excellent help and cooperation we got from the Madras Christian College staff and students in carrying out this very arduous balloon campaign in Tambaram motivated me to accept Bhabha's offer to return to India for a longer stay. And so, having returned to Rochester at the end of 1950, I returned to India at the end of 1951 and brought my family.

The 1950 experiment was an auspicious beginning for my work in India, which should last throughout the decade. I realized then that the geographical position of India, combined with the facilities built up at the TIFR, presented a unique combination for research on many other basic problems related to CR, a fact which Bhabha had realized already when he founded the institute. The geomagnetic field at low latitude prevents the bulk of low-energy CR from reaching the earth's atmosphere, so that the very rare high-energy processes could be studied here without being swamped by background, a great advantage over the situation in the USA and Europe. It remained to identify feasible experiments, which could be expected to yield new and relevant results in high-energy physics. We chose to investigate the following problems:

1. The chemical composition of high-energy CR, especially a search for evidence that it may reveal traces of its prehistory, its acceleration by as yet unknown processes at unknown sources, and its passage through interstellar space. Are all atoms completely or only partially ionized before acceleration? In other words, what is the temperature in the source region? How many, if any, long-lived radioactive nuclei which may be present in the source have survived the transit to the solar system? How long have the particles been on the way, how much interstellar matter (mostly hydrogen gas) have they traversed?, etc.

2. What happens when CR nuclei of energy far greater than could then be produced in laboratories collide with other nuclei? How do complex nuclei then disintegrate? What are the collision cross-sections for the various disintegration products?

3. What unstable particles are created as the result of the prodigious energies released in these collisions? (Some of them were known to be pions which had been discovered a few years earlier by C. F. Powell in Bristol.) How many subatomic particles are created? What is their angular and energy distribution when they emerge from the collision centre and what can this tell us about the interaction of subatomic particles

## Stimulating discussions

*B. V. Sreekantan*

The Tata Institute of Fundamental Research was founded by Homi Bhabha in June 1945, and immediately after that experimental cosmic-ray research was organized under three different groups—the high-altitude studies group under A. S. Rao, the nuclear emulsion group under H. J. Taylor and the cloud chamber group under A. B. Sahiar. I joined the cloud chamber group of the institute in August 1948, and as suggested by Bhabha I started to build fast-pulse electronics circuits and detector systems for a systematic investigation of $\mu$-meson decay. In 1949 we moved from the Peddar Road premises, which was Bhabha's own house, to the spacious Yacht Club building next to the Gateway of India, and by the time Peters came in August 1950, the activities in all the three groups were in full swing and the institute had also started work in other areas like nuclear spectroscopy, under B. V. Thosar, and nuclear reactions, under R. Ramanna. Towards the end of 1950, Bhabha organized the first international conference on elementary particles, which was attended by many leading cosmic-ray physicists and theoretical physicists. Peters was already there in connection with his heavy-primary experiment carried out in Madras in collaboration with TIFR. Just around this time Bhabha suggested to me that I should take a Geiger telescope down the Kolar Gold Mines and measure the intensity of the penetrating component, and then using the $\mu$-decay set-up check whether all underground penetrating particles are indeed muons. By the time Peters returned in December 1951 from the US to join TIFR on a more permanent basis, Naranan and myself had completed the intensity measurement up to a depth of 1000 ft below ground and were busy building the detector system for measuring the angular distribution of particles at various depths. Our very first paper entitled 'Cosmic rays underground', published in the *Proceedings of the Indian Academy of Sciences* in 1952, was based on extensive discussions with Peters. The second paper entitled 'On the angular distribution of penetrating cosmic-ray particles at a depth of 103 MWE below ground' (which had a bearing on the proportion at production and lifetime of the just then discovered K-mesons), which also appeared in the *Proceedings of the Indian Academy of Sciences*, was communicated by Peters himself.

Peters stayed on at TIFR till 1959 and during the eight years that he spent there played a major role in not only leading the activities of the nuclear emulsion group, but also in influencing the activities in other areas of cosmic-ray research. In 1955 he started, along with Lal and Rama, investigations on cosmic-ray-induced radioactive isotopes in the atmosphere.

Though in the beginning Peters was not very enthusiastic about my starting extensive air-shower work at TIFR since India did not have any special advantage over other groups, he did change his opinion and supported me later. In starting this work I had taken the stand that the opportunity for developing frontline electronics and detector systems was equally important and challenging and an air-shower investigation did provide this wonderful opportunity. The nanosecond timing system that we developed in this spirit, and also the total absorption spectrometer, became extremely important assets to much of the later investigations on the time structure of particles in extensive air showers. Interestingly, Peters, after moving to Copenhagen, started studies on time structure of muons in air showers in search of 'heavy-mass particles' which he called plutons, and at Ooty we started time-structure studies on hadrons using a total absorption spectrometer. These studies led to one of the most important results from Ooty in high-energy-interaction studies, namely the dramatic increase in the cross-section for nucleon–antinucleon production at tens of GeV energies much before the advent of the CERN accelerators. Peters spent almost a month with us at Ooty when we were doing this exciting experiment in the summer of 1965. Discussions with him were stimulating and always made us feel more confident.

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