

NUCLEAR TECHNOLOGY

rather like a car battery. These plates are connected alternately to the two terminals of a source of high voltage electric power. If the voltage is applied at the moment when a particle is crossing the chamber, a small electric discharge jumps from one plate to another along the track of a particle crossing the gap. The whole apparatus is filled with a gas such as neon or argon.

The photographs of these tracks give a record which is far inferior in definition to those provided by the bubble chambers: the tracks are clumsier and not so clear. However, there are considerable advantages to make up for this lack of clarity.

Among these is the possibility of selecting interesting events. The high voltage which produces the spark between the plates is controlled by a counter — of the Cerenkov type, for instance — placed before the chamber in the particle beam coming out of the accelerator. The counter can be designed to neglect all particles which are considered to be of no interest. In addition, thanks to the electronic devices in the control counter, the sparks can be made to last for as little as half a microsecond. Therefore, it is only during this fleeting fraction of a millionth of a second that the sparks follow the track of the particle through and between the parallel plates. During this short period, the number of stray particles is extremely small. The photograph taken during the microsecond concerned will therefore show practically nothing but the events which are of interest, even though hundreds of thousands of “uninteresting” particles cross the chamber before or after.

Physicists state that this is a great improvement upon the bubble chamber or cloud chamber which are filled with a substance possessing too long a “memory”: the events occurring there last for milliseconds, that is over a thousand times longer than in the spark chamber. This period is quite long enough for the entry into the bubble chamber of particles other than those originally considered to be of interest.

Another of the good points of the spark chamber had already been

taken advantage of in the technique of the multiplate cloud chambers. This was the choice of a high density material, such as lead, for manufacturing the high voltage plates. The number of atomic nuclei with which the particle arriving may produce an interaction is accordingly increased.

For instance, for an experiment on neutrinos with the big Brookhaven alternating gradient accelerator, L.M. Lederman is planning to construct a spark chamber $1.2 \times 1.5 \times 1.8$ m. It will contain material weighing about ten tons. At CERN several physicists are interested in this type of apparatus, in the groups of G. von Dardel, G. Fidecaro, H. Faissner, D. Harting and A. Lundby. In addition, in the Accelerator Research Division, F. Schneider is studying the general properties of the chamber with a view to developing it.

An impressive number of laboratories seem to have rediscovered this sturdy and simple instrument, the spark chamber. One is naturally tempted to ask why it was not exploited sooner. It appears that progress in electronics is responsible for this renewed interest in a relatively old technique. The dead period of the counter controlling the high voltage pulse has been considerably reduced and this offers the advantage, already mentioned, of excellent discrimination in time.

Electronics,

ten years ago, seemed to be on the point of revolutionizing a considerable number of conventional techniques. This has happened to a certain extent, as testified by the above example.

One of the CERN electronics experts, I. Pizer, went to Berkeley. He brought back a report full of ideas on solid state detectors, clipped pulses, zero-crossing, negative resistance region and **tunnel diodes**. These, said I. Pizer, act as rapid switches in electronic circuits.

Although some of our electronics experts are not very enthusiastic about this, the information pinned

up on the door of a well-known electronics workshop is a sign of the general interest in tunnel diodes.

At Berkeley, in the opinion of the majority, nobody presented a practical circuit which fully exploited their characteristics. Perhaps fast electronics will soon be in a position to disclose all the advantages of this small apparatus which has taken its place alongside the ubiquitous semiconductor devices.

Solid state detectors

will one day replace photomultipliers, it seems. At present, they have the drawback of low output voltage and can only be applied to low energy detectors.

In the same context, Guy von Dardel also mentioned “spaghetti chambers”. This culinary adjective describes the application of a discovery made a few years ago, which will soon be exploited. This will mean an improvement in **scintillation chambers**, instruments which make it possible to observe directly the trajectory of a particle passing through them, owing to the emission of fluorescent light. In order to be photographed, the phenomenon however has to be amplified by a hundred million. The new optical device uses bunches of small diameter fibres — the “spaghetti” — transmitting the light along their axes, considerably reduces the depth of field necessary for observing an event. This will make it possible to construct large-sized scintillation chambers.

The multiple event recorder

attracted much attention. This apparatus (Berkeley) transfers the pulses of 180 counters on to magnetic tape in 20 microseconds. The counters may, for instance, be arranged to cover a considerable solid angle and detect the events occurring there.

Cerenkov counters

are used to determine some characteristics of particles by exploiting the luminous phenomena to which

Prof. V. F. Weisskopf

4th Director-General

At its session held on 8 December, the Council of the European Organization for Nuclear Research appointed Prof. Victor F. Weisskopf Director-General. This distinguished Austro-American scientist, whose biography is published in this issue of the "CERN COURIER", will assume his new duties on 1 August 1961, for two years. He will succeed Dr. J. B. Adams who will then return to Great Britain to direct the plasma physics laboratory at Culham.

Prof. Weisskopf will be the fourth Director-General of CERN, his predecessors having been Prof. F. Bloch, Prof. C. J. Bakker and Dr. J. B. Adams.

When announcing the new appointment, Mr. F. de Rose, President of CERN Council, pointed out that CERN had become such an important research centre in Europe that it was now able to attract distinguished scientists from all over the world.

*

67,7 million Sw. frcs for research at CERN

The CERN budget for 1961 amounts to 67,7 million Swiss francs.

This sum will cover capital expenditure, such as the new experimental equipment to be used with the two particle accelerators at Meyrin. A great deal of intricate and fragile equipment is necessary to perform the many experiments proposed in the experimental physics programme, especially for the 28 GeV proton synchrotron.

Other budget headings cover expenditure on electric power, the accelerators being heavy consumers of power, maintenance charges for the equipment and buildings situated on the 100 acre CERN site, near the French border. They also cover the salaries of over one thousand people.

The 14 member countries will contribute to the CERN budget in proportion to their national income, percentages being as follows:

Austria	% 1.87
Belgium	4.02
Denmark	1.93
France	20.57
German Federal Republic	18.92
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

Nuclear Technology

they give rise. The Berkeley Conference revealed the increased accuracy of these counters and mainly the gas-filled ones (CERN) for differentiating the particles which are mixed in very high energy beams.

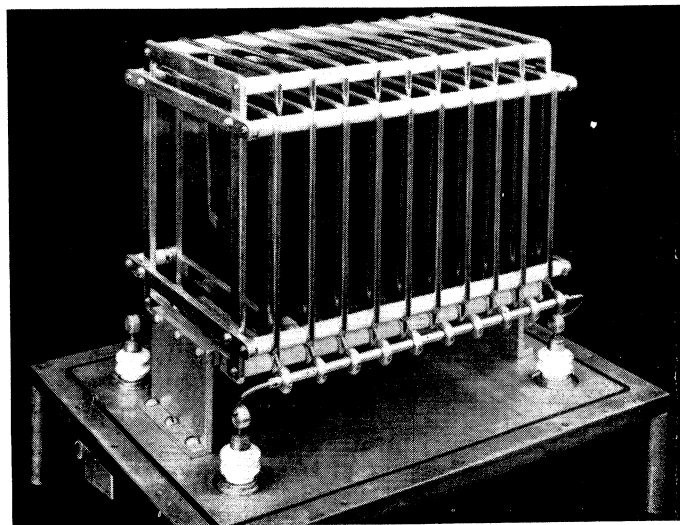
The measurement of track photographs

was much discussed at Berkeley. In this respect, a European physicist said on his return that "a CERN vic-

duced by the bubble chambers. Whence the search for more up-to-date, more automatic apparatus CERN's IEP-X in particular.

The measurement of track photographs entails such complicated techniques that an extra two days were added to the time which had originally been set aside at Berkeley for this subject. These additional discussions dealt with the program-

A view of the inside of a spark chamber similar to that constructed by the G. Fidecaro group. The sparks "jump" from plate to plate when a particle goes through the chamber and can be photographed so as to provide a permanent record of the behaviour of the particle. The chamber shown was constructed at Princeton by J. W. Cronin and G. Renninger.



tory had been announced in measured terms". CERN would be the only laboratory to offer a practical solution at present. The CERN IEP-X seemed to offer the only chance at present of dealing with the avalanche of photographs of particle tracks recorded on miles of film by the bubble chambers.

The details of this technique will not be discussed here; a summary appears on page 26, in the article on bubble chamber data analysis by Lew Kowarski.

According to Yves Goldschmidt-Clermont, who had good reasons to keep in close touch with developments in this field, "electronic computing is now in general use for measuring the photographs obtained from bubble chambers. The great number of laboratories engaged in this work nearly all use coding projectors, which record directly on perforated tape the point co-ordinates measured along the tracks."

These are concrete solutions, indeed. But they are far from sufficient, as they can take care of only a fraction of the photographs pro-

duced by the bubble chambers and future problems.

Bubble chamber:

The analysis of the tracks left in the bubble chambers by the particles which it is wished to study poses very great problems for some physicists. But their colleagues-designers of bubble chambers still continue to improve their equipment.

Perhaps they do so in the hope of spurring on the physicists. Perhaps they want to drown them for ever in a flood of documents... intended ironically enough, to put some order into the complicated structure of modern physics.

Whatever the reason, the bubble chambers are improving. The largest of them, the 180 cm chamber of the Berkeley laboratory, has had its cooling system modified. As a result it produces a photograph every 10 seconds instead of every 12 as in the past. The same laboratory has announced that the construction of a new chamber intended to replace the 40 cm one has begun; it will incorporate a horizontal mirror with illumination from the rear.