Dr. Peter Scheuer

Peter Scheuer, who died early on the morning of Sunday 21 January 2001 at the age of 70, was a theoretical astrophysicist of outstanding gifts, who played a central role in many of the key developments in radio astronomy and high energy astrophysics from the mid-1950s until the time of his death. He will be best remembered for his remarkable contributions to radio astronomy and the physics of extragalactic radio sources, but his interests and influence went far beyond these topics.

Scheuer was born in Frankfurt am Main to a Jewish family which emigrated to the UK in June 1939. He was educated first at Slough Grammar School and then at Aylesbury Grammar School. He became a naturalised British subject in December 1946 and in the same month was awarded an Open Scholarship to St. John's College, Cambridge. After an outstanding undergraduate career, he was taken on as a research student by Martin Ryle in 1951 in the recently formed Radio Astronomy Group of the Cavendish Laboratory to provide theoretical underpinning for the remarkable discoveries which were being uncovered by radio techniques. These were to prove to be turbulent years. His doctoral dissertation was largely devoted to the bremsstrahlung emission of the interstellar gas in the plane of the Galaxy and the derivation of the theoretical formulae for this process, correcting the classical formulae for application at radio wavelengths.

In 1955 Ryle's group completed the first radio interferometric survey of the northern sky and compiled the 2C catalogue of radio sources. The catalogue contained vastly more faint radio sources than would be expected in any of the standard cosmological models. In particular, these observations were in fatal conflict with the predictions of the then-fashionable steady state cosmological model of Bondi, Gold and Hoyle. The nature of the discrepancy can be appreciated from the slope of the number-flux density relation for faint radio sources. According to all the standard models, including steady state theory, this slope had to be less negative than –1.5. In contrast, Ryle found a slope of –3. This result was hotly contested, not only by the proponents of steady state theory, but also by the Australian radio astronomers at Sydney, led by Mills, who found far fewer faint sources and called into question Ryle's result.

The Cambridge radio astronomers realised that the flux densities of the faintest sources were being systematically overestimated because of the presence of faint unresolved sources within the beam of the radio interferometer. In a paper, rightly considered a masterpiece, Scheuer showed how the correct slope of the number counts could be found by studying the interferometer traces themselves, rather than by attempting to extract the sources from the records. He found a slope of –1.8, now known to be exactly the correct answer. This discovery was the first really convincing evidence for the evolution of the radio source population, which contradicted the postulates of the simplest steady state picture. Somewhat surprisingly, Scheuer's great paper was published in the Proceedings of the Cambridge Philosophical Society rather than in a main-line astronomical journal. He later applied the same techniques to the rather simpler case of surveys in the X-ray waveband.

The controversy over the radio source counts reached its apex at the Paris IAU Symposium on Radio Astronomy in August 1958 and involved vitriolic debates between the Cambridge and Sydney. His memoires of this turbulent period, published in 1990, are characteristically even-handed and give a splendid snapshot of a turbulent period in astronomical history.

After holding a research fellowship at St. Johns College, Cambridge, and a Fellowship of the Royal Commission of 1851, Scheuer was pleasantly surprised to receive a friendly letter from Joseph Pawsey, Head of the Division of Radiophysics at CSIRO, inviting him to take up a fellowship for three years in Australia to work with Mills' group. Ryle and Pawsey realise that a period of rapprochement was needed to improve relations between the groups. The main purpose of Scheuer's programme was to discover whether or not the excess of faint sources could be associated with the effects of resolution of extended bright radio sources by a radio interferometer. By 1965, he had shown conclusively that this effect could not account for the excess of faint sources.

Ryle wanted Scheuer back in Cambridge to lead the theoretical effort within the Radio Astronomy Group and in 1963, he was appointed an Assistant Director of Research in the Cavendish Laboratory and Fellow and College Lecturer of Peterhouse. The present writer was fortunate enough to be among his very first research students in what was by then called the Mullard Radio Astronomy Observatory. During the 1960s, he wrote a number of innovative papers on diverse subjects. Papers of particular originality concerned the theoretical analysis of the structures of radio sources using the technique of lunar occultations, the discovery of the use of the Lyman-□ decrement as a measure of the intergalactic abundance of neutral hydrogen (now called the Gunn-Peterson effect, but the discoveries were independent) and the recognition that interstellar scintillation is the cause of the short-period variations in the flux densities of pulsars. Throughout this period, he continually came up with important ideas before they were published by others. In 1965, I recall a typical example in a colloquium he gave on what came to be called the inverse-Compton catastrophe, some time before the paper published by Hoyle, Burbidge and Sargent.

The topic which attracted his most sustained interest was, however, the physics of extragalactic radio sources and the physical processes which give rise to the ejection of collimated jets of relativistic material from the nuclei of active galaxies. These studies resulted from the superb radio images which were being produced by the aperture synthesis radio telescopes designed and constructed by Ryle and for which Ryle was awarded the Nobel Prize jointly with Antony Hewish. These revealed in unprecedented detail the radio structures which are created when a beam of relativistic plasma interacts with the ambient interstellar and intergalactic gas. The unravelling of the essential physics of these sources was a challenge, and one of Scheuer's major contributions in 1974 was the construction of a simple, but robust, analytic model for the evolution of these structures which has been widely used.

These studies led naturally to considerations of the stability of relativistic jets and his papers showed how susceptible these are to the relativistic equivalent of the Kelvin-Helmholtz instability. With the discovery of superluminal motion in the cores of radio galaxies and radio quasars, Scheuer and Readhead developed a simple formalism for understanding the properties of the sources and were among the first to realise that both of the relativistically separating source components are beamed. They showed that the cores of the sources should suffer synchroton self-absorption, a prediction subsequently demonstrated to be correct by higher resolution radio observations at higher frequencies. Another long-standing problem which he tackled was the understanding of the linear polarisation of the synchrotron emission seen in the lobes of extended radio sources. Contrary to one's naïve expectation, strong linear polarisation does not necessarily imply an ordered field, but rather that whatever the initial field, it can be stretched and tangled by turbulent motions within the source region to create remarkably large linear polarisations.

These achievements were the result of a penetrating intelligence which could cut through the formalities of detailed theoretical analysis and display the essential physics with economy and elegance. At one time, there was a controversy about whether or not the standard formulae for synchrotron radiation were correct. Scheuer's two page demonstration of the error which had been made contrasted with the heavy labour undertaken by others.

Scheuer was rigorous about not putting his name to the papers of his students unless he had made a very significant contribution to their work. He supervised students who made innovative contributions to the physics of pulsars and particle acceleration, but his name does not appear in these works. I remember vividly discussing with him his idea that particles could be accelerated by a combination of shocks and convection inside the lobes of radio sources, the embryo of what has become the favoured process of the acceleration of charged particles in strong shock waves. Some years later his student Tony Bell wrote one of the seminal papers on particle acceleration in shocks under Scheuer's supervision, embodying a number of these early ideas.

It is probably true to say that his remarkable talents were more highly regarded abroad than in the UK. He held Visiting Professorships at Caltech (Fairchild Visiting Scholar), CSIRO in Australia, the Max Planck Institute for Radio Astronomy, the Arcetri Observatory and the Raman Research Institute at Bangalore. His colleagues abroad were astounded that it was only in 1992 that he was promoted to Reader in Cambridge University. As an individual he was modest and reserved. By his own confession, he "was not an avid committee man". He had a delicious dry sense of humour, which all his friends knew well and would often be signalled by a very distinctive burst of booming laughter which would resound throughout the Rutherford Building of the Cavendish Laboratory. He was always at least two steps ahead of others in any calculation or discussion, his reasoning being based upon his profound grasp of basic physics. Many of us learned more about the real essence of thinking about physics and physical problems from Scheuer than from any of the other distinguished physicists with whom we have been privileged to work.

As a Lecturer and Reader in Physics, he delivered courses on essentially all aspects of physics and brought the same qualities of physical insight and the ability to concentrate on the wood rather than the trees in his lectures. He could teach undergraduates some of the most horrifically complicated bits of physics by simple physical arguments, which most of us would not have even begun to attempt.

Only about 18 months ago, he made his colleagues aware of the incurable cancer which was to be the cause of his death. His wife Jane nursed him through this difficult period with utter devotion. He is survived by Jane and their daughter Suzi.

Brief details

Peter August Georg SCHEUER.
Theoretical astrophysicist, radio astronomer.
Reader in Physics, University of Cambridge, Fellow of Peterhouse, Cambridge.
Born 31 March 1930 at Frankfurt am Main, Germany.
Married Jane Elizabeth Morford 1974 (one daughter).
Died 21 January 2001, West Wickham, Cambridgeshire.

Malcolm Longair. 24 January 2001.