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SOME ASPECTS OF THE DEVELOPMENT OF THE BRAZILIAN SYNCHROTRON RADIATION PROJECT

by

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The history and the development of a Synchrotron Radiation project in a country such as Brazil illustrates a number of aspects which are relevant for the purposes of the present Roundtable.

The motivations, the aims, the political and economic decisions as well as the practical support in a country like Brazil are in many aspects markedly different from those in more developed countries. And there is no doubt that in order to achieve success in North-South cooperation one must take into account such differences in the general aspects of technical and scientific evaluation between developing and developed countries.

One can say that the Brazilian Synchrotron Radiation project was born by chance. It did not arise as a consequence of planning, nor did it come to fulfill any need of technical, scientific or industrial development, as usually happens in the more developed countries.

However, on a closer look one can see that aspects similar to those occurring in developed countries are included in what we called the chance event of the Brazilian project.

Reading the chapter on Synchrotron Radiation by S. Kapitza in the book *Trends in Modern Physics* published in 1978, I noticed that the author points out that linear electron accelerators with energy of about 15 MeV can be useful injectors for Synchrotron Radiation installations. My attention for this point arises from the fact that in the Institute where I work, the Brazilian Centre for Research in Physics (CBPF), we had a 15 MeV linac, a home-made accelerator which had been unused for several years. This accelerator had been built by an electronic engineer who in fact made it with no particular purpose in mind. He had finished his Ph.D. abroad, and his thesis work had been building parts of a linac. Thus, after his return home, he wanted to build a linac, a job in which he was quite successful.

After this linac was ready, a physicist, who had also received his Ph.D. in neutron physics in a foreign country, arrived and found that he could use this equipment for time of flight measurements in nuclear reactions. So, everyone was happy, and the authorities in the nuclear field

decided to support the project in collaboration with a nuclear physicist from an advanced country.

The type of experiments carried out with the equipment were of the kind that advanced countries would not consider worthwhile pursuing, but which they are happy to see done in a less developed country. These experiments may be useful in training, and they may provide new data on nuclear structure which could be published in an international journal etc.

Because of local difficulties mainly to be ascribed to the lack of technical development, the project took a few years longer than expected, and when everything was ready to operate, most scientific problems which could have been dealt with were outdated. Moreover, when the experiments began, the supporting authorities realized that it was too expensive to keep the equipment running, and they simply withdrew from the project. Thus we were left with an unutilized 15 MeV linac. For several years successive commissions discussed the possibility of finding a new use for such an accelerator.

This story dates back to the seventies, and it was not so pessimistic as it is being described here. Infact, it shows that by that time we already had competent people capable of doing reasonable scientific work. The mistake was selecting the wrong field for investigation, and the uncritical and wrong orientation of North-South cooperation.

I will now tell you the story of a more successful achievement which happened in the same institution at about the same time.

More or less since its discovery, we had developed a Mössbauer effect equipment with local facilities. This equipment was clearly much less ambitious from the technical point of view than a nuclear installation. The Mössbauer equipment was initially used as a spectroscopic method in areas of physics, chemistry, metallurgy, mineralogy, biology and archaelogy. Within a few years it had led to number of papers, published in specialised periodicals, as well as to several Ph.D. theses. It has certainly been a successful achievement.

From the point of view of North-South cooperation, we started to bring to the North a number of interesting problems, arising from the originality of the local minerals and the archaeological material for instance. Several nuclear physicists changed over to the new field, contributing their experience to cooperation with specialists in other areas.

So, the main reason for this successful achievement has undoubtedly been a reasonable selection of the techniques to be used, which were not above the local capabilities, but more than anything else the multidisciplinary character of the field itself. The consequences of putting together qualified people from different scientific fields is that one helps the other and that new views and new solutions are opened up for existing problems.

Due to the relatively small size of the equipment required, it was easy to get financial support for the selected experiments. However, a few years later we experienced difficulties in keeping pace with the technical developments which had in the meantime occurred. More sophisticated electronics, low temperature devices (until today most developing countries do not have helium liquefiers), computer techniques and other developments taking place in more advanced countries were expensive and difficult to obtain and operate. We had to push more and more to the originality side of the research work in order to stay competitive.

Thus, in the eighties, when we read Kapitza's contribution on Synchrotron Radiation, it seemed that we were facing a situation for some aspects similar to that many countries experienced in developing their Mössbauer effect equipment.

First and above all the interdisciplinary character of this light source is to be mentioned, which can be used by physicists, chemists, biologists and in very important industrial and technological applications. We soon noticed that a booming was occurring in the field of Synchrotron Radiation: dedicated machines, applications in surface physics, crystallography, optical and U.V. spectroscopy, catalysis, to mention just a few of the more relevant areas, as well as most important applications in

microelectronics.

From this point of view, i.e. from the user's point of view, we were in a rather good situation. In the seventies and the eighties there had been an increase in the number of qualified people in most of these areas and certainly users existed in Brazil for a Synchrotron Radiation facility.

What about technicians and engineers in areas such as electron optics, high vacuum, magnets and so on? Clearly, we were -- and still are -- very weak in this respect. Brazilian science policy has pushed the formation of hundreds of Ph.D.s abroad, and more recently at home, but there is no such policy for technicians. The few technicians available are absorbed by local industries, which can pay much better salaries. Moreover, these people have no chance for a career in places such as Universities or even in most research institutions. As a consequence, the main difficulties for going on on with the idea of building a Synchrotron Radiation facility at home arose from the technical side.

But now comes the question: why should we build a Synchrotron Radiation facility at all? The same question in more advanced countries will find a very different answer. In those countries the scientific community, or at least the science policy decision makers, can express the needs for a particular development to solve scientific and industrial problems. For example, one can say Synchrotron Radiation is needed to investigate free-electron lasers, to make EXAFS in a given type of catalyser or to produce micro-chips for industry. The existence of people capable of building up the required Synchrotron Radiation facility is not the basic issue, perhaps only in terms of salaries for engineers and technicians. As a consequence, the decision can be taken on the basis of planning, with all figures for costs, necessary manpower, timing and the details of the Synchrotron Radiation equipment for the purposes required available. The scientific community is large enough to ensure a full time time use of the facility and perhaps it is only a question of good advertising to get both the support from the authorities as well as to convince the colleagues of the potentialities of Synchrotron Radiation.

The situation is quite different in country like Brazil. Considering the matter from the point of view of the needs as expressed in developed countries, we do not need a Synchrotron Radiation facility. But, infact, we need such a facility for different reasons.

Above all, we need to expand qualified manpower in science and technology, not only in number but in a different way than has happened until now. We need to drastically change the number of experimental physicists as compared to that of theoretical physicists. Such ratio can be taken as an indication of the level of development. A clear correlation exists between the GNP and the ratio of experimental to theoretical people. For obvious reasons in less developed countries practically every physicist is involved in theoretical work.

But in order to increase the number of experimental physicists it is necessary to find areas of feasibility in which people can be correctly trained, which means doing the best possible research work. There is no doubt that Synchrotron Radition is in an excellent position in this respect.

As explained above, in Brazil we need engineers and technicians in the critical areas for the Synchrotron Radiation facility. Thus, if we plan to build at home such a facility, we have to train such people beforehand and simultaneously. Here we have a critical point for North-South cooperation, in sending trainees to the more advanced countries which are now building Synchrotron Radiation facilities. In this respect, if a Synchrotron Radiation facililty is to be constructed in Trieste, and ICTP activities will be closely connected with this enterprise, it will offer an excellent opportunity to train people from less advanced countries.

We insisted in saying that we want to build such an facilty at home. We explicitly avoided the possibility of buying the installation, as a blackbox, which would repeat many failures of the past, particularly in the nuclear field. We want to construct it in order to increase simultaneously the technical manpower in the country. These people will be useful not only for our purposes, but for all other potential areas in which these techniques are of importance.

Local industry has had a large development in Brazil, and in the opinion of experts from abroad who have been in several missions to the country, it is possible to make up to 80% of all parts of the Synchrotron Radiation machine locally. It is clear that this is an important argument for convincing the supporting authorities to go on with the project.

During the past years we have been discussing with the Brazilian scientific community about the Synchrotron Radiation project. Meetings with physicists, biologists and medical people have been quite successful, and this has convinced us of the potentialities of the users' community.

Meetings with applied research institutes such as the Oil Company Institute, which uses catalysers, metallurgy institutes and so on, have not been so successful. Although some interest has been expressed by the applications of Synchrotron Radiation, it appeared to these people to be somehow remote as a practical tool for their activities. However, quite recently an important support to the Brazilian project came from the governmental organization in informatics. We were offered a site for the future Synchrotron Radiation installation near the Centre for Informatic Technology which has all facilities for the basic techniques involved in informatic applied research.

I come now to a critical aspect of the development of the Synchrotron Radiation project in Brazil, in which internationally collaboration has proved to be of utmost importance.

With the development of the discussion of the project among scientists, the authorities decided about two years ago to support the Synchrotron Radiation project in term of planning and organizing a National Synchrotron Radiation Laboratory. Somehow surprisingly, the acceptance of these plans by the authorities provoked a reaction and a split in the scientific community.

A number of people, particularly among physicists, are deeply worried about a project which can drain a substantial amount of resources. They claim that if the funds are coming from the same sources of support

for all activities in physics, the Synchrotron Radiation project will be even perhaps disastrous to all other activities in physics.

This kind of debate is clearly not limited to less developed countries, but in our case it raised difficulties at the level of science policy decision makers.

One of the main arguments of those who do not agree with the Synchrotron Radiation building, is that the home made planning cannot be given full credit, particularly in terms of total costs. This is a consequence, they say, of the lack of experience in the country in these areas. The danger of a money eating monster with an unknown appetite for the rather meager resources available for physics created a strong difficulty for the Synchrotron Radiation project.

The board of the Synchrotron Radiation project decided then to call for a meeting inviting experts from both developed and developing countries for a debate in political, economic and scientific aspects of Synchrotron Radiation. The purpose of this encounter has been to give a more solid basis for the Brazilian project, on the basis of international experience in planning the Synchrotron Radiation facility.

The meeting in Rio de Janeiro which took place in November 1985, was supported by UNESCO, ICTP and the Ministry of Science and Technology of Brazil. It was a successful encounter, not only for its purposes, but it allowed also to compare the different developments occurring in several countries.

As an important result of the *Meeting on Synchrotron Radiation in Developing Countries*, an international advisory committee was established for the Brazilian Synchrotron Radiation project. The experts from more experienced countries gave us asistance to the local project and the continuity of such a committee is undoubtedly of great importance for the future of our project.

The debate in Brazil between those which believe that the Synchrotron Radiation facility will be of great importance for the development of science and technology and those who are cautious and conservative in this respect, is now going on on a more firm basis, and very recently the Ministry of Science and Technology decided to support the project by giving it special funds from other sources than the existing ones. This has been for a large part a consequence of the international support given to the Brazilian Synchrotron Radiation project.