

Nobel Physics Prize for his development of the emulsion technique and for the discovery of the pion; Occhialini was awarded the 1979 Wolf Prize (shared with George Uhlenbeck) for his contribution both to the pion discovery and to that of pair production with Blackett, who obtained the 1948 Nobel Physics Prize.

By Owen Lock

One hundred years ago.....

Marking a full century of subatomic physics, an occasional series of CERN Courier article looks back to what was happening exactly one hundred years ago.

All over the world, this year is being celebrated as the centenary of the discovery of the electron by J.J. Thomson at the Cavendish Laboratory, Cambridge, in 1897. At a time when sovereignty interests in science were much to the fore, it is surprising that this discovery has earned such universal recognition. It was not as if the electron came out of the blue.

The saga is described in Abraham Pais' masterpiece 'Inward Bound' (Oxford University Press). Despite having been investigated for many years, cathode rays were still controversial. Were they rays or particles? In 1895 Jean Perrin in France had revealed that they carried negative electric charge.

In 1897, Emil Wiechert in Königsberg, after carrying out cath-

ode ray experiments, said that cathode rays had to be carried by negatively-charged particles, assuming they had unit charge, carrying only a small fraction of the mass of a hydrogen atom. Walter Kaufman in Berlin was puzzled by the result that the charge/mass ratio of the cathode ray particles appeared to be the same, no matter what gas was used.

Thomson also measured this charge/mass ratio, and, like Wiechert, suspected that it was so small because the cathode ray particles themselves were small. Unlike Wiechert, Thomson had the temerity to state: 'Thus ... we have in the cathode rays matter in a new state, a state in which the subdivision of matter is carried very much further...'

Two years later, Thomson had measured the charge on what would soon be universally called electrons (he preferred 'corpuscles') and had also investigated their photoelectric role. As several other researchers were to do in the ensuing century, Thomson took the baton of discovery and ran with it.

Emboldened by his electron discovery, he also proposed in 1897 that his electric corpuscles were a component of all atoms, the first step in what was to become his famous 'plum-pudding' model of the atom which was not overthrown until Rutherford's epic discovery of the nucleus some fifteen years down the line.

Thomson directed the Cavendish research with a firm hand, and the direction of Cavendish research had been profoundly altered by Röntgen's 1895 discovery of X-rays. In 1896 Thomson had published, with his student Ernest Rutherford, a classic paper on gas ionization by X-rays. For his part, in 1897 Rutherford was

Electron centenary

Many events are being organized to mark the centenary of the discovery of the electron by J.J. Thomson at Cambridge. Consult <http://www.ioppublishing.com/Physics/Electron>. However for a memorable guided tour through electron history, try the website prepared by the American Institute of Physics' Center for the History of Physics, <http://www.aip.org/history/electron>

This includes a recording of Thomson's venerable yet exultant voice from the soundtrack of the film, Atomic Physics, copyright © J. Arthur Rank Organization, 1948 - "Could anything at first sight seem more impractical than a body which is so small that its mass is an insignificant fraction of the mass of an atom of hydrogen? - which itself is so small that a crowd of these atoms equal in number to the population of the whole world would be too small to have been detected by any means then known to science." Thomson died in 1940, three years after the death of his famous pupil, Rutherford, who was 15 years his junior.

working on the 'Becquerel rays', discovered in Paris the previous year, and soon to become better known as radioactivity.

Elsewhere in physics, two topics were much discussed, both of them in connection with empirical formulas whose deep meaning would not become apparent for some time. In 1885 the Swiss scientist Jakob

Distinguished Indian physicist M.G.K. Menon inaugurates the 7th International Symposium on Radiation Physics in Jaipur, India, in February. After participating in pioneer cosmic ray experiments in Powell's Bristol laboratory (see page 2), M.G.K. Menon went on to become Director of the Tata Institute, Bombay, and has served as senior government advisor in India as well having been a member of many international committees. Right is Bikash Sinha, Director of Calcutta's Saha Institute of Nuclear Physics and the Variable Energy Cyclotron Centre, who is the new President of the International Radiation Physics Society.

Balmer wrote down a formula which described the wavelengths of the spectral lines of hydrogen. This remarkable relation 'fitted the data extremely well', as today's physicists would say, but nobody could explain why. It was also an infinite series. The mystery of the Balmer series, which was examined by Lord Rayleigh, Thomson's predecessor at Head of the Cavendish Laboratory, in 1897, was only partially explained by Niels Bohr's quantum picture in 1913. The underlying explanation of the empirical infinite series had to await the arrival of quantum mechanics proper and the solution of the hydrogen atom problem by Schrödinger in 1925.

The other hot topic one century ago was black body radiation, where the precision results at Helmholtz' laboratory in Berlin defied detailed explanation. Different empirical formulae seemed to break down at some wavelength range or other. Diligently exploring this road, Max Planck in Berlin embarked on a series of papers 'Vorlesung über Thermodynamik' which would eventually culminate in his famous 1901 proposal of the quantum hypothesis.

Elsewhere, the installation of the big telescope at Chicago's new Yerkes Observatory heralded a new chapter in astronomy.

Radiation in Rajasthan

The exotic Indian city of Jaipur in arid Rajasthan was the setting for the recent International Symposium on Radiation Physics. Opening the meeting, the distinguished Indian physicist M.G.K. Menon described



the underground experiment at the Kolar Gold Fields, an early player in the worldwide search for proton decay, predicted by Grand Unified Theories.

In a keynote address, Founding President of the International Radiation Physics Society and neutron detection specialist P.K. Iyengar focused on the latest developments in neutrons and their application, as well as plasma and laser technology.

Compton scattering, a key discovery early this century in the interrelation of matter and radiation, remains a cornerstone of radiation physics. Symposium contributions came from S. Manninen of Finland and Malcolm Cooper of Warwick.

On the applications side, the use of beams for cancer therapy was illustrated with experience from the 250 MeV proton beams in Cape Town, South Africa, while C.J. Roberts described the management and disposal of nuclear waste.

Indian researchers are very active

in this wide-ranging field of physics, involved in sophisticated detectors to measure photon multiplicity at CERN (January 1995, page 14), in a radioactive ion beam project to extend the nuclear range of Calcutta's Variable Energy Cyclotron, and in X-ray studies for materials science.

Extraterrestrial radiation, in the shape of the enigmatic neutrino signal from the sun and the all-pervading cosmic radiation, was described by S.M. Chitre of the Tata Institute.

On a lighter note for an evening lecture, Bikash Sinha, Director of Calcutta's Saha Institute of Nuclear Physics, traced the evolution of Indian science from 450 BC to the present day. Sinha is the new President of the International Radiation Physics Society, taking over from John Hubbell of the US National Institute of Standards and Technology, Gaithersburg. Dick Pratt of Pittsburgh continues as Secretary.