Presidential Address

ON THE AWARD OF THE EDDINGTON MEDAL TO PROFESSOR ANDRÉ LALLEMAND

THE EDDINGTON MEDAL of the Society is awarded to André Lallemand, Director of the Physical Astronomy Laboratory of the Paris Observatory, for his outstanding work on photomultipliers and particularly for his successful development of the electron camera.

Astronomers obtain almost all their knowledge of the universe from photons that they receive from remote objects. They expend immense labour upon devices designed to gather in as many as possible of these photons. In the case of optical frequencies, for the past century the photographic plate has been the chief means of detecting the photons. Most of what we know about the astronomical universe depends upon its use. Nevertheless, even in the frequency range in which it is sensitive the photographic plate is in practice disastrously wasteful of the photons presented to it. It is therefore natural that astronomers should honour one who has pioneered far more efficient means of detecting those so carefully-gathered photons.

The two limitations to photographic detection of very faint objects are lack of sensitivity and inability to distinguish them from the sky background, even with long exposures on large telescopes. As early as 1937, Lallemand predicted from quantum-efficiency considerations that gains by a factor of the order of 100 over conventional photography could be obtained by using the photoelectric effect. He has been working on essentially this problem since the end of World War II. The first step towards this goal was the development of photomultiplier systems of outstanding quality. This was achieved in the early 1950's. He also pioneered the use of photomultipliers that are sensitive in the near infra-red.

These successes did not satisfy Lallemand because an ordinary photomultiplier does not use the geometrical information contained in an optical image. In 1951 he completed a primitive version of the electron camera in which the electrons liberated from each point of a suitable photo-cathode are accelerated by an electric field of the order of 30 kv and electrostatically focussed on to a nuclear-track type emulsion. This has the advantages of fine grain, linear response and the ability to detect even single photo-electrons. This prototype camera gave gains in speed by factors between 20 and 50 in direct celestial photographs.

Subsequent work was devoted to improving the performance and reliability of the electron camera. Of various possible systems, Lallemand preferred to place the nuclear emulsion in the same vacuum as the photocathode and to use direct electrostatic focusing. This system gives very high definition. It has the additional advantage of lightness, which enables it to be placed at a moving focus of a telescope. The tube containing the cathode and plate magazine is pumped down and cooled in liquid air to prevent thermal emission and to delay the deterioration of the cathode produced by gas molecules exuded by the electronographic emulsion. Still better performance has recently been obtained by improving the vacuum using a titanium ion pump. At very low photographic densities the gain may be as much as a factor 10^4 over the unaided photographic plate.

Another remarkable development has been that by Lallemand and Duchesne of a camera in which the image dimensions are reduced by a factor of as much as 7 in the electron optics. This effectively transforms an *f*/1 optical objective into an *f*/0·14 lens without loss of image detail; this performance is evidently impossible with optics alone.

While preparation of the electron camera for a night's work is still lengthy and laborious, the efforts involved have been rewarded in the past few years by success in a series of important astronomical investigations. We recall especially those made by Lallemand, Duchesne and Walker at the Lick Observatory using the instruments that many of us were privileged to see there during last year's meeting of the I.A.U. They include studies of the rotation curve of the quasi-stellar nucleus of M 31 which is found to be in very rapid rotation out to about 3″ from the centre; spectra of stars contracting gravitationally towards the main sequence which display emission lines and ultra-violet continua; spectra of ex-novae and of external galaxies; high time-resolution spectra of the explosive variable AE Aquarii.

The electron camera has also been used extensively in France. At Haute Provence, M. Chopinet and R. Duflot have obtained spectra of faint nebulae and derived radial velocities from the Hβ, N1 and N2 lines; at Pic du Midi, G. Wlérick, J. Rösch and M.-F. Dupre have achieved advances in photography of double stars and planets; at Meudon, some of the same astronomers have developed the technique of photographing the solar spectrum at high dispersion with exposure time of 0·1 sec or less. The possibility of using very short exposure times provides an opportunity of ameliorating the matter of "seeing", and the linearity of the emulsion-response enables faint features such as stellar companions to be identified in the vicinity of strong ones.

The award of this medal is an expression of our admiration and gratitude for what Dr Lallemand has already achieved and with it we offer our good wishes for many other achievements in the future.

W. H. McCREA