OBITUARY

HARRIS CHARLES LEVEY

JOHN J. MAHONY

Harris Charles Levey, Professor of Applied Mathematics in the University of Western Australia, died on 13th June 1966, as the result of a heart attack. He is survived by his widow Hannah (nee Lasica), and two daughters, Ruth, aged eleven, and Amanda, aged eight. Their great personal loss is shared by his large number of friends. He will be greatly missed in the mathematical community in Australia, to the development of which he has made notable contributions.

Born in Melbourne on the 27th April, 1923, he received his early education at University High School. For financial reasons his subsequent education at Melbourne University was completed as a part-time student. In 1943, he completed his course for the degree of B. Sc. with a major in physics in which he was awarded first class honours. Then, while working at first in the P. M. G. Research Laboratories and later as Tutor in the Department of Mathematics, he took courses for the degree of B. A. (Hons.) in mathematics. The first class honours he obtained in 1946 serve to underline both his natural ability in mathematics and his great powers of application. He began research under the direction of Professor T. M. Cherry while continuing as a tutor in the Department of Mathematics and receiving partial support from the Aeronautical Research Laboratories, then a division of C.S.I.R.. The high opinion held of him is indicated by the fact that his teaching duties included giving the third year lectures in Applied Mathematics. His work on the theory of the hodograph method, applied to transonic flows, was presented for the degree of M.A. which was awarded with first class honours in March 1949. Subsequently, as an employee of the Aeronautical Research Laboratories, he undertook post-graduate study in the Department of Applied Mathematics, University of Manchester. In December 1951, he was awarded the Ph. D. degree for his work, under the supervision of Professor S. Goldstein and later Dr R. E. Meyer, on the role of viscosity in eliminating certain paradoxical properties of inviscid gas flow solutions.

He returned to Australia as Senior Scientific Officer in charge of the Theoretical Fluid Mechanics Group at the Aeronautical Research Labo-

https://doi.org/10.1017/S1446788700004547 Published online by Cambridge University Press

ratories, Melbourne. In addition to the administrative and consultative duties associated with this position he engaged in research into a wide variety of aerodynamic problems. In August 1958, he joined the University of Western Australia as Reader in (charge of) Applied Mathematics and in January 1961, he was appointed as the University's first Professor of Applied Mathematics. He remained in this position until his death, apart from one year of leave spent in research at the Division of Engineering and Applied Physics, Harvard University. These later years of his life were as full professionally as only someone of his wide interests, warm humanity and boundless energy and enthusiasm could make them.

When he joined the University of Western Australia the Department of Mathematics was small, effectively its courses were service courses for other departments, professional mathematicians had only rarely emerged from its graduates, and Applied Mathematics did not exist as a discipline within the University. The subsequent expansion of the University has provided the opportunity to remedy many of these defects and Harry Levey played a major role in the development of the Department as a whole as well as its Applied Mathematical activities. His presence was of great value in recruiting the additional staff required. Former associates, not all Applied Mathematicians, came partly because they valued his mathematical ability, the breadth of his interests, his friendship and his ever-ready generosity of his own time and talents. This high personal and professional reputation helped him to arrange visits by distinguished mathematicians who have contributed to the development of Mathematics in Western Australia. At the time of his death tangible results for his years of efforts were beginning to appear. The serious study of Applied Mathematics is attracting a reasonable number of very able students. A modern course structure, the intellectual challenge offered and his own inspiring teaching are in a large part responsible for this. An active graduate school is developing with students coming from within and without Western Australia. But reform of syllabus has not been confined to that of interest to the brilliant mathematics student only. He has played a leading role in developing, as far as the University's resources would permit, a variety of service courses suited to the modern needs of other departments.

He contributed to a wide range of University activities and the many friends he made in such manner are spread throughout the whole fabric of academic life. He was sympathetic to students and their difficulties and gave to them freely of his advice and assistance. He was an enthusiastic supporter of staff-student social functions. He was active in the Mathematical Association of W.A. and played a leading role in the reform of mathematics syllabuses in the secondary schools to meet the needs of both the future university entrant and the school leaver. He was a member of the

Society for Industrial and Applied Mathematics and the American Association for the Advancement of Science, an associate fellow of the Royal Aeronautical Society and a council member of the Western Australian Branch of A.N.Z.A.A.S.. He was one of the foundation members of the Australian Mathematical Society, had served several terms as a council member and was Vice-President at the time of his death. The Society has every reason to be grateful to him for his active role in the formation of the First Summer Research Institute, of which he was one of the Secretaries.

The majority of his published research work is in the field of fluid mechanics and the nature of much of the earlier work reflects the aerodynamic activities at the Aeronautical Research Laboratories while he was there. His later publications reveal the ever broadening scope of his research interests once he was able to give freer reign to his curiosity. Despite several illnesses in the later years and the pressure of other duties he maintained his research activity and there were definitely no signs of his 'drying up'. In my opinion, his greatest strength as a mathematician lay in his tremendous skill as a classical analyst. He did not deign to turn this expertise to advantage in the publications race by solving pseudo-problems because he believed strongly that Applied Mathematics should concern itself with scientific and engineering problems. He would use pseudo-problems to build his own armory of analytical techniques but he never bothered to keep the results of the investigations per se.

His first published mathematical work [2] concerned the breakdown of continuous one-dimensional unsteady flow in a simple compression wave and the development of mathematical techniques for introducing shock waves into such flows. This work was later developed by the co-author into the first successful solution of the problem. His work for the master's degree was extended into a project of considerable length and led to the publications [3], [6] and [8]. Earlier workers had used the hodograph method to generate classes of solutions for plane transonic flows past bodies which were approximately circular in cross section. Other results suggested that the existence theory for such flows was pathological in nature. It had been conjectured therefore that the hodograph solutions were irrelevant and that in practice in any transonic flow past a body the supersonic region would be terminated by a strong shock wave. Levey, sceptical of this conjecture, designed a body, bearing a reasonable resemblance to conventional aerofoils, for which hodograph theory predicted a smooth transition from supersonic to subsonic flow. Experiments with this designed cross section showed that there was no catastrophic breakdown of the supersonic region over a range of Mach Numbers although there were small temporal fluctuations. The conjecture was disproved and the design itself was of interest to aerodynamicists concerned with low drag transonic aerofoils.

Many of his other early papers [4], [7], [10], [12], [13] and [14] present the results of calculations performed as support for particular experimental programmes. In some cases only estimates of relatively small effects were desired and in these the models and the mathematics are chosen at an appropriate level. But in papers [12] and [14] far more detailed results were required from the mathematical analysis which is correspondingly more sophisticated. Particularly is this so of Levey's derivation in the joint paper [14] of the solution behaviour near the shadow boundary. Similar difficulties had been encountered frequently in the literature in analogous contexts but the correct solution had never been obtained before. The work provides a clear indication of his abilities as a classical analyst which is amply confirmed in reference [17] where a problem of over twenty years standing is solved most elegantly.

Besides working on problems of such diverse nature he maintained a continuing interest in the class of problems termed singular perturbations. This began with his work in Manchester which is described in essence in reference [5], wherein the complete structure of all solutions to a non-linear system is deduced by an intricate and carefully reasoned argument. In later papers [9] and [11] he developed perturbation techniques for obtaining analytic approximations to such solutions. This work did much to draw attention to the inadequacies of the P.L.K. technique for wide classes of problems and also to the abuses of the method in the literature even when it was adequate if properly applied. His interest in singular perturbation theory led him to consider problems such as non-linear effects in the diffraction of shock waves [16], resonance in non-linear systems [21] and antenna theory. Some of this work has been continued by research students who had been working with Professor Levey. Further the work in [18], which led directly to the problem solved in [20], was undertaken as a first step in a major singular perturbation problem he had just begun to consider at the time of his death. His extensive knowledge of the current techniques for solving singular perturbation problems and his much more rare awareness of their limitations had led him to propose the writing of a research monograph on this subject in conjunction with the author. He had received a grant from the Australian Research Grants Committee to finance a senior post-doctoral fellowship in support of this project but this has had to lapse.

One of his great interests in recent years was his work [15], [19] in theoretical biology resulting from his collaboration with Dr C. J. Perret of the Department of Microbiology, University of Western Australia. Both believed that mathematical model making had a great role to play in the development of biological sciences and their joint published work supports their contention. Unfortunately a series of illnesses to both parties prevented the further development of their joint work which each felt needed the full collaboration of someone with the other's experience to yield fruitful results. It is not surprising that Harry Levey should be an initiator of such collaboration in Australian Universities.

But is is not merely for his excellence as a mathematician nor for his contributions to mathematics in Australia that so many people will remember Harry Levey, compelling though those reasons be. A personality, warm, generous and versatile as his was, made him many friends both through his work and his wide range of outside interests. To these fortunate friends there is above all the memory of the gentle warmth of his humor and the attractiveness and kindness of his personality.

Publications list

[1] 'The Vibration of Telephone Line Wires' (with P. R. Brett), *The Failure of Metals by Fatigue*, M. U. P., 1947.

[2] *The Formation and Growth of Shock Waves* (with A. F. Pillow), A. R. L. Report A. 47, December 1947.

[3] 'High Speed Flow of a Gas Past an Approximately Elliptic Cylinder', *Proc. Camb. Phil. Soc.* **46** (1950), 479.

[4] *On the Calculation of the Aerodynamic Field of Stabilised Flames*, by J. Fabri, R. Siestrunck and C. Foure; Translation and Notes by H. C. Levey, A. R. L. Translation T. 14, July 1952.

[5] 'Two Dimensional Source Flow of a Viscous Fluid', *Quarterly Applied Mathematics* 12 (1954), 25.

[6] *Exact Solutions for Transonic Flow Past Cusped Aerofoils*, A. R. L. Report A. 87, March 1954.

[7] *The effect of a Small Protuberance on Potential Flow Past an Aerofoil*, A. R. L. Note A. 134, June 1954.

[8] 'A Shock-Free Airfoil', *J. Aeronautical Sci.* **23** (1956), 1129.

[9] *Singular Perturbations: A Model Equation*, A. R. L. Note A. 157, January 1957.

[10] The "Ground" Interference of a Carrier Deck, J. Roy. Aero. Soc. **61**, 1957.

[11] 'The Thickness of Cylindrical Shocks and the P. L. K. Method', *Quart. Appl. Math.* 27 (1959), 77.

[12] 'Heat Transfer in Slip Flow at Low Reynolds Number', *J. Fluid Mech.* (1959), 385.

[13] 'The Back Effect of a Wall on a Jet', *Zeit. Ang. Math. u. Phys.* **11** (1960), 152.

[14] *The Interaction of a Plane Shock and a Cylindrical Body* (with J. J. Mahony), A. R. L. Report 121, August 1961.

[15] 'The Theory of Uncatalysed Linear Expanding Systems' (with C. J. Perret), *J. Theor. Biol.*, **1** (1961), 542.

[16] *Diffraction of Waves of Finite Amplitude*, Technical Report No. 1, Crufts Laboratory, Harvard University, 1962.

[17] The Circular Wing and Related Problems (with P. E. Wynter), *Proc. Roy. Soc.* A, 268 (1962), 390.

[18] *The Generation and Propagation of an Undular Jump*. Read at 2nd Australian Conference on Hydraulics and Fluid Mechanics, Auckland, 1965. Printed in Conference Proceedings.

[19] 'A Note on the Theory of Uncatalysed Linear Expanding Systems' (with C. J. Perret). To be published in *Journal of Theoretical Biology*.

[20] 'Series Representations of Fourier Integrals' (with J. J. Mahony). To be published in *Quarterly of Applied Mathematics*.

[21] 'Resonance in Nearly Linear Systems' (with J. J. Mahony). Manuscript in preparation.