Marking emulsion sheets with radioactive nylon fibres for assembly into emulsion blocks, TIFR, Bombay, 1953.

with nuclei and with each other? What are the rest masses of these particles, their decay times and other properties?

Thus an enormous research programme lay before us, in which the advantages deriving from India's geographical position could be exploited.

4. There is, however, at least one more subject of great interest in high-energy CR research which we did not take up, namely the study of the so-called extensive air showers. These are produced in the atmosphere by extremely rare CR primaries of extraordinarily high energies. Here India has no geographic advantage over other regions since the measurements on extensive air showers have to be carried out on the ground, where the thick overlying atmosphere excludes low-energy background at all latitudes. A vigorous programme on extensive air showers was, nevertheless, also initiated at the institute at that time, and produced under the leadership of B. V. Sreekantan many useful results. The success of his work can in part be ascribed to the fact that India possesses in the Kolar Gold Mines one of the deepest underground installations suitable for CR research.

But the attention of the group which I had joined concentrated on high-altitude measurement and on the first three listed subjects. We employed nuclear emulsions and balloon technology and were able, in the course of time, to improve both these technologies significantly.

Intensive scientific work at the institute engulfed me almost immediately after returning from the US. Among the large number of CR interactions which had been found in the emulsions exposed in the 1950 flights there was one very rare and huge one with nearly four hundred created subatomic particles, initiated by a primary CR nucleus of magnesium. This interaction remained for years the largest nuclear disintegration observed anywhere in the world. It became the subject of much theoretical investigations on meson production, and it yielded a great deal of new information.

For one thing, it answered a question which was still under discussion at that time, namely whether pions are produced individually in successive encounters with nucleons of the target, or whether they are produced *en masse* in nucleon-nucleon collisions like a cloud whose size increases with energy. The several hundred particles created in our event were incompatible with single-production models.

The event also permitted a new technique for determining the very high energy of the primary. Postulating symmetry in the forward and backward emission of secondary particles in the

Enduring influence

R. R. Daniel

When Bernard Peters first came to India in 1950 to conduct a well-planned high-altitude rubber balloon experiment to study primary cosmic rays, the group at TIFR consisted of fresh M Sc's in their twenties with just one to three years of introduction to research. H. J. Taylor, professor of physics at Wilson College, was our research guide while Homi Bhabha used to take part in scientific discussions and planning. And Bernard, fresh from the success of the discovery of heavy nuclei in cosmic radiation, was in a hurry to achieve more. To accomplish this he came prepared to drive himself to the limit and to sweep the rest of us with his excitement and success. He worked with us literally day and night, shoulder to shoulder, sharing every bit of work, manual or intellectual, in the launch ground or in the laboratory. His subsequent stint at TIFR from 1951 was a turning point in the lives and careers of many young men who went on to achieve great things in their own lives. Bernard's association with TIFR was only for about seven years, but its effect was lasting and immense.

It is not just the very good science that was done during his tenure in TIFR that I consider to be his great contribution. It was the objective method of approaching problems and the importance of honesty in thought and action that he inculcated in the minds and lives of his young colleagues by his example and emphasis that left an enduring impact. We were very impressionable in those days, and the open discussions he encouraged, his respect for individual opinions, and the close relations he established with each one of us contributed to our acceptance of the value system he stood for and promoted. In my own experience I recall that in spite of his intense interest and activity then on the study of heavy nuclei in cosmic radiation, he allowed me to start a programme on my own to study nuclear disintegrations caused by energetic helium nuclei in photographic emulsions.

Yet another quality in him is worth mentioning. It is a common practice among scientists to continue research for a lifetime on the same problem in which they made interesting contributions in their youth. This is one of the major reasons why the quality of research carried out by even good scientists becomes pedestrian with time; and this practice is quite widespread in not only India but the world over. Bernard was different. He was always looking for new openings and opportunities. Even within the seven years he was with us he changed his field of prime interest from primary cosmic rays to the search for radioisotopes produced by cosmic rays and their applications in various fields. He was always open to change. This example stood many of us in good stead in our later careers.

Of course he was an aggressive, high-pressure worker. And he expected his younger colleagues to be always hardworking and sincere. In summary, the abiding benefits that Bernard Peters left behind to TIFR and the band of young researchers were scientific temper for the individual and an enabling atmosphere in which free and objective human thoughts can thrive.

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