*Aust. Met. Mag.* 39 (1991) 137–139

# Obituary

## Dr Patrick Squires
## 1914–1990

Dr Patrick Squires, one of the pioneering giants of cloud physics, passed away in Reno, Nevada on 14 November 1990, at the age of 76, following a lengthy illness. He is survived by his widow, Mona, three sons, John and Peter of Boulder, Colorado and Martin of Reno, two daughters, Eroca of San Franciso and Helen of Reno, and nine grandchildren.

Dr Squires was a Fellow of the American Meteorological Society and a member of the American Association for the Advancement of Science. He served as an associate editor of the *Journal of the Atmospheric Sciences* and as a consultant to the National Science Foundation, US Air Force, US Army, Naval Air Systems Command, and US Navy. He served on the National Academy of Sciences — National Academy of Engineering Advisory Committee to NOAA, the Venus Panel of the Planetary Missions Board and the Zero-g Advisory Panel of NASA, and the National Hail Research Experiment Advisory Panel.

Pat was born in Carlton, a suburb of Melbourne, Victoria, Australia on 12 July 1914. He attended Assumption College at age ten in the seventh grade, and completed the 10th grade at age thirteen in preparation for a career as a priest. However, he spent his next two years independently studying science, and at the age of sixteen he entered the University of Melbourne. He received his Bachelor of Arts degree in Mathematics from that University in 1934.

He left the University during the Depression and initially worked in the actuarial department of an insurance company. In 1937, he joined the Commonwealth Meteorological Bureau, which was taken over by the Royal Australian Air Force in 1941 as a war-time measure. Patrick Squires served as a squadron leader and weather analyst in the Royal Australian Air Force during World War II.

He was known for his scientific acumen, which resulted from his ability to apply mathematical techniques to practical problems. Throughout his career, he balanced his keen mathematical and physical intellect with a down-to-earth appreciation for atmospheric measurements. He vigorously approached the tasks of measuring aerosol particles and cloud droplets. He conducted painstaking measurements with available equipment early in his career and thereafter pursued the long-term development of more appropriate instrumentation. Pat strongly believed that understanding and describing the real world was the role of an honourable man. In contrast, Pat told a story about one weather observer who insisted that the wind run measurement be started at the precise second of the hour at which it was recorded. Pat held in contempt such rigorous adherence to the ritual, rather than to the substance, of scientific commitment.

Pat believed that reality should be revered beyond the transience of personal gain or aggrandisement. Pat was also fond of ancient history, and once expressed his view that magnanimity in victory was the noblest trait in a fellow human being.

Following the war, he joined the Radiophysics Division of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). In 1946 and 1947, experiments by Schaefer and Langmuir generated virga by dropping dry ice

into wintertime stratocumulus cloud decks. Kraus and Squires took advantage of the difference in seasons to seed summertime cumulus clouds in Australia. In early February 1947, a particularly favorable weather situation resulted in an experiment which showed beyond reasonable doubt that cloud seeding can, on occasion, result in marked changes in local weather. In this experiment, two thunderstorms appeared to have been triggered, producing heavy rain at the ground, the first documented man-made precipitation event utilising the scientific principles embodied in the Bergeron process. Subsequent works showed that such clear results of cloud seeding were rare.

Pat realised that a more complete knowledge of cloud physics was necessary to understand the formation of precipitation, and that systematic experiments, field observations, and explanatory conceptual models formed the foundation on which an enduring scientific basis to support rainmaking could ultimately be based. His studies combined theoretical modelling with observational facts in the true tradition of physics at a time when a scientist was likely to be labelled as either an experimenter or a theoretician. (Now, there are also modellers; it is a pity that Pat is not around, encouraging researchers through his own example, to strive for balance in these things.)

Pat owned a 400 acre apricot farm in Grose Vale, New South Wales, Australia, which he tended on weekends. While he was readying his tractor to plow the orchard one morning, his six-year-old daughter Helen came out to help him. She looked up at the sky and remarked how interesting the clouds were, arranged in long rows. She asked him how the clouds got that way. He replied that he had been up early, plowing the clouds.

Pat's physical insight was outstanding. His Australian work with Stewart Turner on air parcel cooling due to mixing at cloud top, and the descending thermals which transported this drier mixed air deep into the cloud, was a pioneering effort in an area which is still a subject of vigorous investigation in cloud physics. Much of his Australian work was conducted in collaboration with Jack Warner, Jim Telford and Sean Twomey.

Pat carried out many careful and innovative measurements of cloud droplet concentrations and size distributions during the 1950s. After thoroughly considering his data, he concluded that there is a definite and systematic difference in the microphysics of continental and maritime clouds. He hypothesised that because small maritime clouds precipitate more frequently than small clouds over land, the higher droplet concentrations of continental clouds, due to higher concentrations of cloud condensation nuclei (CCN) in continental air masses, inhibited the initiation of the coalescence process.

In 1959 the University of Melbourne conferred upon Patrick Squires the degree of DSc on the basis of the international standing of his published research. In 1962 he joined the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, as a program scientist, where he also served as an adjunct professor with the Colorado State University in Fort Collins, Colorado.

In the 1960s he measured the urban production rate of CCN and estimated the relative anthropogenic contribution to the global population of CCN. Among other things, this work formed the basis for the concept whereby increased CCN concentrations lead to clouds with higher albedos and hence a mechanism for radiative cooling, the 'Twomey effect' hypothesis, which is a current topic of climate research.

In 1966 Dr Squires was recruited as a founding member of the Desert Research Institute's faculty to head its atmospheric research program, and he served as the Director of the Laboratory of Atmospheric Physics, which later became the Atmospheric Sciences Center. His drive, initiative and unshakable scientific integrity made it possible for the Desert Research Institute to maintain basic scientific endeavours as a major interest. The esteem in which funding agencies held his advice kept DRI's atmospheric science support viable. He also held the Marston Chair of Atmospheric Physics at the University of Nevada, Reno.

He had conflicting thoughts of assuming a leadership role: his reluctance to leave an active and vigorous scientific research career for an administrative position was overshadowed by his concern that scientists should have a scientist leader to look after their interests and to provide direction.

As Director of the Laboratory of Atmospheric Physics, he recruited top-notch scientists to DRI, and conducted the Pyramid Project in 1966–72, a study of winter orographic cloud seeding in the Sierra Nevadas. The Pyramid Project produced an estimated 12 per cent increase in the snowpack in its target region. He also conducted dry-ice seeding over the Reno International Airport to clear it of super-cooled fog. Administratively, his efforts enabled the Desert Research Institute to become an autonomous research organisation of the University of Nevada, Reno. During this period he built an improved continuous flow diffusion chamber for the study of CCN in collaboration with his US students and colleagues. This project led to significant improvements in characterising CCN. He served as a Principal Investigator and consultant in NASA's Atmospheric Cloud Physics Laboratory Program, and was an organiser of the Third International Cloud Condensation Nuclei Workshop.

In 1977 Pat returned to NCAR as the Director

of the Convective Storms Division. He actively campaigned for the Cooperative Convective Precipitation Experiment (CCOPE), which was conducted in Montana in the summer of 1981. He retired from NCAR in 1984 due to failing health, and moved from Boulder, Colorado back to Reno, Nevada in 1989. On 15 November 1989, the Desert Research Institute's atmospheric science library was dedicated as the Patrick Squires Library of Atmospheric Science, since he had created and aggressively nourished this library; books and knowledge were always foremost in his professional and private life, and he wanted others to participate in his intellectual adventures. On 22 February 1990, the Board of Regents of the University of Nevada System conferred on Dr Patrick Squires the honour of Research Professor Emeritus.

Sir Isaac Newton said that if he had seen a little further than others, it was because he stood on the shoulders of giants. For the past four decades, many of us feel that we, too, have been carried along by Pat to new vistas which we otherwise would not have seen. His scientific insight, his witty humour, his personal example, and the encouragement he gave to others are missed; we will continue to miss them. As somebody remarked, one of the 'Good Guys' has gone.

In his honour, a memorial fund has been established with the Desert Research Institute. Contributions to the fund will be used to enhance the learning and research facilities of the Patrick Squires Library of Atmospheric Science.