exception to this rule, there were even at that time cases where two partners appeared instead of a solitary leader. I mean two partners : there are so few instances when there were more, that they can be almost ignored, whereas duets are fairly frequent, for example in the list of Nobel prize-winners. We find such famous couples as Pierre and Marie Curie, or Frédéric and Irène Joliot ; a few pairs of names equally great to the initiated but less well-known to the general public, such as Cockcroft and Walton, or Banting and Best, the discoverers of insulin ; or again among more recent Nobel prizemen, the two great Chinese-American theoreticians, Lee and Yang. This two-headed individualism does not yet make a team ; it is a relationship in which two personalities add up to a richer whole. This may sometimes lead to true heights, as in the cases I have mentioned, or else follow the well-known pattern of Sherlock Holmes and Dr. Watson.

Alongside these masters, as a rule individual but sometimes twinned, there was a kind of three-tier mediaeval organization made up of the masters themselves and of their journeymen and apprentices. The journeymen, as shown by their name, were birds of passage, already in possession of some status. Younger than the master, they followed his ideas, and the master supervised their work. The apprentices helped the journeymen and the master kept a somewhat condescending eye on them. Many discoveries, especially experimental discoveries, were due to groups made up in this way ; there might be three or four essential contributors but the part played by one dominating personality — the master or one of the journeymen who was already taking a lead — could usually be detected. The others were younger and had less experience ; they were still learning. In a laboratory of this kind, there

* Talk given in French at the 1962 meeting of the Schweizerische Stiftung für angewandte Psychologie, held in Zurich on 6 March.

were the technical services provided by such people as mechanics and computers with their little old calculating machines, and typists. But a scientist worthy of the name was also expected to know how to use a lathe in the workshop and even a typewriter. The supporting technicians, if any, did not take part in the scientific work itself. It was gradually becoming clear that a discovery, the establishing of a new fact, would henceforth require the work of several people ; but this work was still taking place at all these distinct levels: master, journeyman, apprentice, technician. The merger was not complete and team work as such did not yet exist.

The evolution towards team work

This state of affairs may not have prevailed in all the sciences, but it did at any rate in those with which I was concerned shortly before the war. Here and there, however, a new style was beginning to appear, where several equals worked together. Why? Because in most of the sciences, and certainly in nuclear science, increasingly powerful tools were being introduced. The assistance of engineers had to be sought for building and operating the big machines. These laboratory machines always had to be adjusted, repaired, etc., as work in a new field always entails straining technology to the limit. Even without the machines, the kind of knowledge required becomes increasingly diversified. A physicist has to work with chemists and mathematicians who are no longer apprentices, nor stooges. The splendid group created by Fermi in Rome included five colleagues of almost his own age. The grouping of these six scientists, although they were completely dominated by the spirit of the leader, could almost be considered as a true team.

In the last few years before the war, particle accelerators made their appearance in nuclear laboratories. Nowadays everyone has heard of cyclotrons ; another kind of machine, the linear accelerator, is less widely known. As I have just pointed out, these machines have to operate at the limit of their possibilities ; they could not accordingly be put in the hands of routine engineers; the engineers themselves had to have a creative turn of mind. It was already being asked whether an engineer could be the equal of a scientist. Did the two really make a team and work together on an equal footing? Was there sufficient mutual respect to hold the team together and share the fruits of the work? To these questions, which began to arise before the war, no entirely satisfactory answer has yet been found.

It is no use dwelling on the wartime period, because war is abnormally efficient in fostering co-operation and team work, and therefore wartime happenings cannot serve as a guide. During those six years a few projects were extraordinarily successful ; they were definitely of the 'know-how' variety but none the less increased our knowledge of nature considerably. Above all, there was the American effort, with many European contributions, which produced the atomic bomb ; other efforts of the same kind led to other outstanding results such as, for instance, radar. All this led to a new idea of the kind of co-operation necessary for tackling the great problems of science. From then onwards, as I have already observed, the quest for a given result becomes predominant. In order to achieve this it becomes necessary to harness together the most distinguished and creative specialists in several different sciences: nuclear physics, solid-state physics, electron physics, electrical engineering, mathematics, chemistry, metallurgy, and sometimes biology, when,

The CERN 'orchestra' is conducted by the Director-General, assisted by a Directorate of three: a member for research, one for applied physics, and one for administration.

There are 12 Divisions, each with its own leader, and each Division is itself divided into a number of sections. Three of the Divisions include experimental teams, each with some five or six physicists.

Experiments are approved by the Nuclear Physics Research Committee, after preliminary selection by the Electronic Experiments Committee, the Emulsion Experiments Committee, or the Track Chambers Committee.

Major policy is decided by the Council, following recommendations by the Committee of Council. The Council is advised by the Scientific Policy Committee and the Finance Committee.

for instance, the question of radiation protection arises. With so many experts working together, it is difficult to point to a single moving spirit. The leader's role is therefore changing, but there always has to be a leader, as in a symphony orchestra which, if it is a good one, is made up of distinguished instrument-players who are not interchangeable, but there must always be a conductor.

In these new teams, the leader is no longer necessarily the source of all the ideas and inspiration. He should rather have the ability to take a broad view, without entering into too much detail, and display some diplomatic gifts, for care has to be taken of both internal and public relations. Among the members of the team, a specialized idea-monger will sometimes be found, alongside other specialists such as chemists or electrical engineers. Team work is beginning to be the general rule and is developing a style of its own.

National and international laboratories

This kind of co-operation flourished mainly in the great national laboratories which sprang up after the war throughout the industrially developed world, in both the East and the West with remarkably little difference. Human nature seems to be the same everywhere, and so are the riddles of nature. The most outstanding of these laboratories were the big atomic centres, like Oak Ridge and Argonne in America, Saclay and Harwell in Europe. Such laboratories are also coming into being in other sciences, such as space research, aeronautics, metallurgy, and electronics. Most of these centres tackle problems of applied science, but some of them are interested in fundamental research. The centres often include several hundred university graduates, scientists or engineers, at different stages of their career which correspond to our classification into masters, journeymen and apprentices. Each of these armies needs a general and several colonels: in each research centre there is a director, who is often a distinguished scientist. Immediately below him there are the heads of divisions or departments, and each department is divided into groups which, even in a very big laboratory, rarely consist of more than, say, four to ten active scientists. These are the groups which correspond most closely to what we might call teams. The group leader, with a higher position in the hierarchy and a higher salary, is not necessarily the most distinguished scientist in the group, but he is the one who co-ordinates and gives a common direction to the work of the group, possibly on account of his diplomatic gifts.

Thus the general idea of a big modern research centre on a national scale gradually begins to take shape. The hierarchy is fairly rigid with its groups, group leaders, division leaders, directors and a great many committees. Scientists complain that they spend an increasing amount of time at committee meetings. However, how can people work together if they do not have an opportunity of exchanging ideas regularly in an organized manner, which means committees ? This is an evil one will have to live with. Obviously, all these unpleasant innovations, a hierarchy, committees and the need to fit into a team, go against the grain for scientists of the old individualist school, but the new era is not without its advantages : safe jobs, higher salaries, and no danger of intellectual isolation.

A laboratory following this pattern may also be created on an international scale. CERN is one of the oldest and most successful creations of this kind, but there are others which are still too young for anyone to gauge their chances of success.

Contrary to an opinion that is often expressed — and this is a point I particularly want to emphasize — the problems arising in international laboratories hardly differ at all from the day-to-day problems of national laboratories. As soon as one gets down to group level, viz. the level of a team whose task has been approved, and means supplied, by some outside authority, and whose problems are strictly technical or scientific, it scarcely makes any difference to the team whether it is national or international. The difficulties inherent in international work lie elsewhere : they appear when the organization is being created, when the first financing and the first family trees have to be agreed upon. But once this stage has been passed, the remaining problems are not nearly so serious. Any energetic leader likes to choose his fellow workers and it is generally easier for him to find them in the circles which he knows best. Accordingly, certain cleavages become noticeable : around an Italian master one finds Italian apprentices, or in a technical group under French leadership the second flight may comprise a fairly large proportion of French engineers. All these trends do not represent more than slight fluctuations.

New problems : publications

We have thus traced the evolution until its present stage ; we started from the image of a solitary scientist, and we arrived at the idea of the team, which seems typical of our times. Let us now consider what concomitant problems have arisen, what would be our reasons to regret the good old days and, failing a return to them, how we can face the snags of the present day.

First of all, let us consider the question of publication. Professional scientific researchers attach much importance to the publication, that is to the appearance in a recognized scientific journal, of an article describing a piece of research and its results, signed by its author or authors. Those not familiar with the course of a research scientist's career cannot understand why this is so important. It is often thought, rather naively, that scientists are vain and like to see their names in print, and that they set so much store by it that they will go to any lengths to achieve it. Once one knows how scientists get their jobs, how they hold them, and how they are paid and promoted, it is easy to understand that having their name on a publication means much more to them than a mere sop to their personal vanity ; it is a question of their children's bread and butter. According to the tradition that has ruled science in our world since Galileo's day, the author who signs an original report is taken to be the originator of the ideas expressed. It may then be asked in a team : who originated the new ideas ? Where there are only two or three members in the team, it can always be said that all of them did. But nowadays, in the big laboratories, articles signed by ten, twelve, eighteen people are beginning to appear ; I have seen one with twenty-nine signatures. Original creators, every one ? This is getting hard to believe. Perhaps just some of them were, and the others were technical supporters, servants ? Imagine a group of people who have lived together for perhaps weeks on end, day and night (because that's how scientists work when the bug bites them), sometimes in dread of a likely failure or even of accidents. Are we entitled to draw the line ; can we say 'this man is a creator and the other a stooge' ? In actual practice, such distinctions can hardly be made, and that is why it is quite usual nowadays to see twenty names taking up half a page on top of a report which occupies a page and a half, and twenty cards in the library catalogue. The idea of original personal work is headed for the cloud-cuckoo land.

Thirty years ago, the number of people in a nuclear-physics laboratory could be reckoned in tens. Now, the staff of CERN, for instance, is some 1150, sub-divided approximately as follows :

— scientists and engineers :	**200**
— technicians :	**625**
— administrative and secretarial :	**175**
— others :	**150**

Fellows, visiting scientists, and supernumeraries, together with experimental teams from various universities, bring the total number to over 1700.

CERN has adopted an ingenious criterion which is probably still suitable for a big laboratory devoted exclusively to fundamental research. Anyone signing a collectively written article should be capable of understanding all the specialized aspects of the work described, to the extent of being capable of taking full responsibility for it. In more strictly technical work, however, specialization may reach a point where this attitude can no longer apply. In the team there may be an engineer, who is the only one to understand how a certain electromagnet works, and a mathematician, who may be the only one capable of following the course of a reasoning involving integral equations. In such cases it is sometimes recommended to split the article up into several separate ones. In practice this sub-division may prove artificial and the separate parts may become meaningless. The various contributions welded together by team work can no longer be easily separated when credit becomes due.

In a few extreme cases a radical solution has been adopted : the work is no longer attributed to such and such an individual but to a whole department or even a whole laboratory. Justice is thus done, but under the present conditions governing scientific careers how are the most deserving to be rewarded ?

On the fringe of this yet unsolved problem and under the very impact of team work, two entirely new phenomena may be observed which add a confusing note to the traditional symphony of scientific communications. One of these is the scientific conference. Important results are published to an increasing extent not in journals but by word of mouth at meetings where 200, 300 or 500 colleagues foregather for discussion. This mode of communication is efficient and even pleasant, but it is habit-forming and ends up taking quite a slice out of the addict's working time; the only sure winners in this game are the airlines. Another development is the distribution of what are called 'preprints'. Instead of sending colleagues reprints from a journal in which the article has been printed, copies of the manuscript are multiplied and circulated before the article has appeared in print.

For a while, until the publication in a recognized journal becomes an accomplished fact, the responsibility of the author remains shrouded in a gentle haze; a typescript does not commit so fully as a printed page does. I have known cases where the 'preprint' was circulated before the knotty problem of who was to sign what had been finally solved.

New problems : the leaders

The spread of team work in research also poses the problem of selecting leaders. In former times this was simple: the leader was the man whose genius was greatest. Nowadays, as I have already said, it is not always the man with the most ideas who becomes leader of a large team. The leader must be able to coordinate, and the financial responsibilities are becoming increasingly heavy. Are those in power always ready to put lots of money in the hands of absent-minded professors?

Finally, leaders are not always chosen; they sometimes choose themselves. In the world of to-day, scientists have prestige and are rather well-paid in senior posts: the profession is beginning to be attractive and this is having an effect on selection, and especially autoselection, in a way that no longer coincides with the interests of pure science as perfectly as it did in the time of the great solitary 'masters'. Increased financial responsibility distorts in another way: caution is beginning to pay and there is a temptation to back only the favourites. For instance, if a daring and even brilliant experiment has been performed somewhere on a certain chemical element, one is tempted not to start another experiment which is just as original but to perform the same experiment on another chemical element. One will thus be sure of obtaining a new result without taking much of a risk. We can therefore see how team work using costly equipment may be led astray by timorous counsel and miss the path leading to unexpected discoveries. Only a few words need be said, in this connexion, on certain temptations which have always threatened the intellectual integrity of research scientists. What is new is that leaders now have much more power, and more power means greater temptations.

Let us also mention, in passing, a more harmless temptation: that of relying on a strong team-spirit built up at the expense of external relations. Individual selfishness, which team work tends to restrict, is then likely to re-erupt, tough and self-righteous, on the higher plane of group relations.

On the other hand, it should also be said that, with the great increase in the number of scientific posts which has occurred in the last 20 years, an ever-growing number of young people have a chance of doing pure scientific work. This has brought about a certain levelling up of temperaments and a certain bureaucratic outlook, especially in the very big establishments. The proportion of individual creative minds goes down, but that of research workers willing to accept the constraints of team work goes up, and it is admittedly easier to do science in this way now than it was 30 years ago, since it suits better the common run of people.

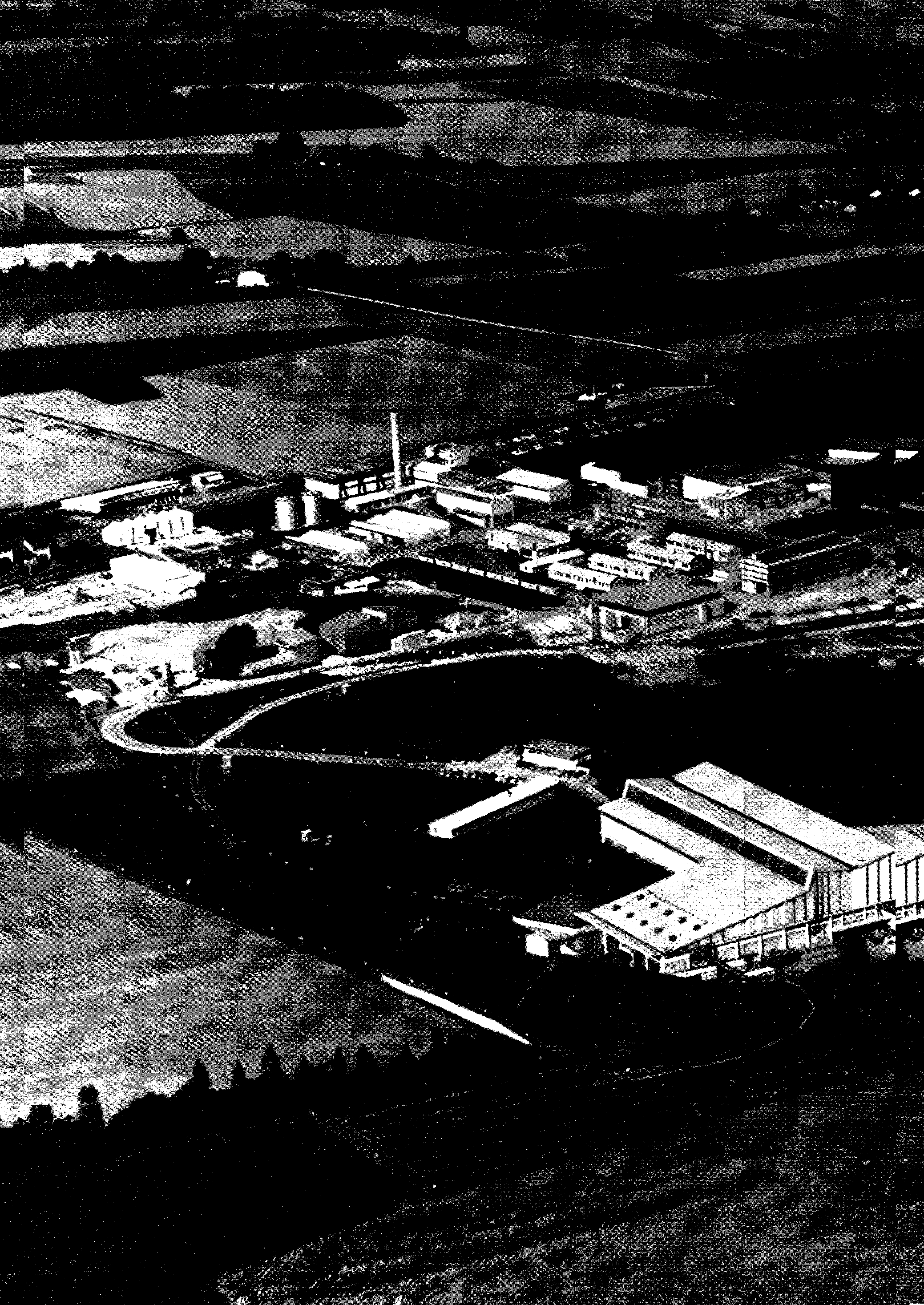
Channels of inspiration

What can be done to counteract this watering down of creative individualism? There is a remedy which is often suggested in practice: this is a kind of specialization among leading scientists. Certain temperaments are more suited to individual work and others to work in a group. Therefore why should the former not be left to meditate in solitude on profound problems and the others put to directing big teams working on slightly more down-to-earth questions? If this trend becomes established, a new kind of hierarchy is likely to be created; one category, higher and obviously looked upon with greater respect, will be 'real scientists' and, slightly apart, perhaps slightly below, the 'applied scientists', good for directing teams. The ideal, however, would be to find men inspired with the spirit that fired the best discoveries in the past, and to make sure that this inspiration was accessible to those willing to follow it, to all of the many teams which are needed at present to break new ground. Neither selection, nor walling-off; on the contrary, the channels of inspiration should be kept wide open. To enable a great mind both to create by himself and to inspire others, I feel the only solution is a deliberate partition of his time. The most radical partition is that afforded by the ages of life: it is well-known that the great individual discoverers get fewer new ideas as they grow older. It is relatively rare for really novel ideas to come from a great experimenter after he is 40. The majority of the fundamental theories were put forward before their authors had reached 30. A career can thus be mapped out in which an inspired scientist would spend his youth and make his reputation doing unorganized work; this would apply to the most capable scientists, who once they had advanced in renown and age would become leaders of teams where their subordinates could reap the benefit of their experience, if not of the fullness of their creative gifts.

In certain cases the scientist's time could be divided fifty-fifty: six months' solitary work, then six months as a leader; or two years and two years. It is perhaps such alternating assignment which holds out the greatest hope, but then such a course must be deliberately arranged so that research work in teams can develop without drying up the sources of individual inspiration. In fact, this dilemma threatens the future of science just as it hangs over great restaurants. How to make food available in great amounts and on the spur of the moment, without adopting methods which kill the flavour: the great restaurateurs are already familiar with this problem; organized science is just coming to it ●

A laboratory created on an international scale

The photograph on the next two pages shows CERN essentially as it is at present, though some of the new buildings under construction have since been completed and other work has been started. The blocks of flats in the top right-hand corner are part of Geneva's new 'Cité Satellite' at Meyrin.



CERN Easter School for Emulsion Physicists

From 8 to 18 April 1962, an Easter School for Emulsion Physicists was held at St. Cergue in the Swiss Jura, under the auspices of the CERN Emulsion Experiments Committee. The main aim of the School was to instruct young research workers in all the different aspects of emulsion work, and particularly in those of emulsion experiments carried out in conjunction with large particle accelerators. Some 51 students were present, 44 of them from Member States. The largest numbers came from the UK, France and Italy (9, 8 and 7 respectively), and the average age was 27.

The School opened with some introductory remarks by Dr. K. Gottstein (Munich), who compared and contrasted the different techniques now in use for high-energy nuclear-physics experiments. He stressed the necessity for employing the best technique for each experiment. Dr. W. Richter (CERN) then spoke about the CERN proton synchrotron, with particular reference to the target facilities which are available. After this, four lectures were devoted to the complex problems of beam transport and beam optics, a field still rather new to most of the European nuclear physicists outside CERN. These talks were given by Dr. B. de Raad and S. van der Meer (CERN), W. Toner (British Emulsion Committee), and Dr. E. Malamud (Lausanne).

Having obtained a beam, the next problem is to allow it to hit a target or to enter emulsion stacks. The technicalities of this kind of work were discussed by Dr. J. Combe and M. A. Roberts (CERN). The properties of nuclear emulsions were described by Dr. E. Dahl-Jensen (Copenhagen) and their storage, assembly, and transport by M. A. Roberts. The next stage in an emulsion experiment is the processing of the pellicles. This is one of the most controversial subjects amongst emulsion physicists and emulsion chemists. Prof. M. Teucher (Hamburg) described what he believed to be the correct routine, which should be followed under all circumstances. This lecture was followed by a most interesting and entertaining ' Brains Trust ' on processing, with Prof. Teucher, Dr. G. Vanderhaeghe (CERN), Dr. Dahl-Jensen and Dr. H. Heckmann (Berkeley) as speakers, and Dr. Gottstein in the chair to prevent them from fighting for possession of the microphone.

The second week began with two talks from Dr. L. Hoffmann (CERN) on the production of high magnetic fields, with special reference to the pulsed-magnet technique and the 200 000-gauss apparatus that has been built at CERN. Dr. W. M. Gibson and Dr. D. H. Perkins, from Bristol, dealt with the different types of measurements that can be made in nuclear emulsions, and Dr. Heckmann talked briefly about the recent accurate determination of the lifetime of the pi-zero meson made at Berkeley by W. H. Barkas and his group. Dr. Vanderhaeghe discussed the characteristics of the microscopes most commonly used today, after which Prof. E. H. S. Burhop (London) gave an excellent survey of the basic theory of statistics and the treatment of experimental data.

The remainder of the School was largely devoted to descriptions of typical experiments for which the emulsion technique is particularly well suited. Prof. Burhop talked on K-meson physics, especially the scattering of K-mesons by protons and the study of hyperfragments ; Dr. H. Winzeler (Bern) surveyed the field of small-angle proton-proton and proton-nucleus scattering experiments ; Dr. Ph. Rosselet (Lausanne) spoke about the determination of the magnetic moments of hyperons using pulsed magnetic fields together with nuclear emulsions as the detector material. Finally, Dr. W. O. Lock (CERN) described the organizational details for carrying out emulsion experiments at CERN.

All the participants were housed in the same hotel, which greatly facilitated discussions between the students and between students and speakers. Two lectures were given on each morning ; in general the afternoons were left free until five o'clock, when a third session commenced and continued until dinner time. This combination of work and relaxation, coupled with abundant snow and fine weather, appears to have been much appreciated. In fact, the attendance at the last lecture was just as great as at the first !

Last month at CERN (cont.)

In the North Hall, the other separator, in the beam k_1, was operated at a potential of 480 kV and a plate separation of 8.5 cm during the experiments with the heavy-liquid chamber. Earlier, it had been used in the same way to give negative kaons of momentum 1.5 GeV/c for the helium bubble chamber from Rome University. For an experiment involving the Universities of Lausanne and Rome, as well as CERN, using nuclear emulsions to find the magnetic moment of positive sigma particles, a potential of 500 kV was used with a plate spacing of 18 cm.

On 4 April, CERN was visited by some 40 Parliamentarians, members of the **Cultural and Scientific Committee of the Assembly of the Council of Europe.** Their visit formed part of a meeting, held in Geneva in conjunction with a delegation from the Assembly of the 'Six', to examine the possibility of establishing a common European policy on scientific research and co-operation.

One of their recommendations was for the establishment of a 'European' astronomical observatory in the Southern hemisphere, comparable to the American one in California. Another was for the adoption of a long-term programme for CERN, which was commended on its brilliant success during its first ten years. All the recommendations made during the Geneva meeting will be submitted to the full Assembly at Strasbourg in May.

All records were broken by the attendance at this year's Annual General Meeting of the **CERN Staff Association,** held on 11 April. The 339 seats in the Main Auditorium were all taken and some people had to stand. In the course of its detailed report of the year's activities the Committee of the Association paid special tribute to Prof. Weisskopf, the Director-General, as well as to members of the senior Administrative staff for their 'comprehension, co-operation, help and patience' in relation to the many matters in which the Association was involved during the year ●

While this issue was still in preparation, CERN was honoured on 24 May by the visit of H. M. King Baudouin I of Belgium. A fuller report will be given in our next issue.

On the last evening a Banquet was held at which Miss E. W. D. Steel, Dr. M. G. N. Hine, and Prof. P. Preiswerk were the guests of honour.

The success of this venture makes it likely that similar schools will be organized in the future. This time, the School was largely technical in subject matter ; the next one would probably have a stronger bias towards physics. However, the basic idea would remain the same, that is, to bring together for a week or two, under relatively relaxed conditions and under the same roof, people who are working in one way or another with nuclear emulsions. Such gatherings are particularly valuable for the young scientists in the smaller laboratories, perhaps at rather large distances from Geneva, who otherwise tend to lose contact with the main stream of knowledge of the emulsion technique and even of the physics to which it is related ●

W. O. Lock

We have been grieved to learn of the death of **Umberto Bonello,** SC Machine Division, on Monday 9 April.

He had been admitted to a clinic the week before for examination, but did not survive the surgical treatment that was found necessary.

After joining CERN in September 1958 as an operator, he became chief operator of the synchro-cyclotron in February 1959. He played a full part in the constant development of the machine, and the vitality and spirit of the team is evident from the experimental results obtained at the SC.

To his young wife and family, all his colleagues at CERN extend their deepest sympathy.

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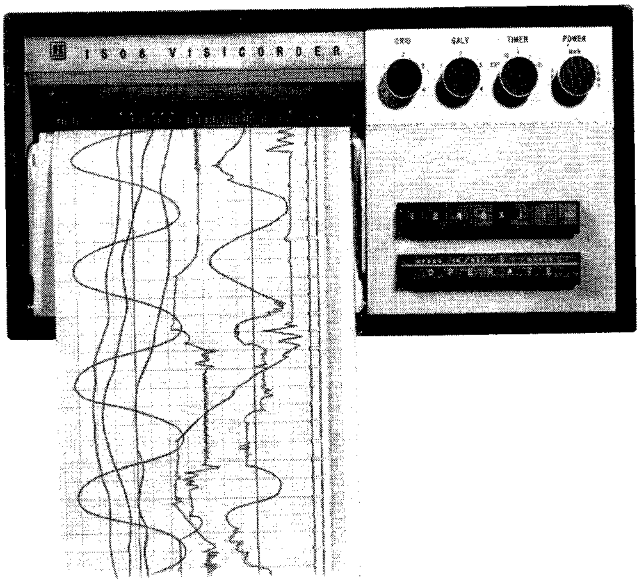

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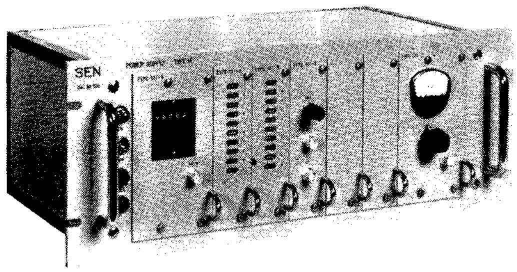

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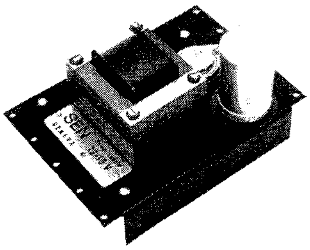

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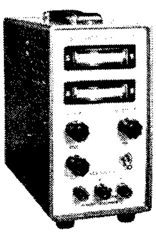

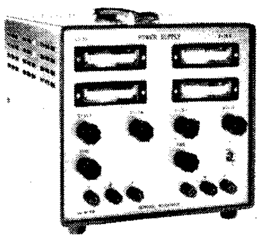

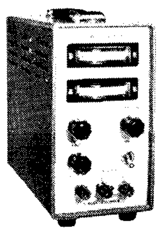

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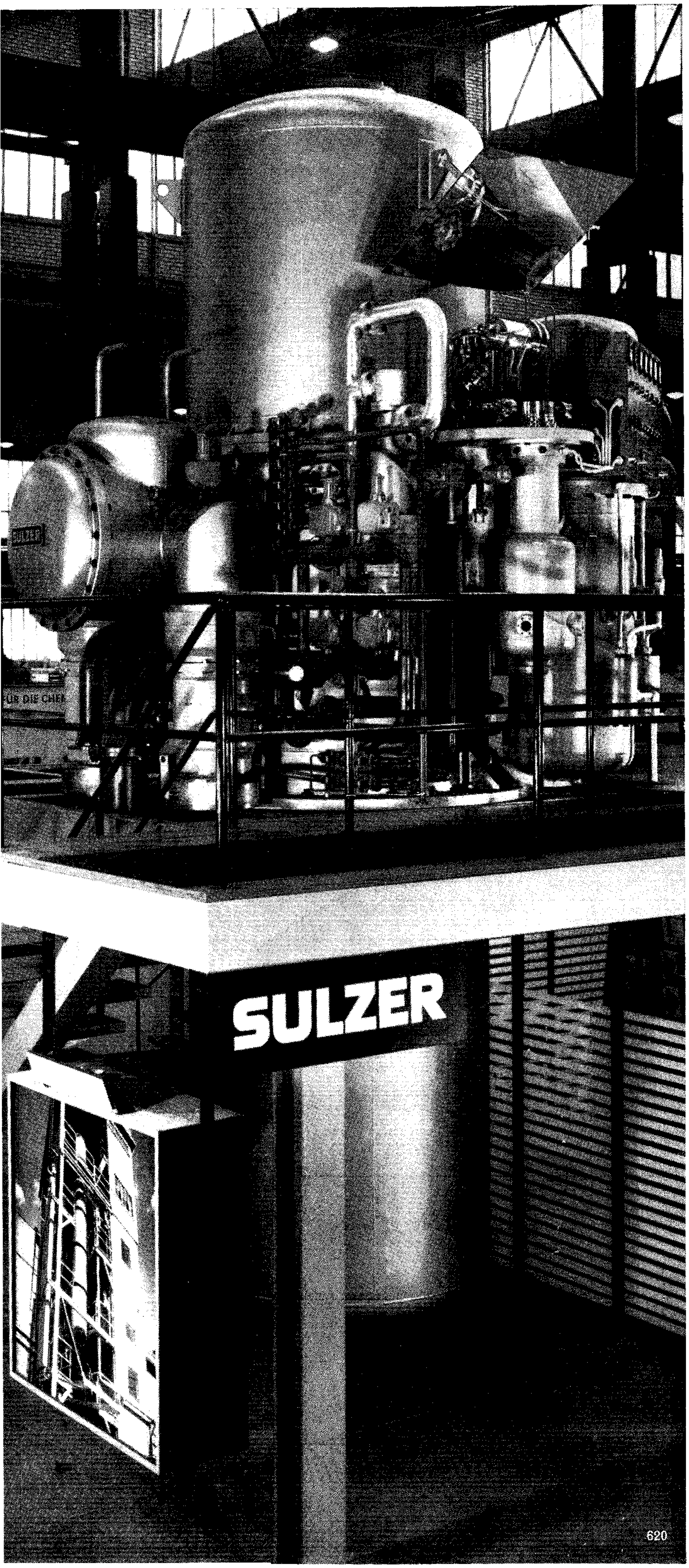
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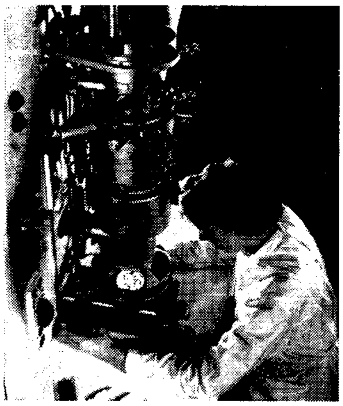

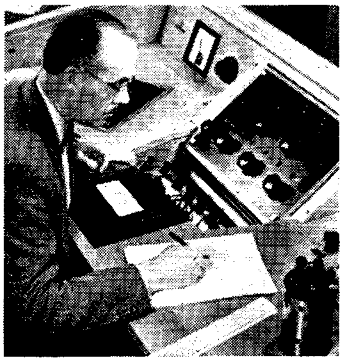

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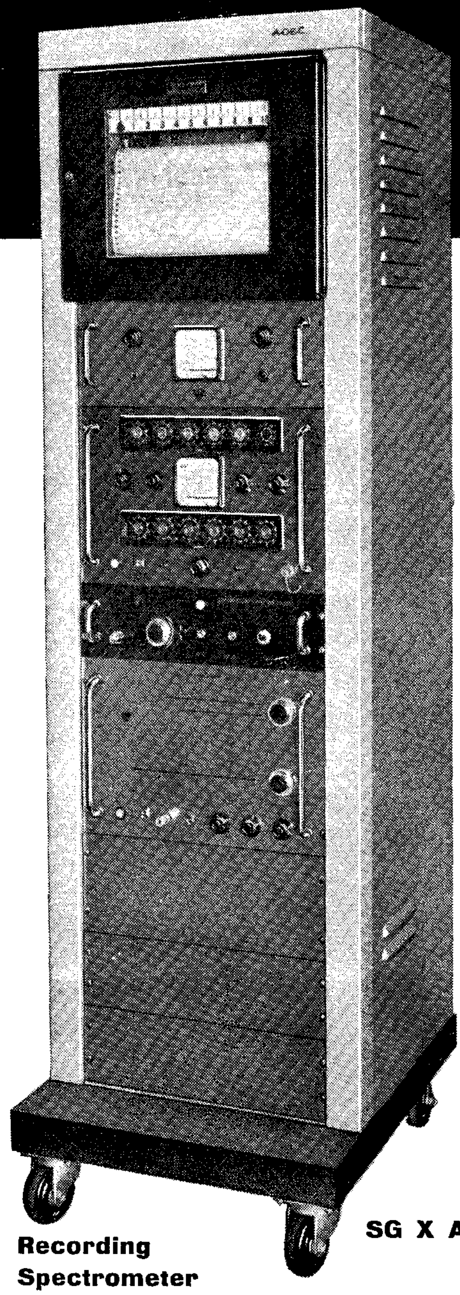

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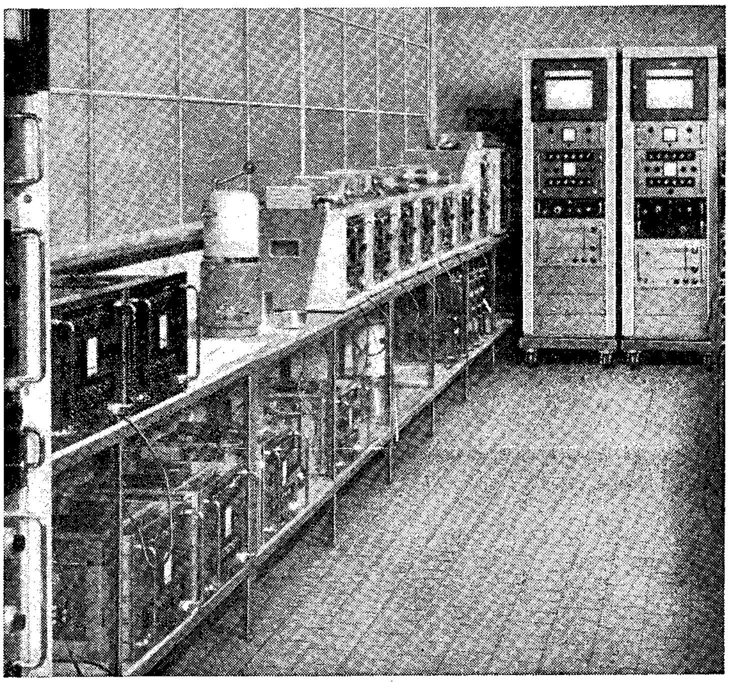

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