Professor Fred Chong's 80th Birthday

5 March 1995
Marigold Restaurant

Guest of Honour Professor Frederick Chong,
Hosts Mr & Mrs Lester To and Mr & Mrs Trevor Lum,
Mister Chairman Derek To,
Fellow Guests,

When Fred Chong came into my office last October and mentioned that I would be invited to his 80th birthday party, I was deeply honoured. When he went on to ask me to speak, I was quite overcome.

We are here as relatives, friends, students, and colleagues of Fred Chong to celebrate one of the two birthdays considered important in Chinese tradition. I have had a little experience speaking at 21st birthdays; none at 80ths, so please bear with me. We are also here for the launching of the book

A View of Mathematics; Big picture plus close-ups
by Fred Chong and Ron Andrews;

hereafter, I shall refer to this as "**The Book**". It is a collection of 33 Items and 5 Appendices.

Emeritus Professor Frederick Chong has outstanding formal qualifications:

First Place in mathematics at the New South Wales High School Leaving Certificate,

Bachelor of Science with the University Medal in mathematics at the University of Sydney,

First Class Honours in the Mathematical Tripos and Master of Arts at the University of Cambridge,

Master of Science at Sydney,

Doctor of Philosophy at Iowa State University,

Lecturer in Mathematics and Physics at New England University College in Armidale,

Dean of the Faculty of Science at New England University College,

Senior Lecturer of Mathematics at Sydney,

President of the NSW Mathematical Association,

Chairman of the Mathematics Syllabus Committee of the NSW Board of Senior School Studies,

Chief Examiner for the NSW Leaving Certificate Examination in Mathematics I and II,

Professor of Mathematics and Head of Department at the University of Auckland,

Foundation Professor of Mathematics and Head of the School of Mathematics and Physics at Macquarie University,

Member of the Academic Senate and University Council of Macquarie University,

Doctor of Science *honoris causa* from Macquarie University, and

Fellow and Chartered Mathematician of the British Institute of Mathematics and its Applications.

During this talk I can only provide a personal perspective of Fred as a colleague and friend. While I have not officially been Fred's student, he has taught me a lot. One thing Fred does effectively is build talks around *key words.* I intend to follow that example. Seven words spring to mind.

The first word is **PRESCIENCE** or pre-knowledge. There are many examples where Fred, well ahead of other Australians, recognised something as being important for the future and then brought it to the forefront of the Australian mathematical community. Fred was no stranger to the work of the famous physicist Paul Dirac since he had heard him, in person, lecture on quantum physics. Dirac was a Lucasian Professor of Mathematics at Cambridge (see the detailed list of Lucasian Professors in Appendix A of **The Book**). Dirac had a great deal of success in Physics using his "delta-function", but this was not really a function in the precise sense understood by mathematicians. Mathematicians struggled to make sense of Dirac's delta-function and related concepts. How excited Fred must have been when he heard the prize winning work of Laurent Schwartz at the International Congress of Mathematicians at Harvard in 1950. For Schwartz had created a legitimate mathematical theory of "generalised functions", the so-called *distributions.* In short order, Fred was telling Australia about "distributions": this was the subject of his invited address at the Inaugural Meeting of the Australian Mathematical Society in Melbourne in 1956. The paper appears in **The Book.** The approach taken in this article rendered distributions accessible to a very wide mathematical audience, unlike the original form which involved more advanced concepts like "abstract topological vector spaces". Now the subject was ready for Fred to teach to advanced undergraduates and to students in the Special Masters Program for Mathematics Teachers (SMPMT; which does *not* mean "Saturday Morning

Pre-Maths Tension"). The attitude towards "distributions" taken by Fred in those early days is now accepted worldwide. They are not just a device for keeping pure mathematicians happy, but rather, they can be understood and used by the working physicist who is serious about making further advances.

Another example of Chong-style prescience relates to the subject of Knot Theory which has been close to <u>my</u> heart for a decade now. Over four decades ago, Fred recognised the importance of knot theory and dedicated his Presidential Address to the NSW Mathematical Association to it – it is in **The Book**. I was amused to see that on the page before Fred's Item on knots there appears a comment by Professor A.L. Blakers, albeit on some other Item. Coincidentally, in January this year, I gave the Blakers Lecture to the National Mathematical Summer School in the Academy of Science Dome building: the topic was "The Mathematics of Knots". The audience consisted mainly of bright Year 11 high school students. The excellent questions they asked at the end of the talk confirmed Fred's early belief that knots <u>are</u> an interesting modern topic, outside the usual syllabus, and they excite young people: to the extent that they held hands and formed knots amongst themselves outside after the talk.

There is another example of Fred's prescience on page 121 of the Macquarie History, called

Liberality of Opportunity: Macquarie University 1964-1989
by Bruce Mansfield and Mark Hutchinson.

The authors say: *"That Computing would be important in the future of university teaching was apparent to Fred Chong as far back as 1965."* The establishment of computing at Macquarie University was admirably directed by Harry Hancock, one of the first staff to join our School, who succeeded despite lack of guidance and financial support from the university administration. Enrolments of 600 students in first year computing units are now common place.

I must move on to my second key word which is **RANGE.** If you look at the Table of Contents of **The Book** you will see that Fred has shed light on the whole gamut of mathematical concerns: mathematics education, elementary topics such as Pythagoras's theorem and conics, advanced mathematics, physics, computer science, and philosophy of mathematics. Fred's range is also apparent from the list of formal qualifications which I gave at the outset of this talk.

The third key word is **ORIGINALITY.** In each aspect of his range of interests, Fred's approach is always highly original and open minded, whether it be in the setting up of Macquarie's mathematics program, his research papers, or new looks at old results such as Einstein's equation $E = m\!/\!c2$, Rutherford scattering, and Maxwell's equations governing electromagnetic radiation. Fred's originality will also be evident in the discussion of our other six words.

BEAUTY is the fourth word. Another story emerges from Canberra. I was there last month for some meetings. At morning tea, I met a Fellow who asked me what was my field of research. Instead of giving the usual response

to my answer, he said that he <u>loved</u> mathematics. He mentioned the name of a few mathematicians he knew; one was Fred Chong. Then he launched into a story about being a student at Armidale. The students taught by Fred considered themselves a special elite group and they continue to do so. One incident obviously had a great impact on him. There was a third year assignment question on differential equations that none of them could do. When Dr Chong walked into the room, they asked whether he would do it for them. Fred proceeded to produce a perfect solution on the blackboard. After the careful placement of the final full stop, Fred turned to the class, put his large head to one side, and said: "Isn't that beautiful?" This Fellow said that he had not previously thought of applying the word "beautiful" to mathematics. He sat there and looked over the blackboard. Then it really hit him. It was beautiful. He had known about beauty in nature, beauty in art, beautiful girls, beautiful music! But this experience awakened him to *intellectual beauty.* I wonder whether Fred can guess who it was I was speaking to in Canberra. It was Emeritus Professor Richard Stanton of the Department of Geology and Geophysics at the University of New England. In fact, he was Vice-President of the Australian Academy of Science in 1989-90. He said that he doubted that he would be able to make a major original contribution in mathematics, and he moved to earth science. What a talent Fred Chong has in exposing the beauty of mathematics! Indeed, in arousing intellectual beauty in general! How many other Chong students around Australia and New Zealand have similar stories? We need to look well beyond the set of mathematics teachers to find them all.

INFLUENCE is the fifth word. Whether it be at the individual level or in committees, Fred has always had the charm and wit to influence people. Under his leadership, our School worked very efficiently and happily in the knowledge that Fred was effective in influencing Academic Senate and Council in our best interests. We can read in the Macquarie history how, after John Ward, Fellow of the Royal Society, contacted Fred 'one Saturday afternoon', an extra Chair in Physics was promptly created at Macquarie which Ward accepted in place of an offer from the University of California at Los Angeles.

My appointment to Macquarie was also smoothly done. I was in Australia at the end of 1969 when my father died and my mother was ill. I contacted Professor Chong who told me that a vacancy would occur in mid 1970 since Neil Trudinger was moving to the University of Queensland. Soon after, I was offered the job, took it up, and have been at Macquarie ever since. With the modern constraints in universities, would Fred still be influential? Certainly! But he was nevertheless very fortunate in having such a gifted secretary as Florence Kaldor to support him.

The next word is an obvious one: **TEACHING.** Evidence of Fred's brilliance in teaching abounds. At age 40 Fred accepted the Auckland appointment. At that time, Professor Keith Bullen, Fellow of the Royal Society and a Foundation Fellow of the Australian Academy, was reported in the *Daily Telegraph* as saying that Dr Chong was the <u>best mathematics expositor that Sydney University had known</u>.

In 1980 at Fred's retirement dinner, Professor Ron Aitchison read out a list of comments from students about Fred's Fourier Theory course. Ron said: "Pity the poor person who has to step into Fred's shoes in that course." This comment weighed heavily on me, as I knew I was that person!

More recently we had an opportunity to experience Fred's teaching style: his lecture to the Royal Society of NSW on Tomography was a gem. The article with Ron Andrews on tomography appears in **The Book,** and I strongly recommend it to any mathematics teachers who have not yet read it.

This brings us to our last key word, **YOUTH.** Ultimately, Fred's gift is to the young. Fred's life of teaching, syllabus design, and continued writing for mathematics teachers, will have repercussions through time. The name "Chong" was known to my generation: when I was in high school we used the excellent geometry text by Maxwell-Chong. Also "Chong" was a prominent name on those difficult past Leaving Certificate Examination papers coloured <u>blue</u>.

Our son Gavin is a kind of "scholarly grandchild" of Fred. Gavin had the good fortune to be taught by the late Mr Jack Neilson who was a Chong SMPMT student whose love of mathematics inspired many young men. Underpinning teachers' confidence in the value of their subject is Fred's ongoing gift to future generations. **The Book** supplies teachers with detailed answers to pupils who ask: "What is this mathematics good for?"

Prescience, Range, Originality, Beauty, Influence, Teaching, Youth: the first letters suggest another word, **PROBITY.** The Macquarie Dictionary says "probity" means **integrity, uprightness, honesty.** How better can we describe Fred Chong's character?

Happy Birthday, Fred.

BOOK REVIEW

A VIEW OF MATHEMATICS
BIG PICTURE PLUS CLOSE-UPS

Frederick Chong and Ronald J. Andrews

(The Mathematical Association of New South Wales, March 1995)

Reviewed by Ross Street

As mathematicians, we know that our subject is fun and useful – even beyond our expectations. However, we have not been particularly good at conveying this to the rest of society. Experts such as Martin Gardner, Ian Stewart, and, more recently, Barry Cipra [C] have provided excellent popular articles communicating recent advances and vitality within mathematics. This approach to public relations is necessary and to be admired when done well.

Over many years, Fred Chong has dedicated enormous energy and talent to a fundamentally different approach: excite, educate, equip our high school teachers and so reach the next generation! The pupil who asks, "But what's it good for?" deserves a substantial answer. The future of our subject depends on it.

This book provides the substance: a treasure trove of applications of junior-tertiary mathematics.

Such a project could go astray. Feynman attempted a recreation of Newton's geometric proof that the inverse square law of gravitational attraction implies planets move in elliptic paths. Here "geometry" means "Euclidean geometry without calculus"#. Certain parts of Newton's argument were unclear to Feynman who was able to replace them; but then the copious diagrams Feynman had drawn were lost and needed to be recreated by the Goldsteins. The result is an "elementary" proof using high school geometry but still requiring the reader's herculean commitment. So [G] is rather useless for the Chong objective. Indeed, the calculus proof in many textbooks is beautiful and only takes a few pages: that fits the spirit of the Chong-Andrews book where calculus is justifiably considered an allowable tool in the context of Australian high school teachers.

In particular, dealing with "the most profound intellectual accomplishments this century" (page 78), the present book includes the authors' original insights into the mathematics of quantum mechanics and relativity. In a few pages, the elements of linear algebra are reviewed, a theorem on Hermitian operators deduced, some physical postulates made explicit, and a beautiful, thorough account of the Heisenberg Uncertainty Principle exposed. Another favourite with me is the passage from affine geometry to the formula $E = m c^2$ which *inter alia* is famous for having halved the sales of [H].

Launched at a celebratory dinner party on Fred Chong's 80th birthday (5 March 1995), *A View of Mathematics* is a collection of thirty three Items and five Appendices. These include six new items, reprints of published articles, and various public addresses and lectures. While maintaining a coherence of purpose, the book sheds light on the whole gamut of mathematical concerns: mathematics education, elementary topics such as the Pythagoras theorem and conics, advanced mathematics, physics, computer science, and philosophy of mathematics.

As the topic for his Presidential Address to the Mathematics Association of NSW, Fred Chong chose knot theory. This is Item VI which was published in 1953. The three pages are recommended reading both from a historical perspective and for an introduction to a topic boosted in 1985 by the discovery (by New Zealander Vaughan Jones) of a new polynomial invariant.

The book contains interesting material arising from the Special Masters Program for Mathematics Teachers (SMPMT) at Macquarie University. The degree was the baby of Fred Chong; Ron Andrews graduated from it. Chong's address to the Fifth International Congress on Mathematical Education 1984 (appearing here as Item XXV) sounded alarm bells at the "paucity of school teachers in Australia with honours or higher degrees in

mathematics". His solution: "Recruit more honours graduates into teaching and provide more inservice programs like SMPMT." This is still good common sense advice and the alarm needs ringing louder; but government barriers continue to be erected.

It is unfortunate that the book is only published as a limited edition. There are messages and examples here that all mathematics teachers, tertiary as well as secondary, international as well as Australian, really need to have at their fingertips.

REFERENCES

[C] Barry Cipra, *What's Happening in the Mathematical Sciences* 1, 2 and 3 (American Mathematical Society 1993, 1994, 1996)

[G] David and Judith Goodstein, *Feynman's Lost Lecture: The Motion of Planets Around the Sun* (Jonathan Cape, 1996) 192 pp. Reviewed by Margaret Wertheim for *The Australian's Review of Books* Volume 1, Issue 2 (9 October 1996) pp. 9, 10, 31.

[H] Stephen Hawking, *A Brief History of Time* (Bantam Press, 1988).