WEDNESDAY 15 JANUARY 2003: CLOUDS AND STORMS: THE SCIENTIFIC LEGACY OF FRANK LUDLAM

Sir John Mason: Frank Ludlam's contributions to cloud microphysics
Frank's main contributions on cloud microphysics, published between 1950 and 1963 were:

- The production of showers by the coalescence of water droplets
- The production of showers by ice particles
- The structure of growth of large hailstones

These will be summarised and assessed in the light of more recent work, which owes much to Frank's ground work and insight.
Professor K A Browning: Kelvin-Helmholtz billows in the atmosphere
The late sixties was a lively period in the development of our understanding of Kelvin Helmholtz instability, with papers being published on laboratory experiments (Steve Thorpe), observations in the ocean (John Woods) and one by Frank Ludlam on KH billows in the atmosphere. Ludlam's paper demonstrated his legendary skill as an observer and his great ability to explain his observations physically. These studies were soon followed by radar and aircraft observations that confirmed the association with clear air turbulence. More recent visual and radar observations are shedding further light on the structure and effects of atmospheric billows and of the importance of potential shearing instability in the presence of moisture.

Dr S H Derbyshire: Plumes, entrainment and convective parametrization
This talk will discuss aspects of Frank Ludlam's legacy to convective parametrization (the simplified representations of the effects of convection which are used in large scale weather and climate modelling). Although "Clouds and Storms" does not speak explicitly of parametrization, the chapter on Cumulus convection shows a keen awareness of the prediction problem. Hence Ludlam's work was used directly in the formulation of the Gregory-Rowntree mass flux scheme. More recent work has emphasized the importance of variability within the convective ensemble; again roots can be found in Ludlam.

Professor R S Scorer: The shapes of clouds
The arrival of Frank Ludlam in the department of Meteorology at Imperial College coincided with my appointment as a lecturer in the autumn of 1949, and we shared an office and talked provocatively as we worked on a book called "Further Outlook" (1954). Perhaps an expert could attribute the different chapters of this 25/- book. We both became editors of Weather and this enabled us to produce "Cloud Study" (1957) which had several separate printings, at a price of 12/6. In these books we received encouragement from Professor Brunt and Dr. Sutcliffe (who was President of the Met Soc.)
We became very involved with the British Gliding Association, and we persuaded Dr Stagg that the Met Office should support the gliding championships with official

forecasts, and we learned a lot from talking to gliding people.
What we shared was a desire to find explanations of the appearance of clouds, and we also disliked the use of computer calculation of forecasts. Ludlam was a great user of slide rule and graph paper and was already building up a scheme of ideas for his own magnum opus. His international reputation was enhanced by visits to Sweden and Italy. It was reputed that he would contradict his own theories quite readily, and this was because anything original that he put forward was treated as if it was his last word, whereas it was more often his first word. We talked of all sorts of ideas using the latest language for the task.
Ludlam read the accounts of transatlantic sailors of decades ago and told us how they had a wonderful 3D view of weather systems from the inside. He chose the site of his house with a western view which associated every little differing cloud with the topography of England 150 miles from his house. Billows, waves and streaks had great significance for him.

Dr M W Moncrieff: The dynamics of organised convection
A generation ago, Ludlam pioneered observations and analyses of organised convection. His book was a tribute to convection and clouds as processors of water and energy in the atmosphere. Convection, clouds, water and energy remain high on the atmospheric science agenda. Quantifying how moist processes work systemically with dynamics is requisite to the physical basis of climate and to improved skilfulness in numerical weather prediction. Recent advances in modelling the following will be summarised:
i) multi-scale coupling and feedback among organised convection, large-scale gravity waves and convective-radiative-dynamical quasi-equilibrium in the Tropics:
ii) mesoscale organization of propagating convection and coherent patterns of summer-time precipitation over the U.S. mid-continent.

Professor A Thorpe: Large scale slope convection
The final chapter of Frank Ludlam's magnum opus is on "large-scale slope convection". In this talk Ludlam's ideas on slope convection as a model of extratropical cyclones will be discussed. These ideas included showing the strong similarity of the circulations in the vertical plane in cumulonimbus convection and in cyclones, even though they occur on quite different horizontal scales. This is a novel picture which led to the idea of an extended parcel theory for this large-scale slope convection. Whilst perhaps not being as influential as it deserves to be, this theory has a lot to offer. Potential vorticity thinking was extensively exploited by Ludlam to develop ideas of relative airflow on isentropic surfaces. These ideas led directly into the concepts of the conveyor belts and coherent airflows that have had considerable
conceptual power in interpreting cyclone dynamics.