Michael McIntyre

Michael McIntyre is Professor of Atmospheric Dynamics in the Department of Applied Mathematics and Theoretical Physics (DAMTP), University of Cambridge. Apart from a short break as a postdoc, he has worked in DAMTP since 1963, but spent much of his early life in Dunedin.

Michael's father, Archie, who died only last year at the age of 89, was a physiologist interested in the nervous system. He had a distinguished career in New Zealand and Australia—and the Australian Physiological and Pharmacological Society has established an A K McIntyre Prize in his honour. (His contributions included the discovery of electro-receptors in the platypus bill and later in the echidna snout.) Archie was a graduate of the University of Sydney and continued his early medical training and research career in Sydney, where Michael was born. Archie moved to University of Otago at Dunedin in 1949, beginning the period of Michael's residence in New Zealand.

Whilst on the subject of family, one of Archie's grandfathers and Michael's great-grandfathers was Sir Edgeworth David, Australian geologist. David was a member of Shackleton's Antarctic Expedition of 1907-09 (the "Nimrod" expedition) and (at the age of 50) one of a group of three who trekked 1260 miles to become the first to reach the Southern Magnetic Pole. (At the same time a larger group including Shackleton made an unsuccessful attempt to reach the geographical South Pole, beating Scott's previous "further south" record, but were forced to turn back 97 miles from the Pole.)

Michael attended the University of Otago and obtained his undergraduate degree in Mathematics from the University in 1963. He then won a Commonwealth Scholarship to study for a PhD in DAMTP. When he arrived in Cambridge there were four new research students in fluid or solid mechanics, and four staff members who wanted new research students. Michael found himself assigned to the supervision of Francis Bretherton, then a young lecturer. (Over a period of four or five years Bretherton was supervisor to Michael, Peter Rhines, Chris Garrett and Brian Hoskins, all of whom have subsequently become international leaders in meteorology and oceanography.)

Being supervised by Francis Bretherton was a daunting experience, especially for a young man whose experience of fluid dynamics was limited and who liked to understand things thoroughly. Michael would spend an hour listening to Francis throwing out ideas for important or at least interesting topics that Michael should investigate. He would then spend all afternoon and evening going carefully through all these ideas and working out what Francis had in mind. Next day he would go to Francis with a question or two, and Francis would say "Oh, there's no need to go into that—I solved the problem last night". But, of course, Michael learned, and mastered, a lot.

In his second year as a PhD student, Michael—a brilliant violinist—committed a lot of his energy into entering the annual BBC Violin Competition. He reached the semi-final round (last 14) in a year in which the winner was Iona

Brown. Michael shared a flat in the house by the river Cam owned by J R A (Anthony) Pearson and his wife, and his flat-mates (all Trinity College PhD students in applied mathematics or astronomy) recall cycling home at night across the fen with the solo part from the Brahms Violin Concerto clearly audible through the open skylight of the small attic room which was the only place Mrs Pearson allowed him to practise. At this time Michael was offered a place in a professional string quartet, and was sorely tempted to join it. Science can be glad that he did not.

After his PhD Michael moved to MIT as a postdoc, where he worked with Jule Charney and Norman Phillips, and he returned to DAMTP in 1969 as Assistant Director of Research in Dynamical Meteorology and DAMTP has been his professional home ever since.

Michael is well-known for his contributions to theoretical fluid dynamics and to atmospheric dynamics. In the 1970s he and his student David Andrews carried out fundamental work on the interaction between waves and mean flows, deriving some very powerful general results (the Generalised Lagrangian Mean theory) as well as more specific results with direct relevance to atmospheric dynamics and transport, particularly to the stratosphere. These resolved much confusion and the techniques that Andrews and McIntyre employed (Eliassen-Palm fluxes and the transformed Eulerian mean formalism) now underpin the majority of diagnostic studies of the circulation in observations and in numerical models.

In the 1980s Michael wrote a succession of papers that have not only left a lasting mark on atmospheric science in ideas and techniques, but also in vocabulary. His Nature paper with Tim Palmer showed some of the first potential vorticity maps calculated from observations, and described them as showing the “breaking” of planetary-scale Rossby waves in the stratospheric “surf zone”. The use of the term “breaking” was troubling to many and much debate, both in correspondence and in the scientific literature, ensued. The Hoskins, McIntyre and Robertson paper in the Quarterly Journal of the Royal Meteorological Society combined a whole range of ideas from synoptic meteorology and from geophysical fluid dynamics to argue for the use of potential vorticity, together with the “invertibility principle”, as the key to understanding large- and synoptic-scale dynamics.A second Nature paper with Michael’s PhD student Martin Juckes described high-resolution numerical simulations of the stratosphere, which showed clearly the implications of planetary-wave breaking for the dynamical structure of the stratosphere (the formation of a sharp edge to the polar vortex through the process of “vortex erosion” and the robustness of the vortex as a material dynamical entity) and for the distributions of chemical species (highly filamentary structure in the “surf zone” and a vortex isolated from the surrounding surf zone and hence with very different chemical character). These simulations were important subsequently in understanding the wealth of chemical and meteorological data that came out of the many observational campaigns prompted by the discovery of the Antarctic Ozone Hole. Michael himself was a participant in one of these campaigns and spent three months based at Stavanger during the first Airborne Arctic Stratospheric Expedition in 1989.

Michael’s more recent interests have included the mean meridional circulation, stratosphere-troposphere exchange, the emission of gravity waves by vortex motion and the effect of gravity waves on the large-scale circulation. A notable contribution was his work with Phil Mote and others on the annual cycle in water vapour in the tropical stratosphere in which the annual variation in water vapour concentration set by tropopause temperatures is carried upwards by the mean circulation. Michael named this the tropical “tape recorder” and that term is now in common use.

For this work Michael has received many notable honours and prizes. He is a Fellow of the Royal Society, was awarded the Carl-Gustav Rossby medal (the highest award of the American Meteorological Society) in 1987 and the Julius Bartels medal of the European Geophysical Society in 1999.

Michael has regularly supervised or co-supervised PhD students and postdocs and several now hold senior positions in universities and research institutes. These include two New Zealanders, Warwick Norton (now Oxford/Reading) and Darryn Waugh (now Johns Hopkins). He was one of those at DAMTP who seized the opportunity to set up a Summer School in Geophysical and Environmental Fluid Dynamics, which has now been running for 13 years. Each year, for two weeks, Michael makes the School his first priority and spends many hours getting to know the students and discussing their research.

Two characteristics of Michael are first his focussed enthusiasm and energy and second his generosity and inclusivity. Most of his collaborators have experienced the phenomenon that once Michael’s attention is focussed on something the pace is very hot indeed. In years past the result was often a succession of late-night phone calls. Nowadays it may be a succession of emails. Michael’s desire to be inclusive makes him an enthusiastic user of the “Cc:” line. A typical experience for a McIntyre collaborator or correspondent is to be Cc’ed into an email exchange, perhaps on solar effects on climate or something similar, which then proceeds at breakneck speed, too fast for a casual observer to follow the details, before expiring a few days or weeks later. Reviewing the messages at this stage is often interesting and informative.

For many years Michael gave up his intense musical life in order to concentrate on science, although music still had an important place in the McIntyre household since his wife Ruth is a professional pianist. Many of us had not heard Michael play the violin until relatively recently. Two occasions are particularly memorable. The first was the funeral of Rupert Ford, Michael’s PhD student and subsequently a lecturer at Imperial College, who tragically died suddenly at the European Geophysical Society Meeting in Nice in 2001. As the funeral ended Michael played,

unaccompanied, the solo violin line from “A Lark Ascending”. The second was a concert later in 2001 performed by Michael, Ruth and one of their musical friends in memory of David Crighton, who had died of cancer a year earlier whilst Head of DAMTP. The concert was performed to a packed and enthusiastic audience at the University Music School Concert Hall. (Characteristically Michael seemed to spend the week before worrying about the fact that large numbers of tickets seemed unsold and spent several months afterwards energetically marketing the resulting CD, sold in support of two funds, one musical, one mathematical, named for David.)

As a fluid dynamicist Michael has also been active in topics outside atmospheric science. With Jim Woodhouse he has made important contributions to understanding of violin mechanics and acoustics and recently with Douglas Gough he has studied the dynamics of the solar tachocline, applying some of the theoretical ideas that he had earlier developed to understand atmospheric dynamics. But Michael’s characteristic quality, obvious to anyone who knows him and evident to anyone who visits his website, is that he can be interested in almost anything. He is a true free thinker, who could not be constrained into any sort of programmatic research and who can provide original, informed and perceptive comment on whatever subject grabs his attention. (This is immediately apparent to any seminar speaker or lecturer who has Michael in his or her audience.) Michael and those like him epitomise what makes academic staff at Universities worth supporting.

Peter Haynes, Tim Pedley