two-ring machine optimized for 100 GeV per beam. It was then decided to study carefully a single ring LEP optimized for 70 GeV per beam, with a radius of 3.5 km.

This second proposal, published in August 1978, was costed out at about 100 M SwFr, i.e. about half the original sum, and construction was estimated to take 5-7 years. It envisaged a machine built in a tunnel of 4m diameter cross-section, with eight straight sections, each of which was an interaction region. Four bunches of electrons and positrons travelled in opposite directions and luminosity in the interaction regions was to be $10^{29}$ cm$^{-2}$ s$^{-1}$. This proposal was based on the use of conventional iron-cored magnets but it was anticipated that later these could be replaced by superconducting magnets in order to achieve 100 + 100 GeV. It can be noted that the cost is only a little greater than that of the SPS, and LEP could be built inside the CERN budget if this was maintained at its present level. Unlike the SPS, however, a new approach is being considered, namely an e$^+$ e$^-$ one shot linear machine which might be built in two stages, if the problems of accelerating very rapidly, intense and small phase bunches could be solved. First stage could be a 1 km long pair to give 100 + 100 GeV followed by a second step of three times the length and energy. Repetition frequency might be 10 Hz.

High energy physics it is clear is no longer following a single route and the diversification of machines is meaning that a world machine is giving place in physicists' minds to a world programme in which all the big laboratories are complementary and international in the widest sense.

### European Synchrotron Radiation Facility

A summary of his lecture prepared by Y. Farge, of Orsay, chairman of the ad hoc committee set up by the European Science Foundation to study European synchrotron radiation requirements.

In 1976, the European Science Foundation, located in Strasbourg, set up a study group on synchrotron radiation under the chairmanship of H. Maier-Leibnitz. This group was composed of sixteen scientists, mainly from various synchrotron radiation facilities in western Europe which comprise: Bonn (Fed. Rep. of Germany), Daresbury (United Kingdom), Desy (Fed. Rep. of Germany), Frascati (Italy), Lund (Sweden), Orsay (Sweden). It presented the following recommendations and conclusions.

1. There will be a large discrepancy between the number of scientists who wish to use synchrotron radiation and the number of stations available on existing or proposed machines.
2. Existing high energy physics machines in general are not well adapted for synchrotron radiation work.
3. Energy consumption of some existing storage rings make their operation for synchrotron radiation work a very expensive proposition.
4. The design of many existing machines precludes the use of wiggler.
5. Strong efforts should be made to obtain dedicated beam time at existing high energy physics storage rings. Additional beam lines should be installed at these facilities to exploit them in an optimised way for synchrotron radiation research.
6. Small storage rings can be realised on a national scale.
Critical wavelength in bending magnets: \( \lambda_c = 1 \text{ Å} \) in normal bending magnets; \( \lambda_c = 0.25 \text{ Å} \) in wigglers; \( \lambda_c = 0.025 \text{ Å} \) in undulators.

The Critical wavelength in wigglers is 0.25 Å power with 6 wigglers 1.5 MW.

Energy: 5 GeV
Beam: 565 mA
Circumference: 604 m
Radius of bending magnets: 22.36 m
Critical wavelength in bending magnets: 1 Å
Critical wavelength in wigglers: 0.25 Å
Photon flux at 1 Å: \( 4.5 \times 10^{13} \text{ ph/s (per m rad horiz.; 0.1% band width)} \)

Beam size at the middle of:
- Dipole magnets: \( 0.18 \text{ mm} \)
- 6.8 m straight sections: \( 0.50 \text{ mm} \)
- 3 m straight sections: \( 0.11 \text{ mm} \)

Total synchrotron radiation power with 5 wigglers: 1.5 MW
Number of bending magnets: 48
Number of undulators: 6

The Machine
It is quite clear that many new scientific fields can be approached if it is possible to gain two or three orders of magnitude in X-ray intensity. The machine sub-group has defined a machine with the following characteristics:
- critical wavelength: \( \lambda_c = 1 \text{ Å} \) in bending magnets
- wiggler in straight section with: \( \lambda_c = 0.025 \text{ Å} \)
- very good focusing of the electron beam in bending magnets and wiggler;
- undulators on long straight sections with tunable wavelength emission (1 Å < \( \lambda < 100 \text{ Å} \)) and very high brightness.

This design is a very good one compared to existing machines or X-ray machines under construction anywhere in the world. The brightness, defined as the photon flux in a given solid angle and a given band pass, divided by the source area, will be five times better than the one at the facility planned at Brookhaven and 50 to 200 times better than at existing machines.

The brightness in undulators will be 10^9 higher in normal bending magnets, though it must be remembered that all the radiation (in a given narrow bandpass) is emitted in a very small solid angle and the number of photons of a given wavelength is therefore not increased by increasing the acceptance of the beam line. It is quite clear that such a machine would constitute a great improvement with respect to other machines. It would be very helpful to build it during the 1980s in order to keep the very good quality which exists in Europe at present in the field of synchrotron radiation, but also to use such a facility as a centre where European scientists from different countries and different fields could work together.