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Editorial

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Mathematical Societies in Asia Pacific Region ......................................................................................... 73
The first issue of the Asia Pacific Mathematics Newsletter (APMN) has been successfully launched in January, 2011. We would like to thank the various mathematical societies in the Asia Pacific region for sending us news items, articles and other useful information and for making announcements about this new publication in their websites, newsletters and bulletins.

Feedback on the inaugural issue of APMN is encouraging. However, we have received only few responses to our request for contributions of articles of interest, news items, etc. If there is something in your field that you think others should be made aware of, do make use of this newsletter to share your excitement and passion. We would also like to stress that this is not a research publication, thus, please do not send us manuscripts meant for research journals. Instead, we welcome expository articles on topics of broad and current interest to the mathematics community.

Response to the Problem Corner is rather poor. Even though the solutions to the last set of problems are given in this issue of APMN, we still welcome alternative solutions, and a book token will be awarded. In addition, a new set of problems (page 34) is waiting for your solutions.

We would again like to emphasise that APMN is meant to provide an interactive platform for communication and cooperation among educators and researchers in mathematics and the mathematical sciences in the Asia Pacific region. To help us serve you more effectively, we would need your active support. We have therefore set up a column (“Letters from Readers”) that will enable you to express your views and ideas on matters and issues relevant to the mathematical and scientific community in this region.

We are fortunate and grateful to have established a collaborative link with the Chinese Mathematical Society (CMS), the Mathematical Society of Japan (MSJ) and the Korean Mathematical Society (KMS) to publish the English translation of selected articles from Communications in Mathematics of the CMS (中国数学会数学通讯), MSJ Mathematics Newsletter (Sugaku Tushin, 日本数学会 数学通信) and the KMS Mathematics Newsletter (대한수학회 소식지) respectively. The first of such articles appears in this issue (page 18). We hope to do the same with other regional mathematical societies. By doing so, we hope to disseminate many interesting articles published in native languages to a wider international audience.

This issue features two articles on the legendary mathematician Srinivasa Ramanujan by Professor K. Srinivasa who specialises in the biography of Ramanujan; and Professor Bruce C. Berndt who is a leading expert on the work of Ramanujan. Other items of interest include an interview with the 2010 Fields Medallist Ngô Bào Châu and a feature on the new centre of excellence in India – International Centre for Theoretical Sciences.

We have also started a new column on Book Reviews (page 44). Publishers are encouraged to send us recently published books for listing and reviewing.

It is gratifying to mention that APMN has been listed in the MathSciNet database. We hope that our publication will be included in other databases in the near future.

Finally, we would like to extend our deepest sympathy and condolences to those who have suffered irreplaceable losses in the recent natural disasters in Japan (see also the Letter from MSJ in page 55). There is no doubt that the Japanese people, with their typical resilience and tenacity, will speedily overcome the trauma and rebuild a new and better environment.
Srinivasa Ramanujan —
From Kumbakonam to Cambridge

K. Srinivasa Rao

Introduction

Srinivasa Ramanujan has been hailed as a natural mathematical genius and compared to all time great mathematicians Euler and Gauss, by his friend, philosopher and guide, G H Hardy. In 1940, Hardy gave two lectures at Yale University, which were subsequently published as a book [1] entitled: “Ramanujan: Twelve Lectures inspired by his life and work”. Earlier, in 1927, Hardy, along with Dewan Bahadur Ramachandra Rao and P V Seshu Iyer, brought out the “Collected papers of Srinivasa Ramanujan”, which have been more recently reprinted [2], in 1999, by the American Mathematical Society and the London Mathematical Society.

This reprinting of the two volumes at the dawn of this century clearly is an indication of the intrinsic worth of the work of Ramanujan in his brief life span of 32 years, 4 months and 4 days, of which he spent five years, 1914–1919, at the Trinity College, Cambridge University. Hardy convinced the authorities to award to Ramanujan the BA degree, by research, of the Cambridge University, for his contributions to mathematics, including his longest paper [2] on “Highly Composite Numbers”, which Hardy considered was in the “scientific backwaters” of mathematics of the times, but was unique as far as its originality and Ramanujan’s creativity in mathematics are concerned.

Unfortunately, for about half of the duration of his sojourn in England, Ramanujan was in and out of sanatoria, and wrongly diagnosed and treated for tuberculosis (TB). In 1919, when Ramanujan was ill, Hardy spoke to Sir Arthur Eddington, who was the Chairman of the Royal Society, London then, to make Ramanujan a Fellow of the Royal Society (FRS), which Hardy felt would act as a stimulus for further research by Ramanujan. Eddington was by then, May 1919, a celebrity, as a consequence of his successful expedition to South Africa, to observe the bending of light during a total Solar eclipse, confirming the predicted angle of deviation by Albert Einstein and hence of Einstein’s General Theory of Relativity. When Eddington asked Hardy whether Ramanujan could wait for the FRS to be awarded to him one year later, Hardy told Eddington that Ramanujan may not be at Cambridge since he was contemplating to send him back to India, whose warmer climate, he thought, would restore Ramanujan’s health and spirits. So, on February 28, 1919, Ramanujan was elected Fellow of the Royal Society. In India, February 28, is celebrated as “Science Day”, due to the discovery and announcement of the Raman Effect by Sir C V Raman on February 28, 1928. It would be fitting if it is also recognised as the day on which Ramanujan became a Fellow of the Royal Society — the first Indian mathematician to become a FRS Professor. G H Hardy sent a telegram to Mr Dewsbury, Registrar of the Madras University, announcing the award of this distinction, on that day.

Mainly due to the efforts of Professor Robert A Rankin, a renowned mathematician and Dr D A B Young, a medical doctor [3], it is now common knowledge, amongst the admirers of Ramanujan, that
the cause of the death of Ramanujan was not the then dreaded TB, but hepatic amoebiasis, which was the cause of his illness twice in his younger days, in India. Since TB was diagnosed, in 1919, by doctors in England and in India, after his return, on March 27, 1919, as a celebrity, he got the best medical attention and the full-fledged backing of the University of Madras. Since the treatment was (not for hepatic amoebiasis but) for TB, it led to his premature death, at about 10 am, on April 26, 1920, at "Gometra", owned by Emberumal Chettiar, in Chetput, Madras.

Birth and Schooling

Ramanujan was born on December 22, 1887, to Komalathammal and K Srinivasa Iyengar, a “gumastha” or clerk to a cloth merchant in Kumbakonam, at his mother’s residence in Erode. It was a Thursday, and since the religious leader Ramanujachariar was born on a Thursday, as in most Iyengar families, the choice of the name for the new born was Ramanujan. As in one of the conventions, his father’s name Srinivasa became the surname and his name Ramanujan (S Ramanujan). He was the first of 3 sons and was sent to the Kangeyan Primary School, in Kumbakonam — a school no longer in existence today. In November 1897, he stood first in the Tanjore District Primary Examinations, and this entitled him to a half-fee concession in the Town High School, Kumbakonam, where he had his schooling, from 1898 to 1903. He passed the Matriculation Examination of the University of Madras, in December 1903. The academic year in the days of the British Raj was from January to December, to enable the Britishers to plan holidays with their families at the time of Christmas and the dawn of the New Year.

While Ramanujan was in the final year, VI Form, in school, two college students, who were boarders in his home, brought George Schoobridge Carr’s “A Synopsis of Elementary Results, a book on Pure Mathematics” (often referred to simply as Carr’s “Synopsis”) which contained about 4865 formulas to show Ramanujan, who they knew was able to give simpler solutions to their collegiate mathematical problems they were being taught by their teachers. Carr’s “Synopsis” which has been reprinted in recent times, has become famous because of Ramanujan.

Ramanujan’s mother used to go regularly to the Sarangapani temple to be one of the lead singers in the Bhajans. This is possibly because at the end of the group singing, “prasaadam” (food offered to the God) would be distributed to all present. Occasionally this was the meal for her first born Ramanujan, since the meager earning of about Rs 25–30 per month, by his father, as a clerk (“gumastha”) to a cloth merchant, was inadequate to make both ends meet for the growing family of Srinivasa Iyengar and Komalathammal!
x = 9, y = 4, in a few seconds, much to the surprise of the boys around him. This was a turning point in the life of Ramanujan, for it was Rajagopalachari [4] who arranged to take Ramanujan to meet Dewan Bahadur Ramachandra Rao, then the Collector of Nellore, stationed at Tirukkoilur.

8. The First Examination in Arts, FA degree (Intermediate) eluded Ramanujan, who failed in 1905 and again in 1907.

School Anecdotes

Two anecdotes have been passed on to us by his classmate, Viswanatha Iyer, and these are perhaps the only authentic ones known [4]: The first is an incident in the mathematics class, when the teacher was illustrating the division process. He said that if there were three students and he had three bananas to be distributed, then each student would get a banana. Perhaps the teacher was trying to drive home that “n divided by n is equal to one: \( \frac{n}{n} = 1 \)”. Ramanujan had a doubt and asked the teacher, “Sir, if no banana is distributed to no student, then will each student get one banana?” It is not known as to what the reaction of the teacher was. This anecdote can be interpreted, with hindsight, to reveal Ramanujan’s inquisitive, intuitive nature, to realise that there could be exceptions to the division rule. Or, he might have liked the teacher to state more precisely, “\( \frac{n}{n} = 1 \), for all \( n \), except for \( n = 0 \)”.

The second anecdote, in 1902, is passed on to us by Rajagopalachari [4], a schoolmate of Ramanujan: One day, during the lunch interval, he told his friend Rajagopalan (in Form VI) that Ramanujan, a Form IV student, was a “great mathematician”. Not convinced of this observation, as a test and a teaser, Rajagopalan gave in writing, on a piece of paper the following two simultaneous equations in two variables:

\[
\begin{align*}
\sqrt{x} + y &= 7; \\
x + \sqrt{y} &= 11,
\end{align*}
\]

and wondered whether Ramanujan would be able to solve them to get the answer for \( x \) and \( y \). This would be classified by some as “out of portion” for a Form IV student, since square roots and solving simultaneous equations were to be taught in later Forms. Given the problem, Ramanujan gave the answer:

\[
\begin{align*}
x &= 9, \\
y &= 4,
\end{align*}
\]

Ramanujan was also entrusted the responsibility of preparing the conflict-free time-table for the Town High School, which had at that time about 1400 students. This was a task entrusted to the senior mathematics teacher of the school, Mr. Ganapathy Subbaier, who had confidence in the abilities of Ramanujan in doing this job. With hindsight, we can draw the conclusion that the work of Ramanujan on Magic squares started at about this time.

Magic Squares

The first Chapter in his Notebook 1, is the only one which has a title and it is “Magic Squares”. Ramanujan starts with the first non trivial magic square for 15, which is 3 x 3, and it is:

\[
\begin{bmatrix}
2 & 9 & 4 \\
7 & 5 & 3 \\
6 & 1 & 8
\end{bmatrix}
\]

A general magic square of dimension 3 is:

\[
\begin{align*}
\begin{bmatrix}
a & b & c \\
d & e & f \\
g & h & i
\end{bmatrix}
&= \begin{bmatrix}
a + d + f &= b + e + h \\
g + h + i &= c + f + i \\
a + b + c + d + e + f + g + h + i
\end{bmatrix}.
\end{align*}
\]

Note that in a magic square, the sum of the elements in the columns; the sum of the elements in the three rows; and the sum of the three elements along the diagonal and the skew-diagonal all add to give the number. Above, the 3 x 3 magic square is filled with the first nine natural numbers 1 to 9. The interested reader can try to form 3 x 3 magic squares for any number
greater than 15 and realise that this is recreational mathematics. One can form also 4 x 4 (Date) magic squares and higher dimensional magic squares. Only Chapter 1 of his first Notebook has a title: “Magic Squares”, all other chapters in his Notebooks are untitled. Chapter 1 of his first Notebook has 3 pages devoted to this topic and Chapter 1 of his second Notebook, has 8 pages, with 43 entries. While his first Notebook has 16 chapters and 134 pages, his second Notebook has 21 chapters and 252 pages. So, experts consider the second Notebook a revised, lengthened version of the first Notebook. Turning the second Notebook around, Ramanujan wrote down some more entries in an unorganised manner (unlike in his well-organised first and second Notebooks) and this is considered as his third Notebook which has 33 pages, containing about 600 theorems and proofs are being provided in an ongoing project by Bruce Berndt and George Andrews. Again, in retrospect, we may conjecture that magic squares is perhaps his first introduction to partitions of integers. For, can we not say that he is looking at the partitions of 15 in 3 parts and the problem is equivalent to solving a set of equations, which is a consequence of:

$$a + b + c = d + e + f = g + h + i = a + d + g = b + e + h$$

$$= g + h + i = a + e + i = c + e + g = 15?$$

An admirer and friend of Ramanujan took him to see his Uncle, Dewan Bahadur Ramachandra Rao, who was the Collector of Nellore, stationed at Tirukkoilur. On the first 4 occasions, they were unable to meet the Collector, and it was only on the fifth occasion that they met him. Although Ramachandra Rao was initially highly skeptical about the prowess of Ramanujan, when he saw the mathematical entries in Ramanujan’s 2 thick Notebooks, he could neither make head or tail of the gamut of notes/entries he saw in them. Note that Ramachandra Rao considered himself very knowledgeable as compared to a school boy as he was a MA in mathematics.

Precocious at School

Ramanujan won prizes in School for proficiency in English and in Mathematics. S L Loney’s “Trigonometry” was a prize book for him in his Form IV at School and he mastered this book. He also won prizes in Form II and Form VI. In 1905, Ramanujan joined the Government Arts College’s Intermediate class in his first year. However, after a few months, he stopped going to the college, probably because he found the classes uninteresting. His own productive period in mathematics also started with his jotting down of mathematical results in his Notebooks, during those 5 years between 1905 and 1909, when there is scant amount of information about his activities. It is known that he even went to Visakhapatnam, perhaps in search of tuitions to eke out a livelihood, for a brief period without informing his family.

His first publication was a 15-page-article on “Some properties of Bernoulli Numbers” which appeared in the Journal of the Indian Mathematical Society (JIMS), in which his earliest contributions were in the form of Questions or Answers to Questions that had appeared. In his illustrious career, Ramanujan proposed in all 59 Questions or Answers to Questions in the JIMS. As Ramanujan was in Triplicane, he was close to the Parthasarathy Temple, which he frequented and more importantly, was where he came into contact with S Narayana Iyer, MA (Mathematics), Manager of Madras Port Trust, whose residence was close to Ramanujan’s. In fact, it was Narayana Iyer who discovered the talent in Ramanujan and brought him into contact with the right people at the right time. He was a pillar of strength for Ramanujan, not only throughout Ramanujan’s lifetime but also even after his death. Narayana Iyer and his wife helped Janaki Ramanujan, Ramanujan’s wife, in every possible way. From the 75th Birth Anniversary of Ramanujan, in 1962, when the Government of India issued a stamp to mark the occasion, Janaki started getting recognition as the wife of the mathematician who impressed everyone with whom he came into contact with, be it Narayana Iyer, Ramaswamy Iyer, Ramachandra Rao, Seshu Iyer, Sir Francis Spring, G T Walker, E H Neville, or G H Hardy. It is the orchestrated efforts of these great human beings, which were responsible for Ramanujan getting all the recognition which he richly deserved — the financial support required for his visit to and stay in England, the BA Degree of the Cambridge University, the Fellowship of the Royal Society, the Trinity College Fellowship, and for tirelessly disseminating his name, fame and achievements, to all concerned. Ramanujan, who failed in his FA degree examinations of the University of Madras in 1905 and again in 1907, became the first Indian mathematician to be awarded the FRS. He was at Cambridge for 5 years, before he returned to India, “only to die”, as Janakiammal regretted soon after Ramanujan died on April 26, 1920. Janaki Ramanujan lived for ~74 years after the death of Ramanujan, till she passed away, on April 13, 1994.
Ramanujan’s paper in the Quarterly Journal of Mathematics 45 (1914) 350–372 entitled “Modular equations and approximations to $p$” contained 19 infinite series formulae for $1/p$, one of which he asserted would be “rapidly convergent”. Only in 1984, Borwein and Borwein used a modified version of Ramanujan’s formula to compute $p$ to 17 million places and found that the formula converges on the exact value with far greater efficiency than any other, thereby proving that the intuition of Ramanujan was correct as usual.

Glimpses into His Work

In a short article like this one, meant for students of Mathematics, it is relevant to give an elementary mathematics result and a number theoretic result of Ramanujan, to make the reader realise why the world of mathematics remembers him today and why several Departments and an Institute have been named after him. This article will be concluded with a selected entry for nested roots of Ramanujan [5]:

$$x + n + a = \sqrt{ (a x + (n + a)^2 ) + x \sqrt{ (a (x + n) + (n+a)^2 ) + (x+n) \sqrt{ \text{etc.} } \ldots } }$$

Interested students should see what the results are when he puts: $x = 2, n = 1, a = 0$ and $x = 2, n = 1, a = 1$. The resulting nested root expansions for 3 and 4, are 2 of the elementary results of Ramanujan, which he first published as Q.289 in the Journal of the Indian Mathematical Society (JIMS), which was started by V Ramaswamy Iyer, who also was the founder of the Indian Mathematical Society (1909). Ramanujan also provided the solutions in the JIMS.

Another elementary number theoretic problem is the Diophantine equation: $x^2 + 7 = 2^n$, for which Ramanujan conjectured that the solutions are: $x = 1, n = 3; x = 3, n = 4; x = 5, n = 5; x = 11, n = 7; \text{and } x = 181, n = 15$. It was only in 1948, nearly three decades after Ramanujan died, on April 26, 1920, that Nagel proved that there are only five solutions and no more exists other than those given by Ramanujan. Did Ramanujan know that this was the case? The fact that he never provided proofs for his entries in his Notebooks but could provide more than one when anyone asked for a proof for any entry, makes one conjecture that he perhaps knew that these were the only solutions but left it as a teaser, as most of his entries were, for posterity to ponder and provide proofs (which in some cases required mathematics developed after Ramanujan’s times).

In general, Ramanujan is one of the all time great mathematicians and belongs to the class of Euler and Gauss, as stated at the beginning of this article. Interested readers may refer to Robert Kanigel’s biography [5] and the biographies written by the present author [6, 7], which also contain glimpses into his mathematics. Finally, mathematics students whose interests have been kindled by this short article, may refer to the comprehensive five volume work of Bruce C Berndt [8], who spent 22 years of his life to provide a proof for each one of the 3254 Entries of Ramanujan in his Notebooks. It would be incomplete if attention is not drawn to the story of the discovery [9] of the “Lost” Notebook of Ramanujan, discovered in the Spring of 1976, when Professor George E Andrews of the Pennsylvania State University was going through the estate of G N Watson and came across about 100 loose sheets of paper in which more than 600 Entries were written in scrawling handwriting, uncharacteristic of Ramanujan. Bruce C Berndt, George E Andrews are bringing out another series of volumes providing proofs for the Entries in this “Lost” Notebook which contain some of the most intriguing work of Ramanujan which has laid the foundation for what he christened as “mock” theta functions.

In Fig. 19, a recently constructed statue of Ramanujan in the foyer of the Coding Theory Institute, SETS, in the Ramanujan IT City, Taramani, Chennai is shown. The photograph of Ramanujan seated, after he was awarded the BA degree by research of the Cambridge University, modified with the later day passport (face) photograph of Ramanujan has been sculpted by K G...
Ravi, and installed in June 2010. The 4-sided pedestal of the statue has the following inscriptions on the sides (anti-clockwise): Srinivasa Ramanujan (December 22, 1887–April 26, 1920); \[\pi = 3+1/(7+1/(15 +1/(1 +1/(298+1/(1+\ldots)))));\] Tau conjecture: \(|\tau(p)| \leq 2p^{11/2};\] Taxi cab number: \(1^3+12^3 = 1729 = 10^3+9^3.\)

**Publication Record**

Ramanujan published 39 papers in all, of which 5 were in collaboration with Hardy. He also proposed 59 Questions and/or Answers to Questions in the JIMS, during his short life span of 32 years, 4 months and 4 days, including the famous Rogers–Ramanujan identities published by Rogers in 1909 and contained in the undated Notebook Entries of Ramanujan, which led Hardy to refer to these as Rogers–Ramanujan identities. R J Baxter (like L J Rogers and I Schur) discovered and proved the Rogers–Ramanujan identities independently and his work led to their generalisations and applications in Statistical Mechanics, in 1984, and to the solution of the 2-dimensional Hard Hexagon Model. He will continue to be talked about in this millennium for his seminal contributions to several branches of mathematics and in particular, for his pioneering work in continued fractions, partitions, introduction in “mock” theta functions and rediscovering all that was known about hypergeometric series in Europe — his footprints in the field of mathematics.


Janaki was chosen as a wife for Ramanujan, by his mother on a visit to Rajendram, Komalthammal arranged the marriage of her 22-year-old son with the 9-year-old girl herself. Janaki went through several travails but learnt suturing. With her pension earnings — from the Port Trust, Madras University and the Hinduja Foundation — she survived without her husband, who died in 1920, for 74 years. From around 1955, she fostered a young boy W Narayanan and supported him for his collegiate studies, got him a job with the State Bank of India, and conducted his marriage to Vaidehi (also a bank employee) and was a guiding spirit for them. She also fully supported her nephew, T Ramaswamy, for his collegiate studies and for his employment. She spent a large part of her later life as a philanthropist, with W Narayanan at Hanumantharayan Koil Street, Triplicane.
Acknowledgements for Photos in the Article

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3. from passport with W Narayanan;
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20. from Mr W Narayanan;
21. post card from Prof Richard A Askey (K Srinivasa Rao);
22. Letter of Janaki, from the website;
23. from Mr T Ramaswamy.

References


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K. Srinivasa Rao, FAvHS, FNASc., FTNASc., was a Senior Professor at Institute of Mathematical Sciences, Chennai during 1964 to 2002. From 2002 to 2005, he created two CD ROMs on the Life and Work of Srinivasa Ramanujan, for the Department of Science and Technology, Government of India. He was the first Distinguished DST - Ramanujan Professor, at the Srinivasa Ramanujan Center, SASTRA University, Kumbakonam, from 2005 to 2009. At present he is associated with the Tamilnadu Science and Technology Center (TNSTC), Kottupuram, Chennai, as a Consultant for enlarging the Pie (pie) Pavilion and Ramanujan Gallery (created by him for the Indian Science Congress Exhibition, 1998, and housed in the TNSTC, since the middle of 1999) into a full-fledged Ramanujan Mathematics Museum. He is at present the Director of the Srinivasa Ramanujan Academy of Maths Talent, Chennai; Vice-President of the DAE Retired Officers Association, Chennai; Vice-President of the Rotary International, Kumbakonam (Central), 2006–2009.
Abstract. Because many of Ramanujan’s theorems were hidden from the public for many years, it was natural that other mathematicians would unknowingly rediscover some of his unpublished work. We give examples of theorems from the theory of the Riemann zeta function, summation formulas, prime number theory, combinatorics, and partitions that have names of others attached to them, but they were discovered much earlier by Ramanujan.

1. Introduction

Born on December 22, 1887, India’s greatest mathematician, Srinivasa Ramanujan, began to record his discoveries in notebooks in about 1904 when he entered the Government College of Kumbakonam for what was to be only one year of study. For the next five years, Ramanujan did mathematics, mostly in isolation, while logging his findings without proofs in notebooks. Ramanujan moved to Madras in 1910 and, while working as a clerk in the Madras Port Trust Office, was encouraged by the Manager and Chief Accountant, S. Narayana Aiyar, and the Chairman, Sir Francis Spring, to write to English mathematicians about his work. After communicating about 120 of his theorems to G. H. Hardy in early 1913, Ramanujan accepted Hardy’s invitation to go to Cambridge, and so on March 17, 1914, Ramanujan departed India for England. At about that time, from letters that he wrote to friends back home in Madras [15, pp. 112–113; 123–125], Ramanujan ceased recording his theorems in notebooks to concentrate on publishing research that he was conducting in England. After returning to India in March, 1919, Ramanujan began to log entries in what was later to be called Ramanujan’s Lost Notebook, which was found by George Andrews in the library at Trinity College, Cambridge in March, 1976. After a lengthy illness, which had confined him to nursing homes during his last two years in England, Ramanujan died on April 26, 1920 at the age of 32.

Ramanujan’s earlier notebooks were not published until 1957 [30], and his later lost notebook was not published until 1988 [31]. Thus, not surprisingly, it transpired that some of Ramanujan’s discoveries were hidden for many years and were in the meantime proved by others.

On June 1–5, 1987, a meeting was held at the University of Illinois to commemorate the centenary of Ramanujan’s birth and to survey the many areas of mathematics (and of physics) that have been profoundly influenced by his work. One of the speakers, R. William Gosper, remarked in his lecture, “How can you love this man? He continually reaches his hand from his grave to snatch your theorems from you.” The purpose of this paper is to provide just a few of the many examples for which others have received credit for theorems, but unknown to them, their discoveries were not original with them; they were first unearthed by Ramanujan.

2. Ramanujan’s Early Work

A perusal of issues of the Journal of the Indian Mathematical Society from its inception in 1907 to, say, the late 1920’s shows that some of the earlier
papers and problems that Ramanujan submitted to the Journal of the Indian Mathematical Society were much in the spirit of mathematics popular in India at that time. Thus, it is not unexpected that some articles published in the Journal in the decade after Ramanujan’s death might contain entries found many years later to be in Ramanujan’s notebooks. In particular, two papers by M. B. Rao and M. V. Ayyar [32] and one by S. L. Malurkar [26] contain several entries from Chapter 14 in Ramanujan’s second notebook [30], [9]. We offer one example from a paper by Malurkar, who studied physics at Cambridge University and who was Director of the observatories in Pune and Mumbai for much of his career.

**Theorem 2.1.** Let $\zeta(s) := \sum_{n=1}^{\infty} n^{-s}$, $\text{Re } s > 1$, denote the Riemann zeta function, and let $B_n$, $n \geq 0$, denote the $n$th Bernoulli number. If $\alpha$ and $\beta$ are positive numbers such that $\alpha \beta = \pi^2$, and if $r$ is a positive integer, then

\[
(4\alpha)^{-r} \left( \frac{1}{2} \zeta(2r+1) + \sum_{m=1}^{\infty} \frac{1}{m^{2r+1} (\alpha^{2m\pi} - 1)} \right)
\]

\[
- ( - 4\beta)^{-r} \left( \frac{1}{2} \zeta(2r+1) + \sum_{m=1}^{\infty} \frac{1}{m^{2r+1} (\beta^{2m\pi} - 1)} \right)
\]

\[
= \sum_{k=0}^{r+1} (-1)^k B_{2k} B_{2r+2-2k} \alpha^{r+1-k} \beta^k
\frac{1}{(2k)!(2r+2-2k)!}.
\]  

(2.1)

Theorem 2.1 can be found as Entry 21(i) in Chapter 14 in Ramanujan’s second notebook [9, pp. 275–276]. It also appears in a manuscript of Ramanujan that was published for the first time in its original handwritten form with his lost notebook [31, pp. 319–320, formula (28)]. This manuscript, along with commentaries, can also be found in [12] and [1]. The special case $\alpha = \beta = \pi$ was first proved by M. Lerch in 1901 [25]. There are now several proofs of Theorem 2.1, and references to these many proofs can be found in [9, p. 276] and [1]. An extensive generalisation of Entry 2.1 can be found in Entry 20 of Chapter 16 in Ramanujan’s first notebook [30], [10, pp. 429–432], and another one in [11]. Moreover, there are further generalisations, including analogues for Dirichlet $L$-functions.

Ramanujan’s formula (2.1) is fascinating for several reasons. It is well known that, for each positive integer $n$, $\zeta(2n)$ can be explicitly evaluated as a rational multiple of $\pi^{2n}$ containing the factor $B_{2n}$. However, except for the fact that $\zeta(3)$ is irrational, which was first proved by R. Apéry [3], we currently know no further information about the arithmetical nature of $\zeta(2n+1)$. If we set $r = 2n + 1$, $n \geq 0$, and $\alpha = \beta = \pi$ in (2.1), we find that $\zeta(4n+3)$ can be represented as a rational multiple of $\pi^{4n+3}$ involving Bernoulli numbers plus a rapidly convergent series. Thus, $\zeta(4n+3)$ is “almost” a rational multiple of $\pi^{4n+3}$. 

3. Bell Numbers and Polynomials

Most readers will be familiar with the name of E. T. Bell because of his popular book [7]. On the other hand, those with a combinatorial interest will identify him with Bell numbers and Bell polynomials. However, these numbers and polynomials should have Ramanujan’s name attached to them, and not Bell’s, because Ramanujan extensively studied these numbers and polynomials in Chapter 3 of his second notebook [30], [8], probably over 30 years before Bell wrote his papers [5], [6] on these numbers and polynomials.

The Bell polynomials $\varphi_n(x)$, $n \geq 0$, are defined by

\[
\varphi_0(x) := 1, \quad e^{x \varphi_{n+1}(x)} := \sum_{k=1}^{\infty} \frac{k^n x^k}{(k-1)!}, \quad n \geq 0.
\]

Readers should verify that $\varphi_n(x)$ is a polynomial of degree $n$, and, in particular, 

\[
\varphi_1(x) = x,
\]

\[
\varphi_2(x) = x + x^2,
\]

\[
\varphi_3(x) = x + 3x^2 + x^3,
\]

\[
\varphi_4(x) = x + 7x^2 + 6x^3 + x^4.
\]

They can be generated by the exponential generating function

\[
e^{x(e^t-1)} = \sum_{n=0}^{\infty} \frac{t^n}{n!} \varphi_n(x).
\]

The $n$th Bell number $B(n)$, $n \geq 1$, is defined by

\[
B(n) = \varphi_n(1).
\]

For example,

\[
B(1) = 1, \quad B(2) = 2, \quad B(3) = 5,
\]

\[
B(4) = 15, \quad B(5) = 52, \quad B(6) = 203.
\]

Combinatorially, $B(n)$ is equal to the number of ways of partitioning a set of $n$ objects into subsets. In early editions of the Japanese classic, The Tale of Genji, written by Lady Shikibu Murasaki early in the 11th century, an arrangement of five incense
4. Koshliakov’s Formula and Guinand’s Formula

The Russian mathematician, N. S. Koshliakov (1891–1958), is chiefly remembered by a formula that now bears his name [24]. However, most of his work has been unfortunately neglected, and consequently his contributions to mathematics under appreciated. In 1942, he was arrested on fabricated charges and sent to a labour camp in the Ural mountains. Classified as an invalid after suffering from complete exhaustion, he found time to do mathematics, often under extremely difficult conditions, before being released in 1949.

Theorem 4.1 (Koshliakov’s Formula). Let $K_0(z)$ denote the modified Bessel function of order 0, let $d(n)$ denote the number of positive divisors of the positive integer $n$, and let $\gamma$ denote Euler’s constant. If $\alpha$ and $\beta$ are positive numbers such that $\alpha \beta = 1$, then
\begin{align*}
\sqrt{\pi} \left( \frac{\gamma - \log(4\pi \alpha)}{\alpha} - 4 \sum_{n=1}^{\infty} d(n)K_0(2\pi n\alpha) \right) \\
= \sqrt{\beta} \left( \frac{\gamma - \log(4\pi \beta)}{\beta} - 4 \sum_{n=1}^{\infty} d(n)K_0(2\pi n\beta) \right). \quad (4.1)
\end{align*}

Why is Koshliakov’s formula interesting? Recall that the theta transformation formula
\begin{equation}
\sum_{n=-\infty}^{\infty} e^{-\pi n^2/\tau} = \sqrt{\tau} \sum_{n=-\infty}^{\infty} e^{-\pi n^2/\tau}, \quad \text{Re } \tau > 0, \quad (4.2)
\end{equation}
is the most common route to the functional equation of the Riemann zeta function
\begin{equation}
\pi^{-s/2} \Gamma \left( \frac{1+s}{2} \right) \zeta(s) = \pi^{-(-1-s)/2} \Gamma \left( \frac{1}{2} \right) \zeta(1-s). \quad (4.3)
\end{equation}
In fact, (4.2) and (4.3) are equivalent. Koshliakov’s formula (4.1) is an analogue of (4.2), and, as shown by W. L. Ferrar [20] and by F. Oberhettinger and K. L. Soni [28], is equivalent to the functional equation for $\zeta(s) = \sum_{n=1}^{\infty} d(n)n^{-s}$, which, of course, is obtained by squaring both sides of the functional equation (4.3).

Koshliakov published his proof of Theorem 4.1 in 1929 [24]. However, his formula can be found on page 253 of the publication containing the lost notebook [31], which was written in

5. Snatching from Guinand Again

Ramanujan’s lost notebook contains at least three further results that were first proved in print by Guinand. In this section we examine another beautiful transformation formula, thought first to have been established by Guinand [21], but found ensconced in a two-page partial manuscript published with the lost notebook [31, p. 220]. For further examples and details, see the forthcoming volume [1] by Andrews and the author.

To state this aforementioned formula, we require some definitions. Set
\begin{equation}
\psi(z) := \frac{\Gamma^\prime(z)}{\Gamma(z)} = \log z - \frac{1}{2z} - \frac{1}{12z^2} + \frac{1}{120z^4} - \frac{1}{252z^6} + \cdots, \quad (5.1)
\end{equation}
as $z \to \infty$, $|\arg z| < \pi$. Next, Riemann’s $\xi$-function is defined by
\begin{equation}
\xi(s) := (s-1)\pi^{-s/2}\Gamma(1 + \frac{1}{2}s)\zeta(s) \quad (s > 0).
\end{equation}
while the Riemann $\Xi$-function is given by

$$\Xi(t) := \xi\left(\frac{1}{2} + it\right).$$

**Theorem 5.1.** Define

$$\phi(x) := \psi(x) + \frac{1}{2x} - \log x.$$

If $\alpha$ and $\beta$ are positive numbers such that $\alpha\beta = 1$, then

$$\sqrt{\alpha} \left\{ \frac{\gamma - \log (2\pi\alpha)}{2\alpha} + \sum_{n=1}^{\infty} \phi(n\alpha) \right\} = \sqrt{\beta} \left\{ \frac{\gamma - \log (2\pi\beta)}{2\beta} + \sum_{n=1}^{\infty} \phi(n\beta) \right\} = -\frac{1}{\pi^{3/2}} \int_{0}^{\infty} \left| \frac{1}{2} \right| \Gamma \left( -\frac{1}{4} + it \right) \cos \left( \frac{1}{2} t \log \alpha \right) \frac{dt}{1 + t^2}.$$ \hspace{1cm} (5.2)

Note that the asymptotic formula (5.1) ensures the convergence of the infinite series in (5.2). The appearance of the Riemann zeta function on the far right side of (5.2) is unexpected. Ramanujan’s recording of (5.2) is given as formula (7) on page 220 of [31] amidst several examples of Fourier sine and cosine transforms. In particular, formula (3) on that page is given as

$$\int_{0}^{\infty} (\psi(1 + x) - \log x) \cos (2\pi nx) \, dx = \frac{1}{2} (\psi(1 + n) - \log n),$$ \hspace{1cm} (5.3)
i.e., $\psi(1 + x) - \log x$ is a self-reciprocal Fourier cosine transform. Guinand evidently discovered the first equality in (5.2) in the course of reading page proofs for [21], for he gives the identity in a footnote at the end of his paper. Furthermore, he writes that it “can be deduced from” (5.3). It is clear that both Ramanujan and Guinand employed (5.3) in their proofs. Referring to (5.2), Guinand asserts that “This formula also seems to have been overlooked.” In [22], Guinand provides another proof of the first part of (5.2) that also depends on (5.3), about which he writes, “Professor T. A. Brown tells me that he proved the self-reciprocal property of $\psi(1 + x) - \log x$ some years ago, and that he communicated the result to the late Professor G. H. Hardy. Professor Hardy said that the result was also given in a progress report to the University of Madras by S. Ramanujan, but was not published elsewhere.” In March, 1913, Ramanujan received a scholarship from the University of Madras, with the only requirement being that he had to write quarterly reports about his research. Three such reports were written before he departed for England in March, 1914. Hardy’s memory was perhaps flawed, because (5.3) cannot be found in Ramanujan’s quarterly reports, which are detailed and discussed in [8], although it can be found in a partial manuscript [31, pp. 219–220], which evidently was also in Hardy’s possession. The second equality in (5.2) was first proved by the author and A. Dixit [14], who gave two proofs of the first equality. Moreover, Dixit [17], [18] has established generalisations and analogues of (5.2).

6. Dickman’s Function

Dickman’s function $\rho(u)$, first introduced by K. Dickman in 1930 [16], plays a central role in prime number theory. For $0 \leq u \leq 1$, let $\rho(u) \equiv 1$. For each integer $k \geq 1$, $\rho(u)$ is defined inductively for $k \leq u \leq k + 1$ by

$$\rho(u) = \rho(k) - \int_{k}^{u} \rho(v-1) \frac{dv}{v}.$$ Dickman’s function is continuous at $u = 1$ and differentiable for $u > 1$. Equivalently, $\rho(u)$ can be defined by the differential-difference equation

$$u \rho'(u) + \rho(u-1) = 0, \hspace{1cm} u > 1.$$ Let $P^+(n)$ denote the largest prime factor of the positive integer $n$, and set

$$\Psi(x, y) := \|n \leq x : P^+(n) \leq y\|.$$ \hspace{1cm} (6.1)

On page 337 in his lost notebook [31], Ramanujan offers several asymptotic formulas for $\Psi(x, x^\epsilon)$, although in a different language. We quote just one instance. “Let $\phi(x)$ denote the number of numbers of the form

$$2^53^55^5\cdots p^5, \hspace{1cm} p \leq x^\epsilon,$$

not exceeding $x$. Then, for $\frac{1}{2} \leq \epsilon \leq 1$,

$$\phi(x) \sim x \left( 1 - \int_{\epsilon}^{1} \frac{du}{u} \right)^{\epsilon}.$$ \hspace{1cm} (6.2)

His next formula is for $\frac{1}{2} \leq \epsilon \leq \frac{1}{3}$, and so on. In the notation (6.1), Ramanujan’s function $\phi(x) = \Psi(x, x^\epsilon)$. Ramanujan hence proved Dickman’s [16] famous asymptotic formula

$$\Psi(x, x^{1/\epsilon}) \sim x \rho(u), \hspace{1cm} x \to \infty,$$

while, in fact, giving a representation for $\rho(u)$ in terms of integrals, as in the first instance (6.2). According to the author’s colleague, A. J. Hildebrand, Ramanujan’s theorem is equivalent to a
folklore theorem, which we cannot find located
in the literature.

**Theorem 6.1.** Define, for \( u \geq 0 \),

\[
I_0(u) := 1, \quad I_k(u) := \int_{\sum_{i=t_1,\ldots,t_k \geq 1}} \frac{dt_1 \cdots dt_k}{t_1 \cdots t_k}, \quad k \geq 1.
\]

Then, for \( u \geq 0 \),

\[
\rho(u) = \sum_{k=0}^{\infty} \frac{(-1)^k}{k!} I_k(u). \quad (6.3)
\]

The series on the right-hand side of (6.3) is finite, since if \( k > u \), then \( I_k(u) = 0 \), for the conditions \( t_1, \ldots, t_k \geq 1 \) and \( t_1 + \cdots + t_k \leq u \) are vacuous in this case. If we make the changes of variable \( \epsilon = 1/u \) and \( u_j = \epsilon t_j \), \( 1 \leq j \leq k \), then we obtain Ramanujan’s theorem, the first instance of which is given in (6.2).

Excellent sources for information on the Dickman function and its prominence in prime number theory are G. Tenenbaum’s treatise [33, Chapter III.5] and P. Moree’s dissertation [27].

### 7. Ranks and Cranks

Let \( p(n) \) denote the number of unrestricted partitions of the positive integer \( n \). In 1944, F. Dyson [19] sought to find combinatorial explanations for Ramanujan’s famous congruences [29]

\[
p(5n + 4) \equiv 0 \pmod{5},
\]

\[
p(7n + 5) \equiv 0 \pmod{7},
\]

\[
p(11n + 6) \equiv 0 \pmod{11}.
\]

Accordingly, he defined the rank of a partition to be the largest part minus the number of parts. For example, the rank of \( 3 + 3 + 2 + 1 \) is \( 3 - 4 = -1 \). Dyson observed that the congruences for the rank modulo 5 and 7 divided the partitions of \( 5n + 4 \) and \( 7n + 5 \), respectively, into equinumerous classes. These conjectures were subsequently proved by A. O. L. Atkin and H. P. F. Swinnerton-Dyer [4]. However, for the third congruence, the corresponding criterion failed, and so Dyson conjectured the existence of a statistic, which he called the crank to combinatorially explain the congruence \( p(11n + 6) \equiv 0 \pmod{11} \). The crank of a partition was found by Andrews and Garvan [2] and is defined to be the largest part if the partition contains no one’s, and otherwise to be the number of parts larger than the number of one’s minus the number of one’s. The crank divides the partitions into equinumerous congruence classes modulo 5, 7, and 11 for the three congruences, respectively.

In fact, in his lost notebook [31], Ramanujan had recorded the generating functions for both the rank and the crank. First, if \( N(m, n) \) denotes the number of partitions of \( n \) with rank \( m \), then

\[
\sum_{n=0}^{\infty} \sum_{m=0}^{\infty} N(m, n)z^m q^n = \sum_{n=0}^{\infty} \frac{q^{\rho(n)} - q^{\rho(n)-1}}{(q; q)_{\infty}}. \quad (7.1)
\]

Second, if \( M(m, n) \) denotes the number of partitions of \( n \) with crank \( m \), except for a few small values of \( m \) and \( n \), then

\[
\sum_{n=0}^{\infty} \sum_{m=0}^{\infty} M(m, n)z^m q^n = \frac{(q; q)_{\infty}}{(z q; q)_{\infty}(z^{-1} q; q)_{\infty}}. \quad (7.2)
\]

In (7.1) and (7.2),

\[
(a; q)_{\infty} := (1 - a) (1 - aq) (1 - aq^2) \cdots, \quad |q| < 1.
\]

We do not know if Ramanujan knew the combinatorial implications of the rank and crank, but from the many results on these generating functions found in his lost notebook, it is clear that he had realised the importance of these two functions. Moreover, on page 184 in [31] he actually records an observation that is equivalent to Dyson’s assertion about the congruences for the ranks of the partitions of \( 5n + 4 \).

Except for discerning an alternative formulation of a later discovery of Dyson, in this section we have strayed slightly from the theme of our paper to emphasise Ramanujan’s anticipation of later, fundamental developments in the theory of partitions. It is also fitting to end our paper on this topic, because there is evidence that Ramanujan’s very last mathematical thoughts were on cranks before he died on April 26, 1920 [13].

We are grateful to Atul Dixit for helpful comments.

### References


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Born in St. Joseph, Michigan, Bruce Carl Berndt graduated from Albion College in 1961, where he studied mathematics and physics, and ran track. He received his doctoral degree from the University of Wisconsin–Madison in 1966. After lecturing for one year at the University of Glasgow, in 1967, he assumed a position at the University of Illinois at Urbana-Champaign, where he has remained since. Berndt is an analytic number theorist who for over 35 years has devoted almost all of his research efforts toward proving the claims left behind by Ramanujan in his earlier notebooks and lost notebook. In 1996, Berndt was awarded the Steele Prize for Exposition from the American Mathematical Society for his volumes on Ramanujan’s notebooks. With George Andrews, he is currently preparing volumes on Ramanujan’s lost notebook.
Abstract. The author explains the main theses and motivation of his book Are Science and Mathematics Socially Constructed? A Mathematician Encounters Postmodern Interpretations of Science, published by World Scientific in 2009. A student of Thomas Kuhn at Berkeley between 1958 and 1963 and later a mathematician, he critically studies an epistemological anti-realism which claims that science is a social construction, “defining” rather than directly mirroring nature; i.e., there is no existing natural order independent of the prior socially determined “paradigms” of scientists. This idea is often combined with the view that modern science is a function of the biases of white male scientists. Such “Postmodern Interpretations of Science (PIS)” are popular in the humanities, especially in areas dealing with ethnic and gender issues, and he feels that their origins can be traced to Kuhn’s The Structure of Scientific Revolutions (although Kuhn denied this). He also states that his book is more a historical and political analysis of PIS than a polemic and feels that PIS is primarily an effect of the disturbed political climate of the 1970s, due to Vietnam.

Motivation for Writing the Book

I have often been asked why a retired specialist in unbounded operator theory would decide to write a book on a topic so different from his usual work. The answer is autobiographical. From 1958 until 1963, I had been in fairly close contact as a Berkeley history student with Thomas Kuhn. My interests, however, changed from history to mathematics in 1967, and I have had a conventional career in this subject until my retirement. After leaving history, I paid little attention to the humanities. Mathematical research and teaching were sufficiently demanding such that I had no time for anything else. I considered myself a fairly well educated person, but the opinions of other disciplines concerning science were unknown to me. Naively presumed that all intelligent people thought that science produced the most reliable knowledge of which we are capable of comprehending and that many (though not all) of its applications are beneficial. All this changed because of three events which occurred between 1995–1996.

First, sometime in 1995 I read, almost by accident, the book by Paul Gross and Norman Levitt Higher Superstition: The Academic Left and its War on Science [6]. Gross and Levitt described a radically anti-scientific attitude which they found fashionable among faculty in subjects like English, cultural, ethnic, feminist, and post-colonial studies, as well as in the relatively new Departments of Science, Technology and Society (STS). This consisted of beliefs that science was a socially constructed, “situated”, historical product like any other area of human culture, whose theories were often generated by contextual factors such as class interest, ideology, or laboratory politics, rather than a rational examination of nature. In addition, instead of being a glorious and progressive achievement of the West since the 17th-century, it has often been an ugly enterprise which has degraded the environment, oppressed women, minorities, the Third World, and is presently an evil tool of corporate capitalism and the military industrial complex.

At around the same time I was reading Higher Superstition, I became aware of the Sokal Hoax. Alan Sokal, a physicist at New York University (NYU), had submitted a totally ridiculous paper to the journal Social Text, edited by luminaries such as Stanley Fish and Andrew Ross. Sokal used a great deal of fashionable jargon and bad mathematics to show that physical reality existed only as a (reactionary) political construct. Anyone with a slight undergraduate training in science could quickly tell that the paper was either a joke or written by a nut. Yet since the thesis and his many New Left clichés pleased the editors, they published it! When Sokal admitted that his submission was a hoax, the resulting furore made the national press.

Finally, in June 1996, while on a research trip to the UK, I was saddened to learn of Kuhn’s death but was impressed by the lengthy obituaries he received in the British press. The news of his passing and the fact that the movement described by Gross and Levitt claimed to trace its origins to his revolutionary book The Structure of Scientific Revolutions [9] rekindled a long dormant interest in his work. As was the case for most scientists, this had been completely invisible to me, since I was living in a hermetically sealed world of my own narrow research.
Had I not had a residual interest in the history of science, I would have ignored the situation; after all, whatever was happening did not concern me as a mathematician and might be exaggerated. In fact, as I was still busy teaching and writing papers in my field, I did just that until well after my retirement. I then did some further reading, since I had both leisure and some curiosity due to my background. I began with Sokal and Bricmont’s *Intellectual Impostures* [17], followed by Noretta Koertge’s *A House Built on Sand* [8] and then moved on to reading up on several of the people criticised by Gross and Levitt and the other books I had read.

What many of them had in common was a profound anti-realism. Science, it was argued, can give only a “representation” not a “true” (whatever this means) account of nature, and since nature cannot be interpreted independently of the conceptual structures scientists bring to the task, there is no “way the world is” independently of these structures. It follows that scientific theories are not “caused” by nature; instead, they constitute nature. The so-called “scientific facts” do not correspond to mind-independent properties of the universe, but are merely products of the more or less sophisticated biases of scientists. Sometimes these ideas were supported by Kuhnian-style arguments (discussed below), in other cases, by invoking Bishop Berkeley to conclude that there is not a “mind-independent” world at all. Often such reasoning was combined with sociology. For Bruno Latour, for example, scientific “fact” as it emerges in the laboratory is a result of an essentially political struggle between rival scientists. Some writers (following Kuhn) admitted that the forces shaping science, however sociological, result from factors internal to science, but for others, science amounted to no more than a concealed (usually reactionary) ideology reflecting the kind of political or ethnic biases mentioned above. In any event, a consequence was that the vaunted “objectivity” of science is an illusion. At best, science may have pragmatic or technological value; however, there is no epistemological reason for it to be preferred over “other ways of knowing”, such as religion and myth. Oddly, such views were popular among people on the Left. This was a radical change because the Left had usually celebrated scientific rationality as a weapon against the obscurantism of the Right since the Enlightenment.

It was a shock for me learn of the profound and negative change — representing a kind of counter-Enlightenment — in the vision of science on the part of many humanistic intellectuals, which had developed since my days as a graduate student in history decades earlier. I felt like Rip van Winkle awakening after a 30-year nap into a new and strange world. Evidently the intellectual climate had turned on its head since the late 1950s and early 1960s. Then, although there was dismay that science had brought forth abominations like nuclear weapons, educated people (whatever their political beliefs) mostly accepted scientific conclusions. We all recognised that scientific theories, almost universally held to be correct, could be false; but we thought that scientific investigation was a self-correcting process. Unless there is a collapse of civilisation, science would automatically yield an ever more precise understanding of nature. Progress is real. We know more in 2011 than we did in 1911 or 1311. This increase in knowledge and understanding, moreover, is a testimony to the power of Western civilisation and (as a whole) has benefited the human race. Physicians as late as the mid-19th-century, for example, probably killed more patients than they helped. Now they can actually cure or prevent diseases. Even in the frustrating and refractory case of cancer, there is sometimes a cure, or if this is not possible, life can be prolonged. Similar progress due to science can be found in many other fields.

The more I poured over this literature, the more I realised that critics like Gross and Levitt or Sokal were right: The curious ideas they describe are deeply embedded in academia. Many are no longer even controversial. In mild or strong form they constitute an omnipresent intellectual miasma. Paradoxically this has occurred at a time when scientific progress has been more rapid than in any previous period of human history. I was so amazed by the phenomenon that in 2004 I decided to write a book about it.

**An Effort at Intellectual History, Political Analysis, and Unmasking**

Since the ideas I was looking at lead either to solipsism or are self-refuting (like all forms of relativism) and had been adequately criticised by Gross and Levitt and others, they did not need to be taken seriously except as a cultural symptom. So I tried not to write a clone of *Higher Superstition*. While polemic was tempting and I could not entirely resist it, I realised that the main focus of the book should be an explanation of how the present condition arose. Since the partisans of the movement I was writing about often referred to their work as the “Sociology of Scientific Knowledge” (SSK) and to their ideas as “postmodern”, I used the term “Postmodern Interpretations of Science” and the abbreviation SSK/PIS. The issue then was to explain the rise of SSK/PIS. What were its intellectual origins and
causes? Was it the product of some social or political transformation peculiar to the United States or Europe in the 1960s? Is SSK/PIS an early warning of possible political consequences in the same sense that the writings of the philosophes of 18th-century France were?

To properly deal with such questions we would have ideally required something akin to E J Dijsterhuis’ magisterial Mechanization of the World Picture: Pythagoras to Newton (1961), but devoted to SSK/PIS. This is beyond our power; perhaps also the ignobility of the subject makes it unworthy of such effort. Instead, we have concentrated on offering a series of “snapshots” of people whose doctrines illustrate the main stages in the progression to the full-blown condition, roughly in the period 1925 to 1975. To this end, we looked at the thought of Karl Popper, Karl Mannheim, Ludwig Fleck, David Bloor (the creator of the so-called Edinburgh Strong Programme), Harry Collins, Bruno Latour, Steve Woolgar, Paul Feyerabend, Steve Shapin (the historian of science), and various feminists such as Sandra Harding, Evelyn Fox Kelleer, and Helen Longino, as well as PIS-like doctrines in mathematics. We also described philosophical contributions to PIS, ranging from the Greek sophists to 20th-century post-structuralists. But PIS is not only an event in 20th-century intellectual history, it is also deeply political. Hence, an equally important goal was to understand the historical environment that allowed it to flourish. Ironically, our method here parallels what SSK uses to deconstruct science. In the language of Karl Mannheim, we wish to “unmask” PIS and reveal the hidden “extra-theoretic” functions it serves. Specifically, we argue that the disturbed political atmosphere of the Vietnam war era was a critical catalyst in the rise of PIS. This is hardly a novel thesis, but the documentation for it is ample and still worth presenting.

The Role and Contributions of Thomas Kuhn

Writing the book also led me to reconsider the role of Kuhn. For better or worse, Structure has been the most influential book in the history of science written in the 20th-century. It has been translated into over 20 languages and has sold more than a million copies. People in all fields read it. It is popular in Schools of Education, and the wife of a colleague studying social work even had to read it! By both friends and enemies of SSK/PIS it has been considered as the ur-text for the movement. Late in his career, Kuhn was appalled by this. He did not foresee the consequences of Structure and had an intense dislike for most of the ideas said to be derived from his work, claiming that he had been misinterpreted.

Yet a careful study of the book will find many things in it that were like manna from heaven to later extremists. This is particularly the case with his notion of “paradigm” and paradigm change. Kuhn was vague on the definition, but a paradigm amounts to a set of common standards, conventions, and values that dictate how a particular scientific discipline is to be done, what problems are to be solved, what fundamental theories are to be employed, what counts as a valid solution, as well as the meaning of or even what the scientist sees. Thus a paradigm is a necessary precondition to all scientific investigation. Most ordinary science, according to Kuhn, is “normal”, i.e., a kind of “puzzle solving”, or attempt to force nature into a scientific version of a Procrustean bed by explaining mismatches or “anomalies” between observation and the apparent implications of the paradigm. “Scientific Revolutions”, Kuhn believed, can only happen when this activity becomes impossible. Anomalies multiply and become intractable. The best efforts to fit them into the paradigm fail. In consequence, a sense of “scientific crisis” emerges. Only then can a new paradigm be introduced. There follows a struggle between the old and new paradigms.

Up to this point, Kuhn has given a defensible account of the way science actually works, but now he seems to endorse an extreme relativism: Paradigms, he believes, are “incommensurable”, i.e., there is no “rational” means to decide between them or even for their respective followers to understand each other. The competing paradigms hold to different standards of evidence and interpretation. Observations are “theory laden”, and their meaning is relative to the paradigm. Consequently, scientists on either side talk past each other just as ideological opponents do, and the transformation from one paradigm to another becomes a “sociological” rather than a rational process. It is actually akin to a political revolution (except that the losers are allowed to live but not to gain tenure).

This theory has disturbing epistemological consequences: Kuhn admits that “scientific progress” exists in the sense that paradigms can solve ever more elaborate puzzles; but no paradigm is “truer” in the sense of correspondence with reality than any other; in fact, Kuhn doubts that “correspondence with reality” makes any sense; his is a coherence theory of truth. What scientists call reality is the interaction of a noumenal, unknowable world with the paradigm that gives it structure and meaning. In this sense when the paradigm changes so does the world. (Modern scientists actually live in a different world, for example, than medieval scholastics.) This view of scientific change and the resulting
anti-realism are, as we saw, core ingredients of PIS. But Kuhn also differs from his more radical followers. Being a Harvard PhD in Physics whose adviser won a Nobel prize, he respected science. Also, he believed that factors, however sociological, causing scientific change were internal to the community of scientists. He admitted that the ambient culture can provide metaphors such as Pythagorean sun worship did for Copernicus, but he rejected the appeal to gender, race, and class bias by sociologists to explain science.

Does PIS or SSK really matter? The effort to write the book has been immense. It involved catching up with more than 40 years of (mostly bad!) books and articles in a year or two. A critic might wonder if it was worth the effort. Perhaps I was making a mountain out of a molehill. After all, PIS/SSK are nearly invisible to practicing scientists, who are doing reasonably well (though not so well as in the immediate post-Sputnik era). Who cares if bad ideas are found in non-scientific academic departments? Many strange things are taught at universities, and as long as faculties, like Voltaire's Candide, just cultivate their own minuscule gardens, however infested they are with weeds and poison oak, no real harm is done. From a cynical point of view there may even be some benefits: The more American kids study this stuff instead of real science, the more good jobs there will be for talented immigrants. However, although fundamental changes in the central beliefs of a culture may initially be harmless, they can eventually have radical consequences. Think of Rousseau or Voltaire and the French Revolution. Also, even in the short term, there is evidence that PIS-type attitudes are infiltrating the US science bureaucracy, particularly funding agencies such as NSF. Graduates of STS departments find a home there as academic jobs dry up. One can detect in NSF proposal guidelines, for example, increasing sympathy for all types of PIS shibboleths. Noretta Koertge has written on this issue. The ultimate effect on scientific research, at least in universities, could be devastating.

References


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Symplectic Group Actions Versus Hamiltonian Group Actions

Jin Hong Kim

Abstract. This article gives a concise survey on some recent progress of symplectic and Hamiltonian group actions on a symplectic manifold. It focuses on the work by Yeal Karshon, Hui Li, Suan Tolman, and the author.

The aim of this article is to give a short but also precise and concrete survey on some recent progress of certain research fields that are entirely based on my research interest. Hence I should mention in the beginning that some important papers and/or related fields could possibly be overlooked.

Frankly speaking, about 10 years ago, I worked on a certain classification problem of finite group actions on a spin 4-dimensional manifold for my PhD thesis, under the guidance of Professor Shoshichi Kobayashi. After that, I have been interested in various problems related to group actions on smooth manifolds, in particular, the torus actions on positively curved manifolds and positive quaternionic Kahler manifolds. Quite recently, I have had great interest in symplectic and Hamiltonian group actions on a symplectic manifold, and through this survey article, I want to introduce some recent remarkable progress that has been made mainly by Yeal Karshon, Hui Li, Suan Tolman, and many others.

This article is organised roughly as follows. I will first explain what symplectic and Hamiltonian group actions are and how closely they are related, and I also describe some recent achievements and current interesting problems are in this fascinating field. Unless stated otherwise, in this article, all Lie groups are the circle group and all smooth manifolds are smooth compact manifolds without boundary, i.e., closed smooth manifolds, for the sake of simplicity.

1. What Are Symplectic and Hamiltonian Group Actions?

Let us denote a smooth manifold by $M$. A differential 2-form $\omega$ on $M$ is said to be nondegenerate only if tangent vector $X$ satisfying the equation $\omega(X, Y) = 0$ for all tangent vectors $Y$ on $M$ is zero. In other words, if $\omega$ denote the map from the tangent space to the cotangent space of the manifold $M$, then the nondegeneracy of a differential 2-form $\omega$ defined above is equivalent to saying that the kernel of $\omega$ is equal to the zero space.

It is also easy to see that the nondegeneracy of a nontrivial differential 2-form implies that the real dimension of the manifold $M$ should always be even. So we may also define the nondegeneracy of $\omega$ by saying that $\omega^{\dim M/2}$ is nonzero. Finally, a symplectic manifold is defined to be an even dimensional manifold equipped with a closed and nondegenerate 2-form $\omega$.

As typical examples, every Riemann surface is a symplectic manifold of dimension 2 whose symplectic form can be provided by an area form and every Kahler manifold is also a symplectic manifold with a Kahler form as a symplectic 2-form. However, it can be easily followed from the Stokes’ theorem that the $2n$-dimensional sphere cannot be a symplectic manifold. It is worth mentioning that in his famous paper [8], Robert Gompf constructed all kinds of symplectic manifolds with a given finitely presented fundamental group that may not be Kahler.

Now let us assume that the Lie group $G$ acts on a symplectic manifold $M$ equipped with a symplectic 2-form or symplectic structure $\omega$. The action of the circle group is said to be symplectic if it preserves the symplectic 2-form $\omega$, i.e., $g^*(\omega) = \omega$ for any element $g \in G$. Let $X^g$ be the fundamental vector field on $M$ induced from an element $X$ in the Lie algebra of the Lie group $G$. It is easy to see from the Cartan’s magic formula $L_X = d i_X + i_X d$, that the group action is symplectic, which implies that the 1-form $i_X \omega$ is closed.

Furthermore, the action is said to be Hamiltonian if the 1-form $i_X \omega$ is exact. That is, if there is a function $\Phi: M \rightarrow \mathbb{R}$, called the moment map or sometimes momentum map, such that $i_X \omega = d\Phi$. In particular, if the first Betti number of the symplectic manifold is zero, every symplectic group action is always Hamiltonian.

Figure 1 shows a typical Hamiltonian action of the circle group on the 2-dimensional sphere that is obtained by rotating the north and south poles, and its moment map given by the height function. Those three dotted circles on the sphere are circle

![Fig. 1. A Hamiltonian circle action and its moment map on $S^2$ with three circle orbits (see [17]).](image-url)
orbits and their corresponding images on the real line by the moment map are indicated by three big black dots. From the figure, it is important to observe that the north and south poles are not only fixed points of the circle action but also critical points of the moment map. It is interesting to note that the Euler–Poincare characteristic of the 2-dimensional sphere is two, which is equal to the number of the isolated fixed points. This is not simply coincidental but is a consequence of a more general fact that the Euler–Poincare characteristic of the manifold acted on by the circle group is equal to that of the fixed-point set. In fact, all fixed-point sets of a smooth group action on a smooth manifold $M$ are always smooth submanifolds of $M$ with even codimensions.

2. Symplectic and Hamiltonian Group Actions and Fixed-point Set

As we have seen earlier, a lot of information about a Hamiltonian circle action can be inferred from the fixed-point sets, and, indeed, this principle continues to be true for more general group actions on a smooth manifold. This is especially the case for a symplectic group action, every connected component of the fixed-point set is again a symplectic submanifold. Yet it is not always true that every symplectic circle action has a nonempty fixed-point set. For instance, the obvious circle action on the 2-dimensional torus $T^2 = S^1 \times S^1$ does not have any fixed points.

In their papers [1, 9, 11], Atiyah, Guillemin and Sternberg, and Kirwan made use of this fact to deduce many remarkable results about Hamiltonian group actions on a symplectic manifold. In particular, we need to recall the fact that Delzant completely classified all symplectic toric manifolds with an $n$-dimensional torus action in terms of simple smooth rational polytopes, called the Delzant polytopes [6]. Here a crucial fact we have to know is that the convex hull of the fixed points of a symplectic toric manifold always forms a simple, smooth, rational polytope.

Furthermore, Audin, Ahara and Hattori, and Karshon have independently completed satisfactory classifications of a symplectic manifold of dimension 4 with a Hamiltonian circle action [4, 3, 12]. To be more precise, according to their classifications, there are the so-called minimal symplectic manifolds such as symplectic manifolds with exactly two fixed 2-dimensional Riemann surfaces, the complex projective space and Hirzebruch surfaces. Also, every other symplectic manifold of dimension 4 with a Hamiltonian circle action can be obtained from one of the minimal symplectic manifolds by the process of repeated symplectic blow-ups.

It is interesting to notice, among other things, that every symplectic manifold of dimension 4 with a Hamiltonian circle action whose fixed points are all isolated is always a complex Kahler manifold. However, it can be shown easily that this cannot be true anymore for higher dimensional symplectic manifolds with a Hamiltonian circle action. To do so, one can use a well-known 6-dimensional example of Tolman that appeared in her paper [21]. Nonetheless, it seems to be true that there exists a higher dimensional complex Kahler manifold whose information of the fixed points exactly coincides with a given symplectic, but not necessarily Kahler, manifold with a Hamiltonian circle action, provided that the fixed points are all isolated.

It is obvious that every moment map $\Phi$ on a compact symplectic manifold has at least two critical points, one maximum and one minimum point. It follows the identity $i_x \omega = d\Phi$ that every critical point of the moment map $\Phi$ is also a fixed point of the group action. So every Hamiltonian circle action on a compact symplectic manifold must have at least two fixed points. In her famous paper [16], McDuff has shown that the converse is also true for every 4-dimensional symplectic manifold with a Hamiltonian circle action. That is, she showed that every 4-dimensional compact symplectic manifold with a symplectic circle action whose fixed points are all isolated is always Hamiltonian.

In the same paper, she also constructed a 6-dimensional counterexample to this fact whose fixed-point set consists of a 2-dimensional tori. However, it is still widely debatable whether or not the converse is true for the case that the fixed-point set is isolated, but not 2-dimensional. For a while, I also have been working on this problem without success, but it is highly likely that even in this case there exists some 6 or higher dimensional compact symplectic manifold with a Hamiltonian circle action whose fixed points are all isolated [13]. At this point, I should mention that in the case of the compact Kahler category Frankel showed a long time ago that the converse holds to be true for any dimension [7]. One of the crucial differences between symplectic and Kahler categories is that Hodge theory works only for a compact Kahler manifold. There is also a partial and affirmative result for semi-free symplectic circle actions by Tolman and Weistman [23]. In order to obtain their result, they made an important use of the ABBV localisation formula by Atiyah, Bott, Berline and Vergne [2]. This formula can be obtained by using the representations at the fixed points and their weights, and it proves to be fairly useful in many situations.

In addition to the results mentioned above, there are a lot of results which clearly show similarities and differences between a symplectic circle action and a Hamiltonian circle action. Among other things, it will
be instructive to notice that every Hamiltonian circle action should always have at least \((\dim M + 2)/2\) fixed points. This can be shown from the fact that a moment map is a perfect Morse–Bott function and so, if all fixed points are isolated, then the number of the isolated fixed points is greater than or equal to the sum of all even Betti numbers. More precisely, since the manifold \(M\) is symplectic, all cohomology classes \([1], [\alpha], \ldots, [\alpha^n]\) are nontrivial. Thus all even Betti numbers are at least one. This implies immediately that the sum of all even Betti numbers is always greater than or equal to the minimal even Betti number condition or minimal dimension condition. However, it seems that there exists a symplectic circle action which admits a much smaller number of isolated fixed points than \((\dim M + 2)/2\). In particular, I expect that a symplectic circle action whose fixed-point set consists of two isolated points with weights \(\{a, b, -a - b\}\) and \(\{-a, -b, a + b\}\) [13] exists.

3. Hamiltonian Group Actions and Minimality Conditions

As briefly mentioned above, Karshon has given a satisfactory classification of Hamiltonian circle actions on a 4-dimensional compact symplectic manifold. However, it is still a widely open problem to classify Hamiltonian circle actions on a higher dimensional symplectic manifold, even though there are several notable attempts towards the classification. These have been done mainly by Li, McDuff, Tolman, and possibly many others. In particular, results of the papers [22] and [15] can be regarded as a first step towards the classification of higher dimensional closed symplectic manifolds admitting a Hamiltonian circle action, and they give some constraints to the existence of certain Hamiltonian circle actions.

We also remark that their results are essentially related to the fundamental questions about the existence of a Lie group action on a given manifold posed by T. Petrie. To be precise, in the paper [20], Petrie asked the following question which motivated their papers:

“Given a compact Lie group \(G\) and a manifold \(M\), can \(G\) act effectively on \(M\)? If so, how and how many different actions of \(G\) can \(M\) admit?”

In general, this is a very difficult question, although there have been a lot of research works around the problem.

Let \(M^{S^1}\) denote the fixed-point set of the circle action. If the action is Hamiltonian, one can show that the following inequality \(\sum_{F \in M^{S^1}} (\dim F + 2) \geq (\dim M + 2)\) always holds. So, in order to reduce the difficulty such as in Petrie’s problem, we may restrict the manifold to a symplectic manifold admitting a Hamiltonian circle action under certain minimality conditions. To be a bit more precise, a Hamiltonian circle action is said to satisfy the minimal dimension condition if \(\sum_{F \in M^{S^1}} (\dim F + 2) = (\dim M + 2)\) holds, and \(M\) is said to satisfy the minimal even Betti number condition if all even Betti numbers \(b_{2i}(M) = 1\) for all \(0 \leq i \leq \dim M/2\). Since the moment map \(\Phi\) is a perfect Morse–Bott function, it can be easily shown that if \(M\) satisfies the minimal even Betti number condition, then the Hamiltonian circle action satisfies the minimal dimension condition. However, the converse is not true in general. Note that if \(M\) is 6-dimensional, the minimal even Betti number condition is equivalent to the minimal dimension condition.

Now assume that the symplectic manifold satisfies the minimal even Betti number condition or minimal dimension condition. Then all even Betti numbers \(b_{2i+1}(M)\) are equal to zero or if the \(i\)-th Chern classes \(c_i(M)\) are all trivial, the cohomology ring of \(H^*(M; \mathbb{Z})\) is completely determined by the total Chern class of \(M\) and the Grassmannian of oriented two-planes in \(R^{n+2}\). It is also interesting to note from a recent paper [18] of Li–Olbermann–Stanley that the fundamental groups of \(X, Y\), and \(M\) are all trivial, that is, they are all simply connected. One of my graduate students and I have also considered Hamiltonian circle actions with the minimality conditions whose fixed-point set consists of three connected components, and have given a partial affirmative answer to the above questions [5].

Moreover, I also dealt with the case that the fixed point has the smallest possible number of components and these components have the smallest possible dimension. Using these smallest possible conditions, they proved in [15] that the total Chern class \(c(M)\) of \(M\) is identical to that of one of the complex projective space \(CP^{n+1}\) and the Grassmannian of oriented two-planes in \(R^{n+2}\). It is also interesting to note from a recent paper [18] of Li–Olbermann–Stanley that the fundamental groups of \(X, Y\), and \(M\) are all trivial, that is, they are all simply connected. One of my graduate students and I have also considered Hamiltonian circle actions with the minimality conditions whose fixed-point set consists of three connected components, and have given a partial affirmative answer to the above questions [5].
almost minimality condition. For example, consider a Hamiltonian circle action on $S^2 \times S^2$ which acts on the first factor by the standard rotation and acts trivially on the second factor. Then the fixed-point set of the circle action consist of only two components $\{n\} \times S^2$ and $\{s\} \times S^2$, where $n$ and $s$ denote the north and south poles of the first factor $S^2$, respectively. Moreover, the sum of the dimensions of the fixed-point sets is equal to 4, that is the dimension of $S^2 \times S^2$. I think that some general formulas for the $S^1$-equivariant Euler class of the negative normal bundle of a fixed-point component will play an important role in obtaining some existence and non-existence results of a Hamiltonian circle action under the (almost) minimality conditions.

Even though what I have done so far is to briefly summarise some recent progress on symplectic and Hamiltonian circle actions, I strongly feel that there are many more problems related to this topic and that much more work should be done in the future. Recently, more Korean mathematicians have started to study this fascinating area called symplectic topology or symplectology, which mainly deals with the Lagrangian Floer theory, contact homology and symplectic invariants. I want to end my article with this: I hope that, through more educational and financial support, a lot of talented Korean mathematicians will become leaders of this field in the future.

References


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Excerpts from Kolmogorov’s Diary
Translated by Fedor Duzhin

Introduction
At the age of 40, Andrey Nikolaevich Kolmogorov (1903–1987) began a diary. He wrote on the title page: “Dedicated to myself when I turn 80 with the wish of retaining enough sense by then, at least to be able to understand the notes of this 40-year-old self and to judge them sympathetically but strictly”.

The notes from 1943–1945 were published in Russian in 2003 on the 100th anniversary of the birth of Kolmogorov as part of the opus Kolmogorov—a three-volume collection of articles about him.

The following are translations of a few selected records from the Kolmogorov’s diary (Volume 3, pages 27, 28, 36, 95).

Sunday, 1 August 1943. New Moon
6:30 am. It is a little misty and yet a sunny morning. Pusya¹ and Oleg² have gone swimming while I stay home being not very well (though my condition is improving).

Anya³ has to work today, so she will not come. I’m feeling annoyed and ill at ease because of that (for the second time our Sunday “readings” will be conducted without Anya).

Why begin this notebook now?
There are two reasonable explanations:
1) I have long been attracted to the idea of a diary as a disciplining force. To write down what has been done and what changes are needed in one’s life and to control their implementation is by no means a new idea, but it’s equally relevant whether one is 16 or 40 years old.
2) Now that I’m 40, I feel more deeply as life flows and goes by since past experience has an independent significance as compared to what one expects at 16 or even 30, when everything is viewed as a preparation for a distant future. Hence the need to capture the present at the very moment it transits from the non-existence of something that has yet to happen to the non-existence of something that has already passed by.

Possibly, the third reason put forward is contentious.
3) The period of “psychological research”⁴ that began in February has been decided to be brought to an end. That caused a certain slackness in me and Pusya in July. So, this diary is being pursued to restore the discipline and at the same time to allow the passion for psychological research to be released in a more organised manner. Hopefully, there will not be too much of this research.

Eventually, this notebook might see some memories, thoughts, psychological analyses besides short current notes, but it will only happen after I have put my life in order.

Tasks to do now:
1) Finish small jobs as soon as possible (shooting,⁵ quality control,⁶ Lobachevsky⁷).

¹ Pusya – nickname of Pavel Sergeyevich Alexandrov.
² Oleg – Oleg Sergeyevich Ivashev-Musatov, Kolmogorov’s son-in-law.
³ Anya – Anna Dmitriyevna Kolmogorova, Kolmogorov’s wife and Oleg’s mother.
⁴ Kolmogorov’s work Pyotr Iljich Tchaikovsky written for the 50th anniversary of the composer’s death and devoted to Pavel Alexandrov was never published.
⁶ One of Kolmogorov’s research interests in mathematical statistics (later he published a paper about it).
⁷ It’s not clear what he means exactly. Kolmogorov wrote a few articles on Lobachevsky at that time.
2) Family matters (bring Vera and Varya, send Varya to Nadya, bring Anya from work and so on).

3) Maintain constant and steady work on big projects (analysis course, turbulence, spectra).

Only later — let mathematics join the variety of purely personal and general interests and hobbies that have flourished in the last two years.

Most important now:

1) Discipline in doing boring work.

2) Confident and consistent clearing [of tasks] to find possibilities for working calmly on big projects.

3) Fighting “temptations” (sweets, reading at the wrong time), including updating this notebook immoderately. (Agreement with Pusya to limit chatting!)

And where is love (Christian and non-Christian) I think a lot about and maybe talk too much about (for instance, to Oleg)? It seems that it is for the sake of love that I have to concentrate on disciplinary rules listed above!

Enough with reasoning! However, it’s not prohibited to supplement records of labour deeds with short notes on moods and pleasures of life.

Saturday, 7 August 1943

It is a little misty, milk-sunny, warm day.

During the morning and after lunch I edited the first 15 pages of Gubler’s work (had to completely rewrite 7 pages). Satisfied with my work.

Pusya is listlessly writing on Lobachevsky, editing Yura’s poetry, being upset about the Kazan troubles.

Marina was taken ill and Shurka drove her to a hospital in a horse cab accompanied by Spitsyn.

A letter came from Sergey Musatov telling us that he could come to Komarovsky no sooner than in a month. He also mentioned that he wanted to write more to me about ‘certain questions’.

Sunday, 21 November 1943

Finally, on the way home from Dimetrusya I resolved my some rather naive puzzle on what distinguishes characters from positive-definite functions (and why characters are generally positive-definite — yesterday I discovered that I had not understood that before!).

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8 Vera, Varya, Nadya – Kolmogorov’s aunts (his mother’s sisters). He wanted to bring Vera and Nadya from Kazan where they had been evacuated to.


10 It might be one of the following: the book Nikolai Ivanovich Lobachevsky, 1793–1943 by Alexandrov and Kolmogorov, a paper by Alexandrov on Lobachevsky geometry, or Alexandrov’s notes for his public lecture about Lobachevsky that was held on the 6th of October 1943.

11 Yura – Yuri Mikhailovich Smirnov.

12 Spitsyn – a neighbour.

13 Sergey Musatov – Anna Kolmogorova’s first husband and Oleg’s father.

14 Dimetrusya – nickname of D. D. Romashov, a schoolmate of Andrey Kolmogorov, Anna Kolmogorova, and Sergey Musatov.
Let $G = \{g\}$ be represented by operators $U_g$ (unitary) in $E'$. Each $x \in E'$ corresponds to a positive-definite function

$$\phi(g) = (U_gx, x).$$

If $\lambda_1, \lambda_2, \ldots, \lambda_r$ are eigenvalues of $U_g$ and

$$x = (x_1, x_2, \ldots, x_r)$$

in the corresponding coordinates, then

$$\phi(g) = \sum \lambda_r x_r \bar{x}_r.$$ 

Taking the average value of $\phi(g)$ over the sphere $S' : ||x|| = 1$, we get

$$M_{S'} \phi(g) = \frac{1}{r} \chi(g) = \frac{1}{r} \sum \lambda_r.$$ 

What remains now is to find out what representation is induced by $\chi(g)$: for instance, is it always a representation in $E_r^2$?

My definition of a character seems to work for all locally bicompact groups. However, Gelfand mentioned that, generally speaking, there was no analogue of characters as positive-definite functions.

Maybe that means $\chi(g) = M \phi(g)$ are discontinuous.

In all cases, the following is true (although the proof is not as straightforward as one would hope):

If a representation in $E_r^2$ can be decomposed into $k$ equal irreducible representations in $E'$, then there is a vector generating all of $E_r^2$ if and only if $k \leq r$.

Acknowledgement

Acknowledgement to Professor A. N. Shiryaev for permission to publish a translation of the excerpts of Kolmogorov’s diary.

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Fedor Duzhin obtained his MS from Moscow State University and PhD from KTH (Kungliga Tekniska Högskolan, or the Royal Institute of Technology) in Stockholm. His research interests are in algebraic topology. He has been a lecturer at Nanyang Technological University (NTU) since 2006. Besides teaching calculus and topology, he is also involved in outreach activities, and trains NTU teams for international mathematics competitions for university students.

15 Nowadays “bicompact” is just called “compact”. 
The news that Ngô Bảo Châu, a 38-year-old Vietnamese mathematician, was awarded the Fields Medal, an International Medal for outstanding discoveries in Mathematics, at the 26th International Congress of Mathematicians (held on August 19, 2010 in Hyderabad, India) was quite unexpected to many who were unfamiliar with the mathematics scene in Vietnam. In fact, Châu’s proof of the Fundamental Lemma in the theory of automorphic forms through the introduction of new algebro-geometric methods had also been listed as one of the top ten scientific discoveries of 2009 by Time magazine.

People now look at mathematics in Vietnam in a different light because of Ngô Bảo Châu’s outstanding achievement. In addition, Châu’s experience and development in the field of mathematics piqued the curiosity and attracted attention of people from all over the world.

When interviewed by Science Times, Ngô Bảo Châu said, “I have only proved the Fundamental Lemma, but not everything in the program. I think it may take my entire lifetime to prove everything in the program.”

Ngô Bảo Châu was born into a Vietnamese family of scholars in 1972. At the age of 15, he was admitted into a class in the Vietnam National University High School specialising in mathematics. Châu received gold medals at both the 29th and 30th International Mathematical Olympiad (IMO) in 1988 and 1989 respectively. He finished his undergraduate study in France and began to research on the Langlands Program as a postgraduate. He then proved the Fundamental Lemma of the Langlands Program in 2008.

The Langlands Program was proposed by Robert Langlands, a Canadian-American mathematician. He developed an ambitious and revolutionary theory that connected two branches of mathematics called number theory and group theory in 1979. In a dazzling set of conjectures and insights, the theory captured deep symmetries associated with equations that involve whole numbers, laying out what is now known as the Langlands Program. Langlands knew that the task of proving the assumptions that underlie his theory would be the work of generations. However, he was convinced that one stepping stone that needed confirmation — dubbed the “fundamental lemma” — would be reasonably straightforward. He, his collaborators and his students were able to prove special cases of the fundamental theorem. Yet proving the general case proved more difficult than Langlands had anticipated — so difficult, in fact, that it took 30 years to finally achieve. Ngô Bảo Châu finally proved the lemma through his novel method in 2008.

Ngô Bảo Châu’s proof of the Fundamental Lemma had been listed as one of the top ten Scientific Discoveries of 2009 by Time magazine. Châu became a full
Recently, Châu made an academic visit to Beijing at the invitation of Professor Shing-Tung Yau, Director of the Mathematical Science Centre of Tsinghua University and Professor of Harvard University. During this period, Châu accepted the interview by Science Times to talk about how he embarked on his academic journey into mathematics.

Showing Mathematical Talent in Vietnam

“I began to really love mathematics after participating in Mathematical Olympiad. After graduating from high school, I decided to pursue mathematics for a career.”

Ngô Bào Châu was born in June 1972 in Hanoi, Vietnam. His father, Professor Ngô Huy Căn, was a professor of physics at the Vietnam National Institute of Mechanics. His mother, Trần Lưu Văn Hiền, was an associate professor at National Traditional Medicine Hospital in Hanoi. Châu was the only child in the family.

As his father obtained his PhD in applied mathematics in the Soviet Union and worked there for a long time, Châu spent his childhood with his mother’s family. By the time his father returned to Vietnam, Châu had already started attending primary school.

Ngô Bào Châu’s father had a great influence on him. “I studied in an experimental primary school (Giang Vo experimental primary), which used special teaching methods such as encouragement of independent reading and freedom of expression. However, my father didn’t like it and he sent me to a school for gifted students with mathematical talents. From then on, because of my parents, I did a lot of mathematical exercises and began to love mathematics.”

Ngô Bào Châu studied in the special class in Trung Vuong lower secondary school where students were specially selected through admission tests. After graduating from junior high school in 1987, Châu was admitted into a class in the Gifted High School of Hanoi National University of Natural Sciences which was specialised in mathematics and aimed at gifted students. Châu participated in the 29th and 30th IMO during his two years in the High School.

According to Châu, “The school for the gifted had a good system of organising mathematical competitions. All the participants had been selected through municipal, provincial and national examinations. We passed many tests, just like sports competitions. Youths like sports but I didn’t like mathematical competitions as there were too many competitions, each with a long preparation process, and the competitions themselves were nerve wrecking. In 1988, I won the 29th IMO gold medal with full marks but after that, I was no longer interested in competitions. I participated in the 30th IMO at the request of school. I also won a gold medal but I didn’t really enjoy it that time.”

In Vietnam, it is a special honour to win the gold medal of International Mathematical Olympiad. Ngô Bảo Châu was received by a general. “He congratulated me. I was very happy because it was a kind of recognition. However, I couldn’t remember whether there had been prizes.” In addition, the medallists of IMO could receive scholarships to study in universities in the Soviet Union or Eastern European countries.

Châu was offered a scholarship by the Hungarian government. After graduating from high school in 1989, he prepared to study in Hungary because of his love for combinatorial mathematics.

“I had learned Hungarian for one year. However, in the aftermath of the fall of communism in Eastern Europe, the new Hungarian government stopped providing scholarships to students from Vietnam. I lost the chance due to this unexpected event.”
Beginning to Research on Mathematics in France

“It was by pure coincidence that I decided to research on the Langlands Program. I wanted to do something and it was a good decision at that great time.”

It was at that time that a professor from France visited the Institute of Mechanics where Châu’s father worked. After knowing that Ngô Bảo Châu had won IMO gold medals, the professor tried to help him secure a scholarship from the French government.

“Thanks to this scholarship as it enabled me to go to Paris.”

Having studied in France before, Châu’s grandfather began to teach him French. “The French education system is different from other countries”. After spending two years in high school, I went to École Normale Supérieure for undergraduate study. Michel Broue, my instructor, suggested that I follow Prof. Gérard Laumon, from Université Paris Sud 11. So I started undertaking doctoral research in university.”

Studying in France at the high school level had a considerable impact on Châu. “High schools in France have two-year college preparatory study, which is quite different from Vietnam, where high schools focus on examination preparation.”

The doctoral training program in France is very different from the United States. During the time when Châu started his doctoral research, the Langlands Program was a well-known project among the French mathematicians. Mathematician Roger Godement, known as the father of automorphic forms in France, introduced the Langlands Program and automorphic forms to France. These had great influence on French mathematicians, including Professor Laumon.

“Almost all the mathematicians were studying automorphic forms. Many people joined this field. Most of them were associated to Godement. They were very strong in this area and as a result this field became very active… Almost every mathematics student was trying to solve this problem. Upon Professor Laumon’s suggestion, I began to research on the Langlands Program in 1993.”

In 1997, Ngô Bảo Châu obtained his PhD at the age of 25 from Université Paris Sud 11. “I solved a problem very similar to the Fundamental Lemma and I began to understand that the key was the geometric model of the trace formula.”

Ngô Bảo Châu became a member of the National Centre for Scientific Research (CNRS) at Université Paris Nord in 1998. It was his first job. At that time, his goal was to prove the Fundamental Lemma of the Langlands Program.

Châu said, “The training system in France is very different from that in America. In the United States, you must work as a postdoctor for two to three years after getting the doctorate degree. There is great pressure to publish papers before applying for a job and even after getting a job, the pressure stays. In France however, I didn't have this pressure. I didn't need to produce papers. All I needed to do was to do research in mathematics.”

During the first seven years after getting his PhD, Châu worked as a researcher, not a professor. “I worked with Professor Laumon at first. When I went back to the problem of the Fundamental Lemma, I tried different methods and got new ideas.”

Ngô Bảo Châu was very happy in France because he could concentrate on mathematics. “CNRS is similar to the Chinese Academy of Sciences (CAS). Researchers are affiliated to CNRS. That is to say, CNRS pay them salaries; although the researchers work with professors in related universities but they don't have to teach. I don't know whether this arrangement is good or bad, but the time after I got my doctorate degree was really a golden era for me. It is a lifelong position when one becomes a researcher of CNRS. I don't have the pressure to apply for funds, to publish papers, to worry about tenure or to teach. All I need to do is to stay there and spend more time on research in mathematics rather than doing other things.”

According to the statistics of MathSciNet of American Mathematical Society, Ngô Bảo Châu has published 15 papers so far. He said, “I am not interested in publishing papers of low quality. I have written few papers, but all of them are good. My colleague told me, 'Don't waste time to write lousy papers. One good paper is better than 100 papers of bad quality.' It is not my way but the standard in France.”

How do colleagues evaluate his work if he has no papers? “I accept evaluation every year. I only need to report what I have done during the year. The French National Research Council evaluates me every five years. I report what I have achieved and what I intend to do. If they feel that it is not bad and give me a good evaluation, the CNRS will continue to support me.”

It was a turning point in 2003. “At that time, I was extremely clear about every problem related to geometry. Things became simpler and clearer. I believed that I got a new idea, but it was just the beginning.” In that summer, Gérard Laumon went to Vietnam for a trip at
Châu’s invitation. Laumon became interested in Châu’s idea and they succeeded in proving the Fundamental Lemma for unitary groups together. They received the Clay Research Award in 2004.

In 2005 Châu received the title of professor at Université Paris Sud 11 and at the age of 33, also became the youngest full professor ever in Vietnam.

**Becoming a Distinguished Guest of the Institute for Advanced Study, Princeton**

“The most exciting moment was the time when I found the solution. I was so excited. I became almost exhausted after that. I didn’t know all the details even though I had found the method. I wrote out all the steps which were more than 200 pages. This was a long process, filled with hardship and pressure. It took me two months to correct a very serious error.”

The Langlands Program has fascinated Ngô Bảo Châu. He spent nearly 17 years working on it.

Châu indicated, “Every mathematician knows the importance of the Langlands Program. You will understand mathematics and geometry in a new way if you know the Langlands Program. Andrew Wiles proved Fermat’s Last Theorem by using the ideas of the Langlands Program. You can see how beautiful and powerful the program is. It is really exciting.”

After proving the Fundamental Lemma for unitary groups, Laumon decided to quit, but Ngô Bảo Châu persisted. “Unitary groups were inapplicable to common forms. As such, I spent a long time on the problem. In 2006, I almost believed it was impossible to obtain the proof.”

Things started to change at this time. Ngô Bảo Châu was invited to visit the Institute for Advanced Study (IAS) at Princeton in 2006. It was his first visit there.

“It was around December 2006, during a conversation with Mark Goresky of the IAS that provided me the missing piece to solve this jigsaw puzzle. I realised that I found the right way and I believed that I could crack the problem in its full form. It took me more than one year to complete the proof.”

Châu had planned to stay for three months at Princeton, but the IAS hoped that he would stay longer: five years. However, he still returned to France. “This is because I belonged in CNRS. I went back to Princeton in 2007 and remained there.”

In June 2007, Châu completed the first draft of his paper, consisting of 200 pages. Then he gave a talk on his proof in a workshop held in France. “Some were suspicious of its validity, but most people were convinced by my proof.” After returning to Princeton, Ngô Bảo Châu continued delivering reports during many conferences.

“During that five months, I relentlessly continued to give lectures, explained my ideas and corrected my own mistakes. In May 2008, I sent my paper to Publications Mathématiques de l’IHÉS in France. It was a long time of scrutiny. Only a few people could check the details, but I didn’t know who the reviewers were.”

By the end of 2009, almost everyone in this field believed that Ngô Bảo Châu had proved this conjecture. The Fundamental Lemma was listed as one of the top ten scientific discoveries of 2009 by the Time magazine:

*Over the past few years, Ngô Bảo Châu, a Vietnamese Mathematician working at Université Paris-Sud and the Institute for Advanced Study (IAS) of Princeton, formulated an ingenious proof of the fundamental lemma. When it was checked this year and confirmed to be correct, mathematicians around the globe breathed a sigh of relief. Mathematicians’ work in this area in the last three decades was predicated on the principle that the fundamental lemma was indeed accurate and would one day be proved. “It’s as if people were working on the far side of the river waiting for someone to throw this bridge across,” says Peter Sarnak, a number theorist at IAS. “And now all of a sudden everyone’s work on the other side of the river has been proven.”*

In January 2010, Ngô Bảo Châu’s paper “The Fundamental Lemma for Lie Algebras” was accepted and published by Publications Mathématiques de l’IHÉS in France.

Châu said, “I heard of the selections made by the Time magazine, but I had no idea how they knew about it.”

**The Invitation from the University of Chicago**

“He is one of the greatest mathematicians of this age. He is very intelligent. I really hope this young man will do more great things.”

– Robert Fefferman, Dean of Physical Sciences Division, professor in Mathematics Department, University of Chicago.

Of course, there was another man who was extremely excited about the proof. It was Robert Langlands, who once left this field but is back now.

Châu said, “Langlands must have thought that it was easy to prove this theorem when he came out with it. He worked on it for ten years with his students. Therefore he named it ‘Fundamental Lemma’. However,
he encountered more and more geometry problems which were not clear to him at that time. He left the field of automorphic forms and began to research on mathematical physics. He was very happy when he first saw me proving the Fundamental Lemma with new methods in Paris. He returned to working on automorphic forms. Maybe I encouraged him, but I don’t know the exact reason for his return.”

In 2010, Ngô Bảo Châu published a paper collaboratively with Robert Langlands.

In January 2010, Ngô Bảo Châu joined the Mathematics Department of the University of Chicago as a full professor.

Constantine, Chairman of the Mathematics Department, University of Chicago, has this to say about Ngô Bảo Châu. “He proved a fundamental theory, a conjecture called the Fundamental Lemma. It was named so because it was the key to the door for the progress of the Langlands Program….Châu’s proof had dramatically opened this door.”

Why choose to go to the University of Chicago? Châu answered, “The University of Chicago gave me very good conditions. If I wanted to, I could teach. If I just wanted to do research, I could stop teaching. I had a tenured professorship. I could do what I wanted to do. If you were a professor in France, you would have to teach, which is a heavy responsibility. However, in Chicago, they didn’t require me to teach and they supported me. And at the University of Chicago there are many people working on mathematics that I like, such as Robert Kottwitz, Alexander Beilinson, Kazuya Kato, Vladimir Drinfeld, and Spencer Bloch and others. So there are more colleagues with whom I can discuss mathematics with.”

Robert Kottwitz, a mathematician from the University of Chicago, had developed the method to solve the Fundamental Lemma of the Langlands Program in a joint work with Mark Goresky and Robert MacPherson from IAS, Princeton University. Châu said, “Other than my supervisor Prof. Laumon, Prof. Kottwitz also had a great impact on me. I used to go to Chicago to visit him. He always generally told me many of his thoughts and opinions. He didn’t compete with me and instead, he helped me clarify many problems.”

Another important reason Ngô Bảo Châu chose to move to Chicago was for the benefits of his children. “There are excellent experimental primary schools and high schools in Chicago.”

At the beginning of 2010, Ngô Bảo Châu became a French citizen. “When I was in France, it was not necessary for me to obtain French citizenship because I had the permit for permanent residence. However, after I had decided to go to America, it became difficult for me to return to France. I had left but did not resign as I had still kept my French University position. I hope that I could return to France regularly to meet and talk to my friends and colleagues, but it is not easy to obtain a French visa in America.”

“It is Pleasant to Work on Mathematics.”

“It is very important to take part in good seminars, and it is necessary to keep on conversing with others. When I attended the seminar in the first year, I couldn’t understand a single word, but I persisted on listening.”

It was not easy for Ngô Bảo Châu to become a mathematician from a Mathematical Olympiad medallist. Not all of the winners of Mathematical Olympiad grow up to be mathematicians, but in Vietnam, almost all of the mathematicians are medallists of the Mathematical Olympiad.

Looking back on his mathematical journey, Châu said, “Participating in the Mathematical Olympiad is different from researching on mathematics. To participate, one needs to master various skills which will help to solve complicated and high level problems in a limited time. The danger in this is that one may not respect the natural conciseness and beauty of mathematics. Whether or not one can become a mathematician ultimately depends on the person himself and his ability to appreciate mathematics. Such a transformation is not direct or obvious. In my opinion, it is necessary to be a ‘connoisseur’ of mathematics in order to become a good mathematician.”

How can one develop one’s taste in mathematics? “To do so requires a lot of time spent on mathematics, to study and learn more about it.”

Châu suggested this to the students who are beginning to work on mathematics, “In France, students have to take part in many fundamental courses and fruitful discussions. You can develop a good taste from the involvement in discussions during the time as an undergraduate. You can learn how the mathematicians put forward questions, why they are interested in them, how they discuss them and how to prove them from the talks of good mathematicians. I had fortunately participated in many discussions and projects, and had learned a lot from these involvements. I came out with the proof for the problem when I was a postgraduate. If I had not joined the discussions, I would not have been able to come out with the problem by myself and hence would not have been able to work on the project.”
Ngô Bảo Châu and his wife have three children. His wife does not go to work but stays home full time. Usually Châu does research in his office. “When working, I don’t speak to anyone. I will talk to the children at home when I am not stressed. After they go to bed, I begin to work. I don’t sleep much.”

When talking about mathematics, he said, “It is pleasant to work on mathematics when you want to research on it. You will feel it in its most natural form; mathematics is the most beautiful language that describes the world. It is very simple, hence it is also the most practical language. It is exact and succinct.”

Since Châu has learned English by himself, he spoke to the journalist in English. “I have read lots of books and papers. Reading has always been my favourite hobby for relaxation.”

When speaking about the future, he said, “I have only proved the Fundamental Lemma, not everything in the program. Our next goal is the Langlands Program, of which the Fundamental Lemma is just the foundation akin to a small mountain. After peaking this mountain, we can see the Langlands Program in its full glory. There is a big mountain in front of us, but the issue now is how to scale it. One good thing is that Langlands has returned and he will direct us in a new direction to solve the problems. I think it may take my entire lifetime to prove everything in the program.”

The original article was published on Science Times, November 18, 2010. Acknowledgement also goes to Dr Chaozhong Wu (Tsinghua University, China) for the help during preparation of this article.

Dan Hong Wang

Danhong Wang was born in Chongzhou, Sichuan Province. She graduated from Department of Chemical Engineering, Chengdu University of Science and Technology (now called Sichuan University). She joined Science Times in 2000 and is currently an editor and reporter reporting on scientific news.

Lizhen Ji

Lizhen Ji is currently a professor at University of Michigan, US. He obtained his BS, MS and PhD at Hangzhou University, University of California, San Diego, and Northeastern University respectively. His current research interests include large scale geometry, integral Novikov conjectures and symmetric spaces.
Lihong Zhi — A Pioneer of Symbolic/Numeric Hybrid Computation

Jiang Jing

The 7th Chinese Female Scientists Award Ceremony was held in Beijing on January 11, 2011. Prof. Zhi Lihong was honoured with the prize. The interview was done on January 19, 2011, in Prof. Zhi’s office in Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences (CAS).

Changing the Research Direction

The topic which Prof. Zhi works on, symbolic/numeric hybrid computation, is quite unknown to most people. After all, conduction of research in this area had just begun in the recent decade. There are less than a thousand people working on it presently. Hybrid computation is gradually playing more important roles in our lives, from the usual digital image processing to methods of communication used for airplanes and satellites, and many more. This is the reason for her eagerness to promote research of this subject.

Prof. Zhi explained that there are two methods for computing, one being numerical computation, and the other symbolic computation. Numerical computation refers to calculating with numbers, as its name implies. Symbolic computation, on the other hand, refers to calculating using equations with exact numbers, letters and mathematical symbols. The former can approximate the solutions quickly, but its accuracy may be unsatisfactory because of certain errors that accumulate. Symbolic computation does not have such errors and can get the complete solutions, but requires more resources and takes a long time.

Since numerical computation and symbolic computation each has its own advantages and disadvantages, in 90s of the 20th century overseas researchers began to figure out how to combine the two methods. “Use the plus points of one to supplement the shortcomings of the other”. Hence hybrid computation was born: a comprehensive method of calculation which has both the accuracy of symbolic computation and the efficiency of numerical computation.

During that time, she was a graduate student under Academician Wenjun Wu at the Academy of Mathematics and Systems Science, CAS. “Mr. Wu thought it was a good topic to work on since nobody in China had done so. He suggested that I do research on that field. I was very lucky that I began to study hybrid computation at about the same time as the overseas researchers,” said Prof. Zhi with an honest and happy smile of a scientist. However, she also admitted that at that time, she actually had “no choice” but to work in this area.

Prof. Zhi recalled that after graduating from high school, she had decided to study fundamental mathematics in Peking University because she was not good at subjects that require memory work. She then entered the Academy of Mathematics and Systems Science, CAS, to work on symbolic computation as a postgraduate student. It all went smoothly. However, she found that her progress in the study of factorisation in algebraic extension field at the PhD level was slow and it was difficult for her to continue. So she had no alternative but to consider changing her topic.

No Research Paper for More than 3 Years

When fate ended her journey down one road, it provided her with a new window of opportunity. It was unexpected that it would be a forced decision that led her to achieve what she has today.

Prof. Zhi solved problems on the approximate factorisation of polynomials using hybrid computation. Her method is widely used through the MAPLE application algorithm. Factorisation is also one of the basic problems in the Stewart-Gough platform. Prof. Zhi and her colleagues’ algorithm is 30 times faster than others’ in solving this problem.
In the case of finding the algorithm of the greatest common factor, Prof. Zhi proposed a method to reduce the complexity of calculating GCDs of univariate polynomials by an order of magnitude from 3 to 2. Recently, the computation for the greatest common factor of approximate polynomials has become significant in image processing. As the algorithmic complexity is decreased, the time for image processing has shortened greatly. It only takes few seconds to recover a clear 1024 × 1024 picture from a fuzzy one.

Regarding being honoured with the title of “a pioneer of symbolic/numeric hybrid computation”, Prof. Zhi commented, “I dare not claim to be one. I am just one of the first to study this topic.” Yet she also pointed out, “However, it is for sure that we are not inferior to the researchers overseas in the field of symbolic/numeric hybrid computation. We may even be ahead of them.”

To the question “Was it difficult to turn to a new frontier?” Prof. Zhi replied with a smile, “It wasn’t much. It is not easy to get an achievement in any subject. In contrast, it is easier to be successful in new areas and interdisciplinary subjects than in established fields, for there are few people working on it.” She expressed that it is necessary to master the knowledge of both fields in an interdisciplinary subject. It is more likely for breakthroughs to occur when one has experience in the two different fields.

To many it is not easy and almost unimaginable that Lihong Zhi had not published a single paper during her first three years in view of the fact that the only criterion currently to evaluate one’s academic performance is the number of papers published. However, Prof. Zhi did not approve of this view, “That’s nothing. Many teachers in our institute have not published papers for years. Yet once finished, the papers are published in top-ranking journals and they are highly cited.”

Prof. Zhi said that the process of undertaking scientific research is not a bed of roses and the key to success is to trust yourself and keep going. It’s just a matter of time before you see the results. “Confidence and perseverance are both important.”

**Be Simple and Pure in Conducting Research**

In addition, “it is also necessary for a scientist to be simple and pure,” said Prof. Zhi.

Professor Samuel Chao Chung Ting, a Chinese-American scientist and Nobel Laureate in Physics, said, “It is dangerous to do scientific research for fame and wealth. Researchers who work only for the sake of being awarded the Nobel Prize are hardly the ones winning it.” Prof. Zhi agrees with this. In her opinion, scientific research is a process of free exploration. It is hard to achieve anything if the aim of working is to attain prizes or promotions.

To another question, “Some people may be surprised about how you can get past the annual assessment if you have no papers and no prizes. How can you keep yourself out of trouble and keep your standing?” Prof. Zhi answered, “It may be related to the academic environment of the Academy of Mathematics and System Sciences, CAS.” She said that the institute always encourages them to carry out research freely without having to set requirements for the number of papers published, nor the “SCI”. What the institute emphasises on is to keep the research original and of high standards.

Prof. Zhi recalled that Prof. Wu used to ask his students to choose their own research directions for themselves and never imposed a need for them to assist him on his research work, although he had heavy duties. "Prof. Wu studied each theorem at least three times when studying Pierpont's 'Theory of Functions of Real Variables'. The first time was to 'read'; the second to 'learn'; and the third to 'understand'. It is difficult to master modern mathematics systematically without repeated studying and thinking. Prof. Wu laid a solid foundation of modern mathematics using this method. I was unconsciously influenced by his attitude of taking the relationship between subjects and knowledge seriously.”

**Teacher Should Not Mislead the Young**

Lihong Zhi has six students now. Two of them are taking their masters, and others are taking their PhDs. Compared to those who have so many students to the extent that they can't know everyone, it seems like her workload is light. “This is my limit. I am already always feeling exhausted.”

“Each student has his own topic. Six students mean six projects. I have to be familiar with the research direction of every project,” said Prof. Zhi.

It was confirmed by her student Qingdong Guo. "Prof. Zhi arranges seminars for us every semester. As our projects are completely different, she will specially set the contents according to everyone's individual situations," said Qingdong Guo.

Prof. Zhi said that as a teacher, she feels responsible for her students. Qingdong Guo said when reviewing his first draft of the undergraduate thesis, Prof. Zhi...
replied the email in less than a day, even pointing out many problems with punctuations, formula formats, expressions, numerical experiments and references, etc. When it came to the second draft, she picked out many new problems. The process of refining the thesis, from the first draft to the final version, took more than a month.

Compared to her meticulous efforts in academia, Prof. Zhi is relatively relaxed about other things. When talking about the research grant, “it is enough, but I don’t know the exact number. I do not care about it. We don’t need expensive equipment to do our research. The older generation had achievements all the same just with a pen and a piece of paper.” However, it is impossible for her to keep out of the affair entirely. If there is a good project, she will also spend time to apply for it. “Still, I prefer to do research without interruption.”

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Lihong Zhi

Lihong Zhi was born in Taicang of Jiangsu Province in 1969. She studied in the Mathematics Department of Peking University from 1987 to 1991. After which, she took up a PhD at the Academy of Mathematics and Systems Science, CAS, working on mathematics mechanisation and symbolic/numeric hybrid computation with Academician Wenjun Wu and Professor Wenda Wu in 1991.

From 1998 to 2001, she worked as an instructor at the Mathematics Department of Ehime University from 1998 to 2001. Lihong Zhi studied at the University of Western Ontario for post-doctoral degree from 2001 to 2002. She worked as an associate researcher at the Academy of Mathematics and Systems Science, CAS from 2003 to 2009 and was appointed as a researcher in 2009.

Jiang Jing

Jiang Jing was born in 1983. She obtained master degree of Communication Science in Graduate University of Chinese Academy of Sciences in 2008. She is currently a reporter and editor of Science and Technology Daily.
Rather sadly, we did not receive any solution to the first set of problems nor did anyone send in any of their favourite problems. We are encouraging you to send in solutions by offering prizes of World Scientific books. One book will be awarded to the first correct answer to any of the problems; a second book will go to the first correct answer to either of the other two problems; the final book will be given to the “nicest” solution of any of the three problems.

First Problem Set Solutions

Problem 1.1: We’ll do this by using a sequence of operations. First, we’ll show how to remove a 1 by 3 strip from an edge of the rectangle.

Operation 1: Look at the six pieces numbered 1 to 6. There are three jumps shown in the diagram. First jump over piece 3 with piece 6, so that piece 3 is removed. Now remove piece 2 by jumping over it with piece 1. Finally, remove 1 by jumping over it with 6.

It’s not something that we need to worry about right now, but pieces 4, 5 and 6 are in their original positions.

First apply operation 1 to the top left of the 16 by 17 rectangle of pieces as shown below. Then apply it 15 more times, but sideways, to finally reduce the original rectangle to the white 14 × 16 rectangle shown in the diagram.

By applying operation 1 in this way 16 times, we can successively “shave” off consecutive strips of pieces that make up a 3 by 16 rectangle until we get a 2 by 16 rectangle. If a 2 by 16 rectangle has a fixed survivor we are done.

We’ll now show how to get a fixed survivor in the 2 by 16 case by first looking at the 2 by 4 case.

Operation 2: In the first of the three drawings above, use piece 7 to jump over first 8 and then 4. Then use 6 to jump over 3 and 7. Finally 5 can jump over 2, 6 and 1 in that order. This leaves 5 as a fixed survivor in the 2 by 4 case.

To do it in the 2 by 16 rectangle, simply repeat the jumps of piece 6 over 3 and 7. Eventually we’ll get to the third drawing above, but the pieces will be labelled
Problem 1.2: First note that a piece on a black square can only move to a black square and the same goes for the piece on a white square. Then look at the patterns of black squares on the bottom left hand 3 by 3 sub board and the bottom right hand 3 by 3 sub board. They are completely different so the move (a) cannot be made.

Part (b) looks a little more promising as the black patterns are the same. However, pieces on odd columns can only move to odd columns and vice versa for even columns. If we consider the bottom left hand 3 by 3 sub board, we see that it only has one black square in the second column, so we have a problem. The piece on this black square, in going to the top right hand 3 by 3 sub board, would have to move to the eighth column where there are two black squares. So move (b) cannot be effected either.

Ancillary Problem 1.2: For what \( r \) and \( n \) can \( r \) pieces in an \( r \) by \( r \) array in the bottom left hand sub board be moved to (a) the bottom right hand \( r \) by \( r \) sub board or (b) the top right hand \( r \) by \( r \) sub board?

Problem 1.3: The answer is \(|x| + |y| = 1\).

Ancillary Problem 1.3: What is the equation of the square with vertices (1, 2), (2, -1), (-1, -2), (-2, 1)?

Second Problem Set

Problem 2.1: Place each of the numbers 1, 2, 3, 4, 5, 6 in one of the six circles below.

In how many ways can this be done so that the sums of the numbers on each side of the triangle are the same? Note that the combinations

\[
\begin{align*}
A & \quad F & \quad D \\
B & \quad C & \quad E & \quad E & \quad B \\
D & \quad E & \quad F, & \quad A & \quad B & \quad D & \quad F & \quad C & \quad A \\
\end{align*}
\]

are considered as the same combination.

Problem 2.2: Twenty one stones are placed in two separate piles on the table. Alice and Bob take turns (ladies first) in removing either one or two stones from either one of the two piles. The winner is the one who takes the last stone from the table. Who wins if both of them are playing as well as possible?

Problem 2.3: Four condemned men are placed on either side of the opaque screen as shown. There are four hats, two of which are white and the other two black. The men are each given a hat to wear, which may either be white or black. None of the men are able to turn around to see the hats behind them and they cannot see what is beyond the screen. However, they are able to hear each other speak, even if they are on opposite sides of the screen. If a man can state what the colour of his hat is without saying anything else, he will be set free. If he states the wrong colour he will be immediately executed. Note that there is no given order in which the men must answer. Given that all four men are perfectly logical and do not wish to die, what is the probability of each man being set free?
The idea of the ICTS of the Tata Institute of Fundamental Research, naturally grew out of a strongly felt need in the Indian scientific community to enhance the research and education ecosystem of Indian science.

There is a need in India today, to create an institution where researchers from India and from abroad can meet and interact for critical periods of time, in a relaxed and conducive atmosphere. These periods depend on the type of activity at ICTS that can range from rapid response short time workshops to programs lasting many months. Visits to ICTS can even be sabbaticals in which faculty members can bring along their students and post-docs.

The idea is to provide a facility that will enhance the creative process and lend a hand to the solution of some of the profound scientific problems of our times. As past experience has shown, major breakthroughs do occur when problems are seen in a different light; and at times when there is a heterosis (or hybrid vigour) when different core disciplines are brought to bear on a given problem. This is natural because as we all know, it is the limitation of the human mind that caused a division of scientific activity we call Physics, Chemistry, and Biology! Mathematics is a bit different though it too, in my view, stems from our cognition of the material reality of the world around us. For these reasons, ICTS would like to run parallel programs in different disciplines. Currently there is an enormous amount of work going on at the interface of Physics, Biology, Mathematics and Computer Science in different combinations.

Besides its focus on being a facility to enhance research in the basic sciences, ICTS would like to contribute to the creation of scientific human resources. We plan to have programs for school and college teachers, facilitate the development of educational material and also employ modern technology in the dissemination of educational material. We are also exploring the idea of a “Math Clinic” where students under some guidance grapple with solutions of mathematical problems from diverse areas of science, technology, finance, health and so on.

ICTS is also aware of the importance of the interface of “pure research” and applied science and technology, and of the importance of discussions of science and technology policy. All these diverse groups can meet and interact at ICTS.

While it is true that ICTS is a science institute, it will also make an effort to integrate science into the larger fabric of human activity and knowledge. Hence we hope to invite people from the arts and civic society to give talks and to spend time with us and enrich us.

How ICTS Happened

The genesis of ICTS owes itself to institutions like the Abdus Salam International Centre for Theoretical Physics (ASICTP) in Trieste, the Kavli Institute for Theoretical Physics (KITP) in Santa Barbara and the Newton Institute in Cambridge. Each of these institutions has overlapping but somewhat different missions. The ICTP was originally created by Salam 45 years ago to help keep developing world scientists and students up-to-date in various areas of Physics and Mathematics. ICTP also organises high-level research workshops and has a successful diploma program for bright students from developing countries. The KITP and the Newton Institute aim to promote scientific excellence and productivity at the highest level. At KITP, educational and outreach activities also go side by side with the scientific programs.

Scientists from India have been regular visitors to these institutions and they and their students have benefited enormously from their visits. The Indian science community has by now critical numbers in various areas to benefit from, and most importantly
also sustain a centre inspired by these institutions, but planned according to its resources and needs.

ICTS Activities Since 2007

Programs:

Even before its permanent campus is ready, the ICTS started functioning from September 2007 and has had a very active start. During this period it has organised 49 programs over 607 program days. About 4000 people participated in these programs and about 1500 were from outside India. 11 more programs are planned for the near future. The programs range over many subjects: Physics, Astrophysics, Cosmology, Mathematics, Computer Science and their many branches. The programs are, till the permanent campus comes up, organised in various institutions across India. A complete list can be found at the ICTS website www.icts.res.in.

Most recently ICTS organised a program on “Scientific Discovery through Intensive Data Exploration”, which brought together experts from diverse areas like Computer Science, High Energy Physics, Astronomy, Bioinformatics, Weather and Climate, to share their expertise on a common platform. During this meeting ICTS organised a panel discussion of “IT Infrastructure in India”. Panellists included members from Academia and Industry.

Public Lectures:

ICTS Public Lectures are an important part of the outreach of ICTS to the civic society. A galaxy of speakers have given public lectures to date.

Juan Maldacena, “Black Holes and the Structure of Space-time”.
Lyman Page, “Observing the Birth of the Universe”.
Joseph Silk, “Dark Matters”.
Marc Kamionkowski, “The Big Rip — A New Fate of the Universe”.
Francois Bouchet, “Oldest Image of the Universe”.
William Phillips, “Time, Einstein and the Coolest Stuff in the Universe”.

During the ICTS Inaugural Event in December 2009, each evening was celebrated with a Public Lecture:
Albert Libchaber, “The Origin of Life — from Geophysics to Biology”.
David Gross, “The Role of Theory in Science”.
Avi Wigderson, “The P versus NP problem — Efficient Computation and the Limits of Human Knowledge”.

Subrahmanyan Chandrasekhar Lecture Series:

ICTS has initiated the “Subrahmanyan Chandrasekhar Lectures” to commemorate the memory of a great physicist and astro-physicist. Eminent academicians delivered these lectures on important new developments in their areas of specialty. The first lecture in any series is aimed at a general scientific audience, while the remaining are aimed at specialists.

Ashoke Sen, “Extremal Black Holes in Strings Theory”.
The second series, “Black Holes — the Harmonic Oscillators of the 21st Century”, was delivered by Andrew Strominger in January 2010.
The third series of the lectures, “The Standard Model of Cosmology”, was delivered by Lyman Page in April 2010.
Ludwig Faddeev, “What Modern Mathematical Physics should be”.
Subir Sachdev, “The Quantum Phases of Matter”.

The following three Subrahmanyan Chandrasekhar Lectures are planned for the future:
Dam Thanh Son, “Applied String Theory”; Uriel Frisch and Satya Majumdar, titles to be announced.
ICTS Campus:

The permanent ICTS campus will come up in North Bangalore by mid 2013. About 14,000 sq m of built up area has been planned for the campus spread over 74,000 sq m of land. This campus will be self-contained and will have world class facilities.

ICTS Family and Personnel:

Several academic members from various institutions in India are adjunct faculty members of ICTS. There is a large program committee of very active members who oversee the program proposals. The adjunct faculty, the program committee, and the future core faculty of ICTS will serve to catalyse a productive academic atmosphere. All this information can be found on the ICTS website.

How ICTS is Engaging with the International Community?

(1). International program organisers and participants:
Out of the 49 programs ICTS has organised, 21 programs were co-organised by the scientists affiliated to universities and research institutes outside India. Over 1450 people from outside of India participated in these programs.

(2). ICTS provides a platform to host various collaborative programs and meetings:
The “Asian Winter Schools in Particles, Strings and Cosmology” are jointly organised every year by China, India, Japan and Korea. The idea is to create a Les Houches type of school for the Asian Region. The 4th school held in January 2010 was held in India. The previous schools were held in Korea, Japan and China. The School covered various areas in String Theory, High Energy Physics and Cosmology. The audience consisted of senior graduate students as well as practising researchers whose primary interest is in String Theory. The lectures covered a selection of basic areas as well as advanced topics at the forefront of current research. Other joint programs that are planned are the 2011 “Asian School on Lattice Field Theory”, the 2012 Number Theory Instructional Workshop and the “Pan-Asian Number Theory Conference”.

Future Engagements:

Once the ICTS campus is ready by mid 2013, it will indeed be possible to have a variety of thoughts on collaborations with similar and other institutions around the world. One idea is to have exchange visits by faculty and post-doctoral researchers. The ICTS will be participating in an initiative called “Mathematics of Planet Earth” during the year 2013. Programs in various areas of Earth and Biological sciences are already being planned in conjunction with various institutions in the world. ICTS is also planning Math programs during that year, primarily aimed at senior high school and college students, as part of its outreach and educational programs.

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His research interests are in Elementary Particle Physics, Quantum Gravity and String Theory. He is a recipient of the 2004 Third World Academy of Sciences (TWAS) Prize in Physics and the 1995 International Centre for Theoretical Physics (ICTP) Prize. He is a J.C. Bose fellow of the Government of India, a fellow of the Indian Academy of Science, the Indian National Science Academy and TWAS, as well as a Distinguished Alumnus of St. Xavier’s College, Mumbai.
Chennai Mathematical Institute

Madhavan Mukund

The Chennai Mathematical Institute (CMI) is one of the important centres in India for research in and teaching of mathematical sciences. The Institute is recognised as a University by the Indian government and awards bachelors, masters and doctoral degrees.

History

CMI began as a research institute in 1989 which carried out only a PhD programme. In 1998, the institute ventured into teaching, with an undergraduate course for Mathematics and Computer Science. An undergraduate course in Physics was added a few years later. Parallel to this, CMI began its Masters programmes in Mathematics and Computer Science. A new Masters course in Applications of Mathematics was started in 2010.

The institute was founded by C S Seshadri, an internationally renowned algebraic geometer. The present Director is Rajeeva Karandikar, who is an expert in probability theory and statistics. The institute has a talented group of about 30 permanent faculty members who have strong academic ties with reputed institutions in India and abroad. The institute also attracts a regular stream of academic visitors, both from India and abroad.

Research

The main areas of research in Mathematics pursued at the Institute are algebra, analysis, differential equations, geometry, probability, statistics and topology. In Computer Science, the main areas of research are formal methods in the specification and verification of software systems, design and analysis of algorithms, computational complexity theory and computer security. In Physics, the research carried out is mainly in gravitation, quantum field theory, string theory and mathematical physics.

One of the unique features of CMI in the context of academics in India is the combined emphasis on research and teaching. All over the world, it is recognised that academic excellence is best cultivated by enabling the interaction between high quality researchers and talented students. In India, this interaction has been inhibited by the fact that most research institutions have been set up outside the university system. In recent years, the government has begun to invest in national institutions to promote research and teaching in basic sciences, but CMI’s initiative predates these efforts by almost a decade.

Teaching

The teaching programmes at CMI are run in collaboration with the Institute of Mathematical Sciences (IMSc), Chennai. The courses are taught by personnel in the faculties of CMI and IMSc, Chennai, as well as distinguished visiting scientists from other academic institutions such as the Tata Institute of Fundamental Research (TIFR), Mumbai, the Indian Statistical Institute (ISI), the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, the Indian Institute of Technology (IIT), Madras, Chennai, the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune and the Ecole Normale Superieure (ENS), Paris.

Students from CMI have gone on to pursue further studies at the best academic institutions in India and abroad. These include Caltech, Chicago, MIT, Princeton, U Penn and Yale in USA, ENS Paris, Univ Paris-Sud and Univ Bordeaux in France, the Max Planck Institutes and Humboldt University in Germany and the Harish-Chandra Research Institute, IITs, IMSc, ISI and TIFR in India.

Although the majority of students from the institute continue in Mathematics, Computer Science and Physics, CMI graduates have also moved into areas such as financial mathematics, management and economics, both in India and abroad. Some students from CMI have also been placed in some of the best software companies in India.
Exchange Programmes

CMI has numerous exchange programmes in place. It has a formal agreement with the ENS, Paris, France, one of the leading institutions in the world in teaching and research in Mathematics, for regular visits by academic members and students of CMI and ENS, Paris working on Mathematics and Computer Science. The institute has a similar arrangement with Ecole Polytechnique in Paris for CMI students working on Physics. The institute also has a formal agreement with the Ecole Normale Superieure in Cachan, France, for exchange of BSc and MSc students, as well as for a joint PhD programme in Computer Science and Mathematics.

CMI is one of three non-European partners in the Erasmus Mundus Master Programme, ALgebra Geometry And Number Theory (ALGANT), funded by the European Union. The ALGANT programme allows students to pursue Masters and Doctorate degrees across institutions participating in the programme.

Infrastructure and Funding

The institute’s campus is located in the State Industries Promotion Corporation of Tamil Nadu (SIPCOT) Information Technology Park in Siruseri, on the outskirts of Chennai. CMI’s programme is fully residential. All students are accommodated in the hostel on campus. The institute has a regular transportation arrangement for students to visit the city for shopping and other activities.

Another unique feature of CMI, in the context of India, is that its funding comes from diverse sources, both public and private. This has given the institute the freedom to organise its activities in a manner that is best suited to achieving its goal of excellence in research and teaching.

The institute receives substantial support for its activities from the Department of Atomic Energy (DAE), through the National Board for Higher Mathematics (NBHM).

The institute also receives generous contributions from the private sector. During the formative years of the institute, the Southern Petrochemical Industries Corporation (SPIC) has been a major source of funding and infrastructural support for CMI. Currently, the Shriram Group Companies, Chennai play a crucial role in providing and organising private funding for the Institute.

Information

More information about CMI’s activities is available from the Institute’s website, http://www.cmi.ac.in.

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Madhavan Mukund is a professor at Chennai Mathematical Institute. His research interests include partial order based models for concurrent systems, logics for specifying and verifying concurrent systems, distributed algorithms.
2011 Workshop Delves into Minds of Mathematical Elite

Some of the world’s top mathematicians attended a two-day mathematics workshop at the University of Western Australia (UWA) from March 1–2, 2011. It was hosted by the Faculty of Engineering, Computing and Mathematics and featured lectures from the International Mathematical Union (IMU) Executive Committee.

UWA’s Winthrop Professor Cheryl Praeger, a member of the IMU Executive Committee and one of the world’s most highly cited mathematicians, said it was a wonderful opportunity for the State to host multi-award-winning mathematicians UWA, providing them with a platform to share their knowledge.

“For example, we have last year’s Kyoto Prize winner, Dr László Lovász. The Kyoto Prize is an extremely prestigious international award, similar in intent to the Nobel Prize,” Professor Praeger said.

In addition to Dr László Lovász, the big names in the mathematics world, namely Wendelin Werner, John Toland, Marcelo Viana, Christiane Rousseau and Ingrid Daubechies shared their research expertise, covering topics such as extremal graphs, entropy, mass transportation and random fractals. The program also included a forum “Mathematics: How a Nation Plans for the Future — the Spanish, Indian and Chinese Experience” as well as an exposition of the forthcoming program “Mathematics of Planet Earth”.

However, the workshop’s significance does not end here. It also marks the start of UWA’s Year of Mathematics, a calendar of events that aims to increase the accessibility of mathematics as a topic of interest, and

heighten the awareness of the role that mathematics plays in our daily lives.

The Year of Mathematics will feature a Mathematics Symposium where UWA will welcome the IMU Executive Committee to Australia for the first time. In addition to business meetings aimed at promoting international cooperation in mathematics, the committee will engage in strategic discussions with the government and industry in a bid to highlight the importance of the mathematical sciences to Australia’s future.

A series of educational, thought provoking and entertaining events where people of all ages can explore the exciting world of mathematics and the array of opportunities that exist can be expected from this year-long program, as it celebrates the role of mathematics in everyday life.

Reproduced from “University News” of University of Western Australia, http://www.news.uwa.edu.au/
The conversation with Dr. Tammy Ziegler of the Department of Mathematics (Technion–Israel Institute of Technology) took place, by pure chance, on the same day that it was announced that Prof. Elon Lindenstrauss of the Hebrew University was the recipient of the Fields Medal — the most prestigious mathematics prize in the world, which is, for mathematicians, the equivalent of the Nobel Prize. Dr. Ziegler, who got her degrees at the Hebrew University, knows Prof. Lindenstrauss and his work well, and was excited and happy for him and the mathematics community in Israel. This feeling was also reflected in the Israeli media, which proudly reported the achievement, while being somewhat surprised to note that high-level research in mathematics was actually taking place, and that Israel, as it became clear, was a major player in the field.

Dr. Ziegler has been in the Technion’s Department of Mathematics for three years. Work that she and her two colleagues, Professor Terence Tao from UCLA and Professor Ben Green of Cambridge University, have recently completed, has aroused much interest among mathematicians since it solves basic problems in the field of prime numbers — a mathematical field that has lately become a centre of attention, after a period of slumber. The results delineate methods for finding asymptotics for arithmetic patterns of prime numbers. The solution combines methods from two seemingly unrelated fields — dynamics and number theory.

Two Thousand Years

The fascination with prime numbers, explains Dr. Ziegler, is almost as old as mathematics. Already about 2,300 years ago, Euclid showed that each natural number (except for 1) can be written as a unique product of prime numbers. Furthermore, Euclid proved that there is an infinite number of prime numbers. His reductio ad absurdum proof is still considered to be one of the most elegant mathematical proofs. It states: let us assume that there is a finite number of prime numbers that can be written entirely as the sequence $P_1 < P_2 < \ldots < P_k$. Now let us look at the number that is the product of all the elements in the series plus 1:

$$M = P_1 \times P_2 \times \ldots \times P_k + 1.$$ 

Here $M$ is larger than $P_k$ and is, therefore, not prime, but $M$ is also not divisible by any element of the sequence. It will always have a remainder of 1. This contradicts the assumption that there is a finite number of prime numbers.

From this, according to Ziegler, comes the question of how frequently do prime numbers appear? A quantitative estimate would be very nice to have. We know intuitively that there are more even numbers than numbers divisible by three, and more numbers divisible by three than numbers that are perfect square roots. Indeed, if we take a very large number (say, $N = 10^9$), we know that it has about $N/2$ even numbers, about $N/3$ numbers that are divisible by 3, and about $N/4$ numbers that are perfect square roots. Dr. Ziegler explains that in these cases, the estimation is easy; in contrast, Euclid’s proof does not provide a way for estimating the number of prime numbers smaller than $N$.

More than 2000 years passed before a formula, stating that there are about $N/\ln N$ prime numbers smaller than $N$, was established. The formula was conjectured by Gauss and Legendre, based on numerical
data, and proved independently by Hadamard and de
la Vallée Poussin in 1896.

The Problem of Prime Number Pairs (Twins)
The next step, according to Ziegler, involved finding
arithmetic patterns in the sequence of prime numbers.
The question is interesting because of the inherent
difficulty in understanding the additive behaviour of
prime numbers. For example, many prime number
pairs that differ from each other by two (called “twin
primes”) are known. It is tempting to conjecture that
there might be an infinite number of such pairs, but
to-date the answer to this question has eluded math-
ematicians; it remains an open problem.

A related question that has interested math-
ematicians concerns the existence of arithmetic
progressions in the sequence of primes. Only in
2004 did Green and Tao achieve a breakthrough
by showing that the set of prime numbers contains
arbitrarily long arithmetic progressions. The two
researchers approached the problem from a different
and surprising direction, using ideas from Ergodic
theory, which is a branch of mathematics that deals
with the study of dynamic systems. Green and Tao
proved the existence of arithmetic progressions of
prime numbers, but their methods did not provide
estimates of the number of k-term arithmetic
progressions of prime numbers, all of whose elements
are smaller than \( N \).

Dr. Ziegler’s doctorate focused on the connection
between the arithmetic progressions and nilpotent
dynamic systems. Prof. Tao’s interest in this work led
to their collaboration. About three years ago Ziegler
started working with both Green and Tao and the
collaboration resulted in finding the important esti-
mates that have aroused so much interest.

When Things Get Complicated
Trying to explain her unique contribution to the solu-
tion of the problem, Dr. Ziegler finds it too complicated
to do in simple terms. The explanation would involve
sophisticated concepts and require the reader to possess
advanced knowledge of Mathematics; thus, it is beyond
the scope of this interview.

In mathematical language, one of the conclusions of
the work of Green, Tao and Ziegler is that each system
of equations of finite complexity, or in other words, a
system that is not hiding within it a problem similar
to prime twins, has prime solutions unless there are
“local obstructions”, and thereby corroborates a multi-
dimensional generalisation for Hardy and Littlewood’s
conjectures of the early twentieth century.

With Paper and Pencil
It is intriguing to find out how mathematicians work,
and Dr. Ziegler explains with a smile: a lot of work and
not being afraid to try new ideas. Dr. Ziegler relates that
her office in the department provides a pleasant and
quiet environment, and sometimes in the evenings she
goes to a café with a notepad and a pencil.

Her work involves thinking hard, discussions with
colleagues both here and overseas in order to analyse
the problem and come up with new ideas. Finally, once
you get an idea for a solution, you have to try and write
it out in full detail. In most cases, though, you reach a
dead end, which means that a significant part of your
work ends up with tossing away ideas that at first looked
promising. There is also no guarantee at the start of the
road that a solution will be found at its end, therefore,
when you do reach a solution, such as Ziegler and her
colleagues did, there is a sense of accomplishment.

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Finite Mathematics (Fifth Edition)

Stefan Waner and Steven R. Costenoble
Brooks/Cole, CENGAGE Learning, Boston, 2011, 2077, xvii + 618 pp, Appendix 44pp

Now in its fifth edition, this book may be used for a one or two-term course in “finite mathematics” for students majoring in business, the social sciences and the liberal arts. It gives a quick entry into the essentials of matrix algebra needed for solving systems of linear equations and linear programming problems. It also gives an introduction to the use of matrices in two-person games in game theory and in the construction of input-output models.

A short chapter covers the basic concepts in the mathematics of finance. The basic notions and methods of discrete probability are dealt with, with a brief introduction to the statistics of empirical data and the use of the normal distribution.

The book is self-contained with a brief review of arithmetic operations on real numbers, algebraic operations on polynomials, real-valued functions and, in particular, linear functions. A short chapter on the basics of sets and operations on sets, as well as counting principles is given in preparation for the following chapters on elementary probability.

The physical layout of the book is attractive. Different colours are used for highlighting texts in different contexts — definitions, results or methods, examples, remarks, and so on. There are plenty of routine exercises for practice, with answers of selected exercises given. The numerical exercises are expected to be done with the aid of scientific apparatus more sophisticated than an ordinary scientific calculator. More specifically, the TI-83/84 Plus graphics calculator and the Excel software are routinely used for the numerical computations. Except for two chapters, the other seven chapters have sections which give details of how those scientific aids are used in the solution of some numerical examples.

There are some new features introduced to support learning — case studies, question-and-answer dialogues, communication and reasoning exercises for writing and discussion. The authors have set up a website specifically for students and users of the book to supplement the normal methods of testing and learning.

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Graphs and Digraphs (Fifth Edition)

Gary Chartrand, Linda Lesniak and Ping Zhang
CRC Press, 2010, 598pp

This is the fifth edition of a classic text in graph theory. Originally published in 1979, the first edition was authored by Mehdi Behzad, Gary Chartrand and Linda Lesniak. This latest edition continues to be helmed by Chartrand and Lesniak, with the addition of Ping Zhang from the fourth edition onwards. The passage of years has only served to increase the quantity and improve the quality of the material found between the two covers.

The book is divided into twelve chapters and covers quite comprehensively, the field of graph theory. The topics include degree sequences, connectivity, Eulerian and Hamiltonian graphs, tournaments, network flows, nowhere-zero flows, planarity, graph embeddings, vertex colorings, map colorings including chromatic polynomials, matchings, factorisation, domination, edge colorings and extremal graph theory. The target audience is made up by the advanced undergraduate and the beginning graduate. The book is extremely readable to the student with mathematical maturity. The coverage, style, rigour and depth of the book all amply help to fulfill its stated objective of describing the story of graph theory in terms of its concepts, theorems, applications and history.

In comparison with the fourth edition, the fifth edition has much more in it. There is expanded or new coverage in a number of topics. There are more examples and exercises. The book has adapted its notation to what is currently the norm among graph theorists. (Although different notations can be viewed as extra “training” for the budding mathematician, familiar notations across different texts make reading much smoother.) We are particularly pleased that the historical discussions of mathematicians and problems have been expanded. This certainly makes the book live up to its claim of describing the story of graph theory for without history, there is no story. However, we have one small concern — the bibliography is rather outdated, and although one can understand
that many references were made in historical contexts, further references to state-of-the-art research surveys and books will positively link the interesting history to the exciting present. Up-to-date references are also important for the beginning graduate, so that he knows which areas of graph theory he can do fruitful research in.

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The Colours of Infinity: The Beauty and Power of Fractals
Edited by Nigel Lesmoir-Gordon
Springer, 2010, x + 207 pp

In 1980, at the IBM Thomas Watson Research Centre in upstate New York, the mathematician Benoît Mandelbrot was probably the first person to view a geometric picture of an unusual set of pixels on the computer screen and discover its enormous complexity and geometric richness. This set had its origins much earlier on at the beginning of the 20th century in the research of the French mathematicians in the field of complex dynamics, Pierre Fatou and Gaston Julia. In the eighties, the properties of this set were well investigated and it was named the Mandelbrot set (or commonly called the M-set). In the following decades, applications and ramifications of the M-set began to emerge in other disciplines.

This book is an offshoot of the full-length 1995 television documentary with the same title, presented by the late science fiction writer and thinker Arthur C. Clarke and produced by the film and documentary maker Nigel Lesmoir-Gordon. While the film is a visually stunning display of computer graphics and animation that captures the imagination of its viewers, the book version is literally an intellectual eye-opener for those who have only vaguely heard of the M-Set or of fractals (a term coined by Mandelbrot himself).

There are not many mathematical equations in the book. There is basically only one important equation — presented in an iterative form \( Z_{n+1} = Z_n^2 + c \) (which Arthur Clarke himself likened to the Einstein equation \( E = mc^2 \) in depth and simplicity). The emphasis is on pictures for visualising the endless process of “self-similarity” in nature. The psychedelic colours and dream-like patterns generated have a surrealistic, hypnotic effect. It is almost unbelievable that they are produced mechanically by a deterministic equation. Little wonder that the M-set is sometimes called the “thumbprint of God”.

It is not just the pictures that mesmerise the mind. A hint of the mathematics behind the apparent order emerging from chaotic processes is beautifully illustrated by an imaginary soccer game played in a definite and yet random way. The mathematically minded reader will enjoy the exposition of the chapter on “Fractal transformations” written by Michael Barnsley and Louisa Barnsley. In it you will find references to the Iterated Function System (IFS), the mathematics behind fractal image compression technology.

If you have seen the documentary, you would have heard Michael Barnsley recalling the recurrent nightmare he had for over 20 years which finally gave him the key to fractal image compression — the Collage Theorem. For the benefit of those who have not watched the film, it is an account that is reproduced in “The Film Script” which is appended at the end of the book. If you have seen the film, reading this complete film script is like watching it again in your mind. If you read it first and then see the film, you would appreciate the film even more.

Lesmoir-Gordon describes in the book how his first acquaintance with the M-Set in 1991 led him in an obsessive-compulsive and yet serendipitous way to a collaboration with Arthur Clarke on a project beyond his wildest imagination. It is an inspiring behind-the-scenes account that is not usually revealed or widely known.

The serious reader will find it intellectually challenging and satisfying when digesting the 134 pages of exposition on the geometric visualisation of the M-Set, the tilings of Escher and the fractal view of financial markets — given by the masters and practitioners of the art and science of fractals like Ian Stewart, Arthur Clarke, Benoît Mandelbrot, Michael Barnsley, Will Rood, Gary Flake and David Pennock.

Y. K. Leong
National University of Singapore, Singapore
Emeritus Professor John Makepeace Bennett

Emeritus Professor John Bennett AO was an internationally recognised Australian computing pioneer and numerical analyst. Starting at the University of Sydney in 1956, in 1961 he became Australia’s first Professor of Computing with an initial title of Professor of Physics (Electronic Computing) though in 1982 this was changed to Professor of Computer Science and Head of the Basser Department of Computer Science, a position he held until his formal retirement in 1986. Born in Warwick, Queensland, he attended the Southport School. This was followed by a BE (Civil). During World War II he used his technical bent to serve in the RAAF in radar units. Following the war, he returned to the University of Queensland to study Electrical and Mechanical Engineering and Mathematics.

John joined the Brisbane City Electric Light Company where, inspired by a radio talk about the Automatic Computing Engine (ACE) being developed at the National Physical Laboratory in Teddington, he saw a possible solution to the repetitive calculations of his employer. In 1947 he set sail for Cambridge, where he became the first PhD student of Sir Maurice Wilkes (who predeceased him by just two weeks). Here he was responsible for the design, construction and testing of part of the Electronic Delay Storage Automatic Calculator (EDSAC), one of the world’s first computers. He then carried out the first structural engineering calculations by computer as part of his PhD. In Cambridge he also pioneered the use of digital computers for X-ray crystallography in collaboration with John Kendrew (later a Nobel prize winner). From Cambridge he moved in 1950 to Ferranti in Manchester to work on the Mark I*. In 1952, he married Mary Elkington, an economist working at Ferranti, and in 1953 John moved to Ferranti’s London Computer Laboratory, where he worked alongside Charles Owen who went on to design the IBM 360/30.

In January 1956, John started as Numerical Analyst in the Adolph Basser Laboratory at the University of Sydney to head operations on SILLIAC (Sydney ILLInois Automatic Computer), having been recruited by Professor Harry Messel, then head of Physics at the University. The computer, generously funded by Dr Basser, was needed for the calculations for theoretical and experimental physics. Through the connections of Dr John Blatt in Physics, the University was able to obtain all that was necessary to build the Sydney version of ILLIAC and the first calculations were performed in July 1956. Short courses on computing were run in 1957 and 1958 but in 1959 a Postgraduate Diploma in Numerical Analysis and Automatic Computing was instituted. The Laboratories became an ever-expanding centre for teaching computer science and for computing services for the University though the latter were split off in 1972 to become the University Computing Centre.

A further generous donation by Dr and Mrs Cecil Green of Texas assisted with the purchase of an English Electric KDF9 in 1964. In time, this was followed by the purchase of many further computers, linked by a revolutionary home-grown network and partially distributed operating system, Bassernet. This was one of the world’s first local area networks. John set up a link from this to ARPANET (the forerunner of the Internet) in Hawaii in the early 1970s. It is perhaps fitting that his son Chris works in streaming media via broadband over the internet. Colleague Professor Arthur Sale (now at Tasmania) has similarly had a long-time interest in cheap access to broadband for the masses.

From the time he arrived at Basser, with which his name became synonymous, John’s enduring vision was to educate students, industry and government in the powers of computers—using whatever computers were available. In particular, he expended considerable energy in demonstrating the use of computers for business and running courses for their staff. He established the Australian Computing Society and was its first President. He co-edited the history, Computing
in Australia (1994). John’s AO in 1983 was for his visionary contributions towards the development of computing in Australia.

John was gregarious and he invited many eminent visitors to Australia to educate staff, students and industry. They included Sir Maurice Wilkes and Professor Sandy Douglas, both English computing pioneers, numerical analysts such as Professor Leslie Fox from Oxford and Professor Ailsa Land of London School of Economics (LSE) and Professor Frank Land also of LSE, an early information systems expert. John had an insatiable curiosity and used his keen intellect to see approaches and solutions to a wide variety of computational problems often inspired by his many visitors. A chance question from one led to his colleague, Dr Don Herbison-Evans, spending many years computerising dance notation and another colleague, Dr Ian Parkin, writing more theoretical graphics papers.

At the time of his retirement, John had over 100 research articles, many written with collaborators. Though knowledgeable about many things, his abiding passion was matrices. He encouraged colleague Professor Jennie Seberry (now at the University of Wollongong) in her work on Hadamard matrices and other combinatoric research. His friend Ailsa Land’s pioneering work in integer programming inspired John’s first PhD student, Dr Bob Dakin, to spend many years researching the Travelling Salesman Problem. His second PhD student, Professor Jenny Edwards (UTS), furthered the integer programming work on large sparse matrices especially in the early days of parallel programming. Another early PhD student, Professor Chung Yuen (Singapore), followed John’s hardware interests, becoming an expert on scalable computing. John encouraged colleague Professor Allan Bromley in his research into hardware, especially historical computing devices and the work of the 19th century computing pioneer Charles Babbage. John took great delight in the subsequent influence of the many descendants of Babbage on aspects of Australian life.

Though formally retired for some 25 years, John remained on top of the latest developments such as quantum computing. For many years he continued to attend conferences and seminars, asking his trademark penetrating questions. He was always an educator and visionary and an inspiration to all who came into contact with him.

John is survived by his wife Mary, son Christopher, daughters Ann, Sally and Jane and their families.

Jenny Edwards, University of Technology, PO Box 123, Broadway, NSW 2007, Australia

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Obituaries

Emeritus Professor Alfred Jacobus (Alf) van der Poorten

On October 9, 2010, at the young age of 68, Alf van der Poorten died from metastatic lung cancer. He had been ill for two and a half years and endured three operations and several rounds of radiotherapy and chemotherapy, but none of these treatments was able to arrest the progress of his illness. Australia has lost one of its leading pure mathematicians.

Alf modestly claimed to have “survived the ministrations of Sydney Boys High School”. In fact he excelled, and was ranked among the top few students in New South Wales in the Leaving Certificate Examination. After a year in a youth leadership program in Israel, Alf accepted a cadetship in mathematics at the University of New South Wales (UNSW) in 1961.

Alf was a student and then an academic at UNSW for eighteen years. Altogether he collected four degrees from the university. He first graduated in 1965 with a Bachelor of Science degree with Honours in Pure Mathematics. He next completed his doctorate in 1968. Alf avoided the compulsory general studies subjects of the science degree by pursuing a concurrent major sequence in Philosophy, which he later converted to a Bachelor of Arts with Honours. Lest his education be totally impractical, he then proceeded to complete an MBA degree.

During the 1960s Alf was extremely active politically. He was President of the UNSW Students’ Union Council from 1964 to 1965 and President of the UNSW University Union from 1965 to 1967. He served on the Council of the University from 1967 to 1973. He was also National President of the Jewish youth movement Betar, President of the Australian Union of Jewish Students and President of the State Zionist Youth Council. In 1966 he received the Australian Youth Citizenship Award “for his attainments in community service, academic achievement and youth leadership”. Alf joined the Board of Directors of the University Co-operative Bookshop Ltd in 1965 and remained a Director until 1982, serving as

Professor Gong was secretary general of the Beijing Mathematical Society, member of the National Natural Science Award Commission, editorial board member of Science China, Chinese Science Bulletin, and Chinese Annals of Mathematics.

As an educator, Professor Gong was a highly respected teacher. He engaged in teaching for most of his life, even after his retirement. He was awarded the Hua Luogeng Chaired Professor Award.

Professor Gong is survived by his wife, children and grandchildren.
Chairman of the Board from 1979.

Alf was interested in all of mathematics but his research was in diverse aspects of number theory. His doctoral supervisor was Kurt Mahler, who was a Professorial Fellow in the Research School of Mathematical Sciences at the Australian National University. Alf’s thesis was titled “Simultaneous algebraic approximations to functions” and it was in this work that he made his first contributions to transcendence theory. It is no surprise that Alf’s second paper was a note on “Transcendental entire functions mapping every algebraic number field into itself”. At UNSW he was particularly influenced by his teachers John Blatt and George Szekeres.

Alf was appointed Lecturer in Pure Mathematics at UNSW in 1969. I first met him late in 1970, at the time of my appointment, and he was already de facto Head of Department since George Szekeres had no interest in administrative details. Alf was promoted to Senior Lecturer in 1972 and to Associate Professor in 1976.

In 1972, John Loxton joined the department, and over the next decade Alf and John wrote twenty-one joint research papers—all of them serious contributions to number theory. A number of these papers were contributions to Baker’s method of linear forms in the logarithms of algebraic numbers and some extended Mahler’s method for determining transcendence and algebraic independence. Other papers related to growth of recurrence sequences and algebraic functions satisfying functional equations, and there was a sequence of papers investigating arithmetic properties of certain functions in several variables. They also wrote about regular sequences and automata. The collaboration of Alf van der Poorten and John Loxton was clearly the most important of both their mathematical careers.

During the 1970s, Alf spent time on study leave in Leiden, Cambridge (UK) and Kingston (Ontario). His hosts were Robert Tijdeman, Alan Baker and Paulo Ribenboim. He took advantage of this time outside Australia to rapidly build his network of mathematical collaborators. Later sabbatical leave periods took Alf, and often his whole family, to Israel, Bordeaux, Delft, Helsinki and Princeton.

In 1979, Alf was appointed Professor of Mathematics at Macquarie University. He was immediately immersed in administrative duties but still found the time and energy to expand his research output. He served as Head of the School of Mathematics, Physics, Computing and Electronics from 1980 to 1987 and again from 1991 to 1996. Macquarie University was founded only in the 1960s. Alf was asked to increase the research profile of the School, and he succeeded in this through making a number of excellent appointments.

In the periods he was not Head of School, Alf served on the Academic Senate. As Presiding Member of the Academic Senate, he was a member of Macquarie University’s Senior Executive and an ex-officio member of the University Council until his retirement from administrative activity at the end of 2001. Alf retired from Macquarie in 2002.

An unusual aspect of Alf’s research output was the number of his joint authors. Of his publications, 178 have been reviewed by Maths Reviews, and this number will rise over the next couple of years. Once he moved to Macquarie University, both Alf’s scholarship and his research output rapidly increased with a constant stream of overseas visitors, mainly courtesy of the Australian Research Council. MathSciNet currently lists sixty-five of Alf’s co-authors, with the most frequent collaborators being John Loxton, Michel Mendès France and Hugh Williams. The list also includes Enrico Bombieri, Richard Brent, John Coates, Paula Cohen, Bernhard Dwork, K. Inkeri, Sidney Morris, Bernhard Neumann, Jeffery Shallit, Igor Shparlinski, Robert Tijdeman and Michel Waldschmidt. In a document such as this it is not possible to fully analyse Alf’s research output. Perhaps it is best to mention work that Alf believed to be highlights of his research. He certainly considered much of the work with Loxton to be important. In addition, in 1988 he solved Pisot’s conjecture on the Hadamard quotient of two rational functions and he used these ideas to produce a new proof of the celebrated S-unit theorem. In 1992, jointly with Bernie Dwork, he studied the “Eisenstein constant”, providing sharp bounds on the Taylor coefficients of an algebraic power series. Work begun in the early 1980s with Bombieri led to the invariant Thue–Siegel method being applied to the explicit construction of curves with prescribed singularities. Finally, in 1999, Alf and Kenneth Williams succeeded in breaking up the Chowla–Selberg formula, allowing evaluation of the Dedekind eta function for all discriminants in terms of singular values of the L-functions.

Alf always attempted to prove that “mathematics is beautiful, elegant and fun, a language as worthwhile learning as any other”, as he remarked to a reporter in 1979. In part this was done by giving vivid and interesting colloquium talks on five continents. In addition, he put real effort into expository writing. One example of this was in 1978 when “A proof that Euler missed … Apéry’s proof of the irrationality of (3)” appeared in the first volume of the Mathematical Intelligencer.
Apéry was a professor of chemistry whose seminar on this surprising result was very terse and not believed by some mathematicians in the audience. Alf sorted out the details and published a full proof. I heard him give a very successful seminar on this material at Rutgers University in 1978. This talk was given at a dozen departments in the US during the fall of that year. As a second example, his fine book “Notes on Fermat’s Last Theorem” was published by Wiley-Interscience in 1996. Alf claimed that reading it “required little more than one year of university mathematics and an interest in formulas”. This is not quite true but nevertheless the book was awarded an American Publishers’ Award for Excellence in Mathematics.

Alf made significant contributions to the mathematics profession both within Australia and overseas. He was the founding Editor of the Australian Mathematical Society Gazette, served on the Council of the Society for many years and was President from 1996 to 1998. As President, he worked hard to reduce any remaining tension between pure and applied mathematicians in Australia. During his tenure as president the Council agreed to underwrite the 5th International Congress on Industrial and Applied Mathematics, ICIAM 2003, the first large mathematics congress to be held in Australia. This was an important and visionary undertaking for the Society.

In 1994–1995, Alf chaired a Working Party, with Noel Barton as Executive Officer, on behalf of the National Committee for Mathematics to report on “Mathematical Sciences Research and Advanced Mathematical Services in Australia”. In 1998 he was a member of the Canadian National Science and Engineering Research Council (NSERC) site visit committee to evaluate Canada’s three national Mathematical Sciences Research Institutes; and in 2003 he was a member of the Association of Universities in the Netherlands (VSNU) review committee for academic research in mathematics. In 1998, Alf joined the new Committee on Electronic Information Communication (CEIC) of the International Mathematical Union (IMU), and was reappointed in 2002 and 2006; he was also one of Australia’s three delegates to the quadrennial Assembly of the IMU at Dresden (1998), at Beijing (2002), and at Santiago de Compostela (2006).

Alf’s contribution to mathematics was recognised by the award of a Doctorate Honoris Causa by the Université Bordeaux I in 1998, for which he was nominated by Michel Mendès France. In his acceptance speech, Alf noted that he had visited the department so many times that he considered it to be his third University. In recognition of both his own mathematics and his services to mathematics in Australia, Alf, jointly with Ian Sloan, was awarded the inaugural George Szekeres Medal of the Australian Mathematical Society in 2002. He was also appointed a Member of the Order of Australia (AM) in the Australia Day Honours List 2004, for “service to mathematical research and education, particularly in the field of number theory”.

Away from mathematics most of Alf’s interests were rather sedentary. His writing of mathematics seemed to occur during the ad-breaks in televised football. He watched all the main codes of football as well as cricket, baseball and netball. Above all, he supported the St George Rugby League Football team from the early 1950s onwards. When mathematical inspiration was hard to come by, he read science fiction and mysteries. Alf claimed never to have thrown a book away and he thus owned some five thousand science fiction books and several thousand mysteries; but he was “not a collector, just a keeper”. Since he also owned a couple of thousand mathematics books, almost no part of his family home was without bookshelves.

Alf is survived by his mother Marianne, his wife Joy, his children David and Kate, and four grandchildren Elizabeth, James, Gabrielle and Ellie.

On behalf of the mathematical community across Australia, I acknowledge our great respect for Alf’s achievements. We honour the very substantial contribution Alf van der Poorten has made to mathematics in Australia.

David Hunt, University of New South Wales, Australia

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News from Australia

Australian Academy of Science

Congratulations to the following winners of 2011 awards made by the Australian Academy of Science! Citations can be found on the Academy's website at http://www.science.org.au/awards/awardees/2011awards.html.

Dr Anthony Henderson, University of Sydney: inaugural Christopher Heyde Medal for research in pure mathematics.

Professor Colin Rogers FAA, University of New South Wales: Hannan Medal for research in applied mathematics and computational mathematics.

Dr Scott Sisson and Dr Mark Tanaka, University of New South Wales: Moran Medal for research in statistics.

Professor Geoff McLachlan, University of Queensland, has been awarded the Pitman Medal by the Statistical Society of Australia “in recognition of outstanding achievement in, and contribution to, the discipline of Statistics”.

Cheryl Praeger, University of Western Australia, received a 2010 BH Neumann Award from the Australian Mathematics Trust for important contributions over many years to the enrichment of mathematics learning in Australia and its region.

Emeritus Professor John Makepeace Bennett

Emeritus Professor John Makepeace Bennett AO FTSE, who had been a member of the Society from 1957, died on December 9, 2010. Professor Bennett was Emeritus Professor of Computer Science at the University of Sydney and was a pioneering computer scientist. He was foundation president of the Australian Computer Society from 1966 to 1967. An obituary is included in this issue of the newsletter.

Professor Gavin Brown

It is with great regret that we report that Professor Gavin Brown AO FAA CorrFRSE died on December 25, 2010 in Adelaide after many months of ill health. Professor Brown went to Australia in 1975 to take up the Chair of Pure Mathematics at the University of New South Wales. He subsequently served as Dean of the Faculty of Science at UNSW, as Deputy Vice-Chancellor (Research) at the University of Adelaide and as Vice-Chancellor at the University of Adelaide followed by the University of Sydney, before being appointed as inaugural director of the Royal Institution of Australia in 2008. He was the second winner of the Australian Mathematical Society Medal, in 1982.

Professor Greg Hjorth

It is with great sadness and regret that we report the death of Greg Hjorth on January 13, 2011 at age 47. Professor Hjorth, of the Department of Mathematics and Statistics at the University of Melbourne, was internationally recognised as one of the top researchers in logic and set theory. He recently gave the Tarski Lectures in logic at UC Berkeley and had been a Professor at UCLA before returning to his home town of Melbourne as an ARC Professorial Fellow. He was also an International Master in Chess at age 20 and was considered one of Australia’s finest chess players.

IMU Executive Committee Annual Meeting 2011

The International Mathematical Union (IMU) Executive Committee (EC) had its annual meeting in Perth, Australia, in February 27–28, 2011. This was the first occasion of an EC meeting in Australia in IMU’s history. The meeting was hosted by the University of Western Australia, which also organised a two-days workshop, the MathWest Workshop 2011, one of the events in the University of Western Australia’s Year of Mathematics 2011. Invited speakers for the MathWest Workshop were Ingrid Daubechies, László Lovász, Christiane Rousseau, John Toland, Marcelo Viana, Wendelin Werner, Manuel de León, Yiming Long, Vasudevan Srinivas and Nalini Joshi. A forum entitled Mathematics: How a Nation Plans for the Future—the Spanish, Indian and Chinese Experience was also held during the workshop, with presentations from Manuel de León (Spain), Yiming Long (China) and Vasudevan Srinivas (India). It was chaired by Nalini Joshi (Australia).

News from China

2010 Ramanujan Prize Award Goes to a Chinese Mathematician

ICTP’s 2010 Ramanujan Prize has been awarded to Professor Yuguang Shi of the School of Mathematical Sciences, Peking University. The prize is in recognition of his outstanding contributions to the geometry of complete (noncompact) Riemannian manifolds, specifically the positivity of quasi-local...
The Ramanujan Prize, which is funded by the Norwegian Niels Henrik Abel Memorial Fund, is awarded annually to a researcher from a developing country aged below 45 years on December 31 of the year of the award, who has conducted outstanding research in a developing country. Researchers working in any branch of the mathematical sciences are eligible. The Prize carries a $15,000 cash award. ICTP awards the prize through a selection committee of five eminent mathematicians appointed in conjunction with the International Mathematical Union (IMU).

**USTC’s Acclaimed Pioneer of Mathematics, Gong Sheng Dies at 81**

Prof. Gong Sheng, former Vice President of University of Science and Technology, who was widely recognised as a distinguished mathematician, died of incurable cancer at Beijing on January 10, 2011. He was 81. An obituary is included in this issue of the newsletter.

**The 7th Chinese Female Scientists Award Goes to Prof. Zhi Lihong**

The 7th Chinese Female Scientists Award Ceremony was held in Beijing on January 11, 2011. Prof. Zhi Lihong was honoured with the prize.

Prof. Zhi Lihong focuses on the development of techniques and algorithms in symbolic and numeric computations. Beginning with her doctoral research at the Institute of Systems Science, she has been working in the complementary areas of symbolic and numeric computations, including exact multivariate polynomial factorisation over algebraic extension fields, symbolic-numeric hybrid algorithms for polynomials, and exact certificates for the polynomial optimisation problem.

The Chinese Female Scientists Award is awarded annually, which has garnered great attention in the circle of science and technology. More than 57 female scientists have received the prize in recent seven years.

**Yuan Yaxiang Named 2011 SIAM Fellow**

Prof. Yuan Yaxiang, from Academy of Mathematics and Systems Science, Chinese Academy of Sciences (AMSS) was elected as the Society for Industrial and Applied Mathematics (SIAM) Fellow of 2011. Prof. Yuan Yaxiang’s main research interest lies in nonlinear optimisation. As such, he is recognised for his contributions in this area and for his leadership in computational mathematics. He received the second Prize of the National Natural Science Award in 2006, the Young Scientist Award of China in 1996, China Top 10 Outstanding Youth award in 1998, etc. Dr. Yuan is currently the President of the Association of Asia Pacific Operations Research Societies and the President of the Operations Research Society of China. In addition, he serves on the Editorial Board of the SIAM Journal on Optimisation and Mathematics of Computation, etc.

SIAM is an international community, which exists to ensure the strongest possible interactions between...
Established in 2005, this annual prize is for outstanding contributions by very young mathematicians in areas influenced by Indian mathematician Srinivasa Ramanujan. The age limit for the prize has been set at 32 because Ramanujan achieved so much in his brief life of 32 years.

The $10,000 prize will be awarded at the International Conference on Number Theory and Automorphic Forms at SASTRA University in Kumbakonam, on December 22, Ramanujan's birthday. Dr. Zhang has made far-reaching contributions by himself, and in collaboration with others, to a broad range of areas in mathematics, including number theory, automorphic forms, L-functions, trace formulas, representation theory and algebraic geometry, the release said.

Born in China, Dr. Zhang has a 2004 bachelor's degree from Peking University, completed his PhD in Columbia University under the supervision of Shou-wu Zhang in 2009 and joined Harvard University as a post doctoral fellow.

Cooperation on Mathematics Education between Sweden and India

As part of the collaboration on mathematics education at the national level between India and Sweden, a workshop took place in Mumbai, February 22–26, 2011.

The first meeting between the Indian and Swedish working group for mathematics education took place in June 2010, at the National Center for Mathematics Education at Göteborg University (NCM). The meeting initiated a valuable discussion and pointed to the need for continued learning from each other, especially in institutionalisation of resource development for Mathematics education.

The second workshop, which took place at the Tata Institute of Fundamental Research in Mumbai in February 2011, was a realisation of this. The theme for the workshop was “Teacher Development”, which is a key topic and vividly discussed around the world right now. For more information on the Indo–Swedish mathematics collaboration, contact the Director of NCM, Bengt Johansson at bengt.johansson@ncm.gu.se.

Mathematical Modelling Meeting Held in Calicut

On March 28–31, 2011, noted mathematician John R. Ockendon from Oxford University, UK, inaugurated a four-day international conference on Mathematical Modelling and Applications to Industrial Problems,
organised by the mathematics department of the National Institute of Technology, Calicut, (NIT-C) at Aryabhatta Hall of the institute in Chathamangalam on Monday. More than 150 delegates from countries including Sri Lanka, Nepal and Slovenia and from all over India participated in the meet as delegates. Mathematicians, subject experts from the USA, the UK, Germany and Australia attended the conference as speakers.

**Indian Mathematical Society Award**

Dilip Kumar, Centre for Mathematical Sciences Pala Campus, Arunapuram, Kerala, has won the IMS Prize in Mathematics of the Indian Mathematical Society for the year 2010. Mr. Kumar was presented with the award at the annual conference of the Indian Mathematical Society held recently at the S. V. National Institute for Technology, Surat, for his research paper “Closed forms of extended thermonuclear reaction rates using generalised special functions and its implications”. He was also the recipient of the Young Scientist Award for the year 2010 of the International Academy of Physical Sciences, Allahabad.

**Chandrashekhar B. Khare**

**Awarded Infosys Prize 2010**

The Infosys Science Foundation named UCLA Mathematics Professor Chandrashekhar B. Khare the winner of the Infosys Prize 2010 in mathematical sciences. The prize recognises outstanding contributions to scientific research that have impacted India across five categories: mathematical sciences, physical sciences, engineering and computer science, life sciences and social sciences. Established in February 2009, the annual prize is one of the largest in terms of prize money for any such honour in India and seeks to elevate the prestige of scientific research in India and to inspire young Indians to pursue a career in scientific research. The award ceremony will be held on January 6, 2011 in Mumbai, where Dr. Manmohan Singh, Prime Minister of India will present to the winners the awards of INR 5 million, along with a pure gold medallion and a citation certificate each.

The Infosys Prize in Mathematics is awarded to Chandrashekhar B. Khare in recognition of his fundamental contributions to Number Theory, particularly his solution of the Serre conjecture. Citation by the Infosys Prize Mathematical Sciences Jury: “Number Theory is one of the central areas of mathematics that often establishes connections between analysis, algebra and geometry. Historically such connections can be traced back to the work of the great Indian mathematician Srinivasa Ramanujan, who discovered completely new number-theoretic aspects of modular forms, and whose ideas eventually led to the modern revolution in Number Theory. The Serre conjecture, formulated by Jean-Pierre Serre, one of the greatest living mathematicians and winner of the Abel Prize, postulates one such connection between modular forms and representations of Galois groups. The conjecture is strong enough to imply among other things, Fermat’s last theorem, a problem that had remained unsolved for more than three hundred years until it was solved by Andrew Wiles a few years back. Partly in collaboration with Wintenberger, Professor Chandrashekhar B. Khare settled the Serre conjecture in the affirmative. Professor Khare’s work is a major breakthrough in the field with many spectacular consequences, and many new ideas introduced in it are expected to dominate the field for years to come.”

**News from Indonesia**

**6th SEAMS–GMU 2011 Conference**

As part of its commitment to both the area of mathematics and to the South East Asian Mathematical Society (SEAMS), the Gadjah Mada University organises an international conference on mathematics and its applications together with SEAMS once every four years, in Yogyakarta, Indonesia. The first SEAMS–GMU Conference was held in 1991 and the last (5th) conference was held in 2007. The 6th SEAMS–GMU Conference will be conducted in July 12–15, 2011. The scientific program will include lectures, presentations and workshops.

The objectives of the conference are to provide a forum for researchers, lecturers, educators and students to exchange ideas, to communicate and discuss research findings and new advances in mathematics, statistics and computer science (theoretical, applied, computational). It is also hoped that the conference will encourage collaboration between researchers from countries in the region and those from outside the country. The workshop preceding the conference will demonstrate the application of mathematics in Finance and Biological Science. The workshop is intended to upgrade the teaching capabilities of mathematicians and applied researchers in the region, in the area of applied mathematics.
CIMPA–UNESCO–MICINN–INDONESIA Research School on Nonlinear Computational Geometry

This research school will take place during July 18–29, 2011 at the Universitas Gadjah Mada University, Yogyakarta, Indonesia. The aim of this school is to nurture new interests in this field, where fundamental mathematical topics and algorithmic issues can be combined to solve practical geometric problems of many applications. The potential of research developments in this important domain is great, from a theoretical, an algorithmic and even an applicative point of view. A good background both in mathematics and computer science is a main requirement for these investigations to take place. Geometric modelling is playing an increasing role in a wide range of domains: computer aided geometric design, geographic information systems, architecture, molecular biology, physical simulations, etc. The increasing demand for compact and powerful representations of shapes, for advanced techniques in geometric analysis and efficient tools in geometric computation had led to the rapid and recent development of nonlinear computational geometry. The objective of the school is to provide an initiation of nonlinear computational geometry and related domains such as effective algebraic geometry and real semi-algebraic set theory.

The 5th International Conference on Research and Education in Mathematics (ICREM5)

This conference will be held in October 22–24, 2011 at ITB Bandung, Indonesia. It is jointly organised by the Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung (ITB), the Institute for Mathematical Research, Universiti Putra Malaysia (INSPERM), the Institute of Mathematics, the Vietnam Academy of Science & Technology (IMVAST), the Indonesian Mathematical Society (IndoMS) and the Indonesian Combinatorial Society (InaCombS). ICREM5 will cover all fields in mathematics, statistics and their applications, as well as mathematical education.

News from Japan

The 2011 MSJ Spring Prize

The 2011 MSJ Spring Prize was awarded to Atsushi Shiho, an associate professor at Graduate School of Mathematical Sciences, the University of Tokyo. Atsushi Shiho is recognised for his outstanding contributions to “Study of \( p \)-adic cohomology and \( p \)-adic fundamental groups in arithmetic geometry”. The Spring Prize and the Autumn Prize of the Society are the most prestigious prizes awarded by the MSJ to its members. The Spring Prize is awarded to those below the age of 40 who have obtained outstanding mathematical results.

The 2011 JMSJ Outstanding Paper Prize

2011 JMSJ Outstanding Paper Prize was awarded to the article written by Michi-aki Inaba, “Moduli of Stable Objects in a Triangulated Category”, Vol. 62, No. 2 (2010) pp. 395–429. Michi-aki Inaba is a lecturer at the Department of Mathematics, Kyoto University. MSJ awards the JMSJ Outstanding Paper Prize each year.

Letter from MSJ

The earthquake that occurred on March 11 has caused considerable damage to the Tohoku District, the northeastern Japan, hence the Mathematical Society of Japan has decided to cancel the MSJ Spring Meeting 2011 scheduled on March 20–23 at Waseda University. The area worst hit by the quake is devastated but our colleagues near the area are starting to work towards getting back to their daily lives, including engaging in research activities.

Facing the un-experienced ordeal, we, the mathematicians and mathematical communities in Japan, have received a lot of encouraging messages and have felt cordiality from mathematical researchers and associations all over the world. On behalf of the colleagues in Japan, I would like to extend deep gratitude to all the people who are supporting and standing by us. Thank you all for the heart warming consideration shown.

Takashi Tsuboi
President of MSJ
starting in 2010, to the authors of the most outstanding articles published in JMSJ (the Journal of MSJ) in the preceding year. The prize committee comprises the editorial board members of JMSJ.

2011 MSJ Algebra Prize
The 2011 MSJ Algebra Prize was awarded to Shihoko Ishii, a professor at the Tokyo Institute of Technology. Shihoko Ishii was recognised for her "Fundamental and outstanding contribution to research in singularity theory of algebraic varieties".

The 7th JSPS Prize
Osamu Iyama was awarded the 7th JSPS Prize by the Japan Society for the Promotion of Science. Osamu Iyama, a professor in the Graduate School of Mathematics, Nagoya University, is honoured for his work on "Representation theory of orders".

Institute of Mathematics for Industry (IMI), Kyushu University (Foundation April 2011)
The purpose of the IMI is to act as "an institute to develop industrial mathematics by amalgamating a broad area of mathematical research". In order to develop applications for the industry from a long-term perspective, researchers in pure mathematics have been appointed, in addition to mathematicians focused on applications, to collectively contribute to mathematics to innovate for the industry.

The activities of IMI include (i) promoting collaboration within the industry, (ii) organising workshops and study groups, (iii) holding seminars for industry-academia partnerships and mathematical tutorials and (iv) raising the quantity and quality of PhDs and future human resources with mathematical background in the real world. The institute has three main divisions: (1) Advanced Mathematics Technology, (2) Applied Mathematics, (3) Fundamental Mathematics. In addition, in order to efficiently promote the above projects/activities, the Visiting Scholars Division, and Partnership Promotion and Technical Consultation Room have been set up.

The Takagi Lectures
The Takagi Lectures, which were inaugurated by the Mathematical Society of Japan (MSJ) in 2006, are the first series of MSJ lectures crowned by a Japanese mathematician. The lectures bear the name of the creator of the Class Field Theory, Professor Teiji Takagi (1875–1960). In Japan, he is also known as the founder of the Japanese School of modern mathematics. Internationally, he served as one of the first Fields Medal Committee Members, together with G. D. Birkhoff, E. Cartan, C. Caratheodory, and F. Severi in 1936. The Takagi Lectures are research survey lectures of the highest level by the finest contemporary mathematicians. They are intended for a wide range of mathematicians, and are held twice a year. The 9th Takagi Lectures will be held on June 4–5, 2011 at RIMS, Kyoto, with distinguished lecturers S. Brendle (Stanford University) and C. E. Kenig (University of Chicago). The lecture notes will be published by the Japanese Journal of Mathematics (JJM).

The 4th MSJ–SI “Nonlinear Dynamics in Partial Differential Equations”
MSJ–Seasonal Institute has been held annually by MSJ since 2008. Each year, the topic of the workshop is chosen by MSJ and leading mathematicians from all over the world are invited accordingly. MSJ especially emphasises on the importance of interaction with Asian mathematicians and the invitation of promising young Asian students.

The 4th MSJ–SI Meeting "Nonlinear Dynamics in Partial Differential Equations" will be held in Fukuoka, Kyushu, Japan during the period September 12–21, 2011. The conference will be divided into two parts: In the first half, during September 12–15, the topics dissipative system, variational method, pattern formations, interfacial equations, etc. will be covered. In the later half, during September 18–21, the topics fluid dynamics, dispersive system, wave equations, etc. will be covered.

List of speakers:
Plenary speakers (Introductory and survey lectures): Eduard Feireisl ('The Academy of Sciences of the Czech Republic), Nicola Fusco (University of Napoli 'Federico II'), Hiroshi Matano (University of Tokyo), Robert Pego (Carnegie Mellon University) and Grozdena Todorova (University of Tennessee)

Yoichi Miyaoka Takes Office as President of MSJ
Yoichi Miyaoka, Professor at the Graduate School of Mathematical Sciences, University of Tokyo, has begun a one-year term as President of the Mathematical Society of Japan in April.
Yoichi Miyaoka’s main area of interest is algebraic geometry, specifically, the theory of biregular theory of algebraic varieties and complex manifolds.

The board of trustees of the year 2011 is formed by the following members: Yoichi Miyaoka, Takayoshi Ogawa, Motoko Kotani, Masa-Hiko Saito, Nobuyuki Tose, Noriko Hirata, Kazuo Akutagawa, Goo Ishikawa, Miyuki Koiso, Takashi Tsuboi, Gen Nakamura and Hideyuki Majima.

News from Korea

2011 Korean Young Scientist Award

Prof. Seung-Yeal Ha of Seoul National University received the 2011 Korean Young Scientist Award in recognition of his outstanding achievements in establishing the stability theory of Boltzmann equation and proposing a new mathematical method for synchronisation theory of Kuramoto model. The model is widely used in the mathematical modelling of flocking phenomena and the synchronisation model in statistical physics. The Korean Young Scientist Award is given by the Korean Ministry of Education, Science and Technology and the Korean Academy of Science and Technology every other year to Korean scientists below the age of 40, who have outstanding achievements and great potential to become world scholars.

News from Malaysia

National Mathematical Olympiad

National Mathematics Olympiads is an annual event managed by the Malaysian Mathematical Sciences Society (PERSAMA). The competition will be held on June 18, 2011 (Saturday) 10:00am–12:30pm, at several centres throughout the country.

19th National Symposium of Mathematical Sciences

The 2011 National Symposium on Mathematical Sciences 19 (SKSM 19) is to be held in November 9–11, 2011. It is organised by the Department of Computer Science and Mathematics, Universiti Teknologi MARA, Penang, in collaboration with the Malaysian Mathematical Sciences Society (PERSAMA). The main objective of this symposium is to provide opportunities for scholars in the field of mathematical sciences to share ideas and views and also to present their results. The theme of this symposium is Ethnomathematics — A Fresh Start in the Exploration of Nature and Modern Technology.

News from Nepal

The CIMP A–UNESCO–Nepal Research School

The International Centre for Pure and Applied Mathematics (CIMPA), France, in collaboration with the Nepal Mathematical Society and Kathmandu University, successfully organised the CIMPA–UNESCO–Nepal Research School from July 19–31, 2011 at Kathmandu University, Duhlikel. It was the first ever international school of mathematics in Nepal. The objective of the school was to provide introductory training in number theory and cryptography to young researchers and graduate students from Nepal and neighbouring countries.

The School was targeted at pure mathematicians not necessarily with a background in computing, as mathematicians from Nepal need to organise and get involved in activities in this area.

The School consisted of two parts.

There were 11 lecturers from seven different countries, the countries being namely France (3), Italy (3), Spain (1), Canada (1), India (1), Japan (1) and Nepal (1). A total of 21 participants from 9 countries (Bangladesh (1), Czech Republic (2), India (6), Italy (1), Pakistan (6), Spain (1), Sri-Lanka (1), Thailand (3)) and 26 local participants attended the school.

News from New Zealand

Newly Elected Fellow of the Society of Industrial and Applied Mathematics Awarded the 2010 Van Wijngaarden Prize

John Butcher of the University of Auckland was elected a Fellow of the Society of Industrial and Applied Mathematics. He is the first New Zealand mathematician to be awarded this honour. Furthermore, John was awarded the Van Wijngaarden Prize for 2011. Awarded every five years by the Centrum Wiskunde and Informatica (CWI), this prize is awarded to two eminent scientists in the fields of mathematics and computer science.
2010 Jones Medal

The Jones Medal for 2010 was awarded to John Butcher of the University of Auckland. Awarded for the first time this year, the Jones Medal is “for lifetime achievement in the mathematical sciences”. (See APMN January 2011 issue, page 53 for more details)

Mihály being presented his award.

2010 NZMS Research Award

The NZMS Research Award for 2010 was presented at the NZMS Colloquium dinner at Larnach Castle (Dunedin) to Charles Semple of the University of Canterbury for his landmark contributions to combinatorics, and in particular matroid theory, as well as leading work in phylogenetics and computational biology.

Newly Elected Fellows of the Royal Society of New Zealand

Estate Khmaladze of Victoria University of Wellington and André Nies of the University of Auckland were elected Fellows of the Royal Society of New Zealand in 2010.

The New Zealand Mathematics Colloquium

The 2011 colloquium will be in Auckland, held jointly by UoA and AUT, December 6–8, 2011. Stephen Galbraith will be chair of the organising committee. For any web-related issues, please send your email to jshanks@maths.otago.ac.nz.

Last year’s New Zealand Mathematics Colloquium was on December 7–9, 2010, in the University of Otago, Dunedin. It was hosted by the Department of Mathematics and Statistics, University of Otago. The 117 participants were treated to 5 plenary addresses, more than 80 excellent contributed talks and 10 posters covering a wide range of topics. The NZMS lecturer this year was Andre Nies of the University of Auckland, speaking on “Interactions of computability and randomness”, the ANZIAM lecturer was John Butcher, also from Auckland, with a presentation entitled “Taylor series | pure and simple: The order of numerical methods for ordinary differential equations” and the NZIAS lecturer was Jacqui Ramagge from the University of Wollongong, talking on “Invariant differential operators on the sphere”. The final two plenaries were from Hamish Spencer of Otago and Michael Eastwood from ANU.

This year there were 16 participants in the Aitken Prize competition for the best student presentation. The winner was Rachael Tappenden (University of Canterbury) and there were two highly commended talks by Emily Harvard (University of Auckland) and Luke Fullard (Massey University), who each received a Springer book voucher.

Prof. Charles Semple (University of Canterbury) was given this year’s NZMS Research Award for landmark contributions to combinatorics, and in particular matroid theory, as well as leading work in phylogenetics and computational biology. The Early Career Award was given to Mihály Kovács (University of Otago) for his innovative research in the field of stochastic partial differential equations, particularly their numerical approximation. Finally, Professor Geoff Whittle of Victoria University was made the Aitken Lecturer for 2011.
The social part of the events started with a most enjoyable Welcoming Reception on the Tuesday night at the end of the first day. The Poster Session was held in this relaxed environment. A considerable amount of time and effort had been put into preparation of the posters and they made an impressive display. This year ANZIAM provided an award for the best poster at the colloquium, which was awarded to Kate Patterson (University of Auckland).

The support and facilities provided by the University of Otago were greatly appreciated and not even the Otago weather could dampen the magnificent view from Mount Cargill. A wonderful dinner at Larnach Castle was another highlight of the Colloquium. (By Agate Ponder-Sutton)

**News from Pakistan**

**21st Century Mathematics Meeting Held in Lahore**

Mathematicians from all over the world have gathered at the Abdus Salam School of Mathematical Sciences (ASSMS), GC University Lahore during February 9–13, 2011 for the 5th World Conference on 21st Century Mathematics 2011. European Mathematical Society President, Prof. Dr. Marta Sanz-Solé, was the guest of honour at opening ceremony of this meeting. About 200 research papers were presented at the five day conference, spread over 22 scientific sessions. Delegates from 40 countries including Austria, Belgium, Bulgaria, Croatia, England, Finland, France, Georgia, Germany, Hungary, Indonesia, Iran, Japan, Norway, Nepal, China, Poland, Romania, Russia, Slovak Republic, South Africa, Spain, Switzerland, Netherlands, Turkey, USA and Vietnam also attended the biggest ever international conference in Pakistan.

The Director General of GCU ASSMS Dr. A. D. Raza credited the success of the conference to its scientific committee, chaired by Prof. Gert-Martin Greuel, the Director of the German Mathematics Research Centre, Oberwolfach. He mentioned at the conference that in the years 2009–2010, the students and faculties published more than 270 research papers in core areas of mathematics in good international journals and out of these, 148 papers were published by the PhD students. “The activities at ASSMS have provided a direct or indirect upward push for a large number of Pakistani mathematics institutions. This push resulted in a remarkable increase of graduate students in Pakistan as well as significant enhancement in the quality of research.”

**12th International Pure Mathematics Conference**

The 12th International Pure Mathematical Conference 2011 is the latest conference in the series of Pure Mathematics Conferences that take place in Islamabad every year in July/August. It is a thematic conference on algebra, geometry, and analysis held under the auspices of the Algebra Forum and the Pakistan Mathematical Society. This time the conference will be in July 29–31, 2011 in Islamabad, the modern, peaceful and beautiful federal capital of Pakistan located at the footsteps of the scenic Margalla Hills. There will be free housing for foreign participants. Some travel grants are available for foreign speakers. Several recreational trips will be organised in and around Islamabad introducing the unique local and multi-ethnic culture.

**News from Philippines**

**2011 Annual Convention of MSP**

The 2011 annual convention of the Mathematical Society of the Philippines (MSP) will be held on May 20–21, 2011. It is hosted by the University of Santo Tomas, on the occasion of its quadricentennial anniversary. The MSP is celebrating its 38th year as the country’s largest professional organisation dedicated to the promotion of mathematics and mathematics education.

**SUPCOM 2011**

The Mathematical Society of the Philippines organises the Summer Upgrading Program for College Mathematics Teachers (SUPCOM 2011) to be held on May 23–24, 2011 at the College of Science, University of Santo Tomas, Manila. SUPCOM aims to help teachers of college-level mathematics upgrade their knowledge, sharpen their mathematical skills, and enrich their teaching techniques. This year’s topic will be on Counting Techniques and Probability.

**NCR Outstanding Finance Educator Award**

Dr. Elvira de Lara-Tuprio, Associate Professor of the Mathematics Department, won the National Capital Region (NCR) Regional Award during the 2010–2011 FINEX-Citibank Rafael B. Buenaventura Outstanding Finance Educator Awarding.
ceremony. It was held in January 26, 2011 at the Bangko Sentral ng Pilipinas. Dr. de Lara-Tuprio is the Director of the 5-year BS/MS Applied Mathematics major in Mathematical Finance (AMF) Program of the Mathematics Department.

This year, 29 nominees from all over the Philippines were screened. The ten finalists were then interviewed and ranked by the Board of Judges led by Cesar Buenaventura, the honouree’s elder brother and retired Pilipinas Shell Chairman, and Sanjiv Vohra, Citi Country Officer for the Philippines. The award aims to inspire finance teachers to achieve excellence and train students to become more competitive in the global workplace. The two previous recipients of this award from Ateneo de Manila University are Dr. Venus Ibarra, the 2008–2009 NCR Regional Awardee, and Dr. Darwin Yu, the 2007–2008 National Awardee. Both of them are from JGSOM Finance & Accounting Department. (By Darwin D. Yu)

**SEAMS–Manila School on the Applications of Algebra and Analysis**

The SEAMS School of Mathematics aims to bridge the difference in standards of undergraduate mathematics at the undergraduate level and mathematics done at the research level in regular International Centre for Pure and Applied Mathematics (CIMPA) Research Schools. The schools will be held in member countries of SEAMS by leading academic institutions or the national mathematical society. The SEAMS–Manila School on the Applications of Algebra and Analysis was held on April 4–15, 2011 at the University of the Philippines Diliman (UPD). It was organised and conducted by the Institute of Mathematics of UPD and the Mathematical Society of the Philippines. Funding for the school was provided by CIMPA–ICPAM, the Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD), the National Research Council of the Philippines (NRCP), Mathematical Society of the Philippines and UP.

The school consisted of ten days of lectures and problem-solving sessions on the areas of partial differential equations, number theory, coding, cryptography and mathematical modelling. The members of the Senior faculty of the UPD Institute of Mathematics gave the lectures and provided handouts. In particular, the school covered mini-courses: Introduction to Partial Differential Equations (15 hours); Number Theory, Coding and Cryptography (20 hours) and Introduction to Mathematical Modeling (15 hours). The school introduced topics and concepts that lead to active areas of research in mathematics to the participants. There were 32 participants, 24 from universities within and outside Metro Manila and 8 from other Southeast Asian countries.

**News from Singapore**

**44th Annual General Meeting of SMS**

The Singapore Mathematical Society (SMS) held its 44th Annual General Meeting on March 9, 2011. The meeting was preceded by the SMS Lecture given by Professor Koh Khee Meng from National University of Singapore (NUS) on Domination in Digraphs. The lecture series aims to feature eminent local mathematicians or mathematics educators to share with the public some of their interests and ideas. This lecture, however, was meant for the school teachers and college students. During this meeting, the out-going Committee nominated a new Committee for 2011, with Professor Zhu Chengbo as the President of SMS.

**The Distinguished Visitor Programme for 2011**

The Distinguished Visitor Programme was launched by the Singapore Mathematical Society (SMS) in 1998. Through the visit of a distinguished mathematician/mathematics educator, who will interact with both mathematicians/mathematics educators at the universities, as well as teachers and pupils at the schools in Singapore, the aim of the Programme is to expose as large and diverse an audience as possible to the excitement and relevance of mathematics, thereby enhancing the locals’ awareness of mathematics. The Distinguished Visitor for 2011 is Professor Frank Morgan, who is currently the Webster Atwell ‘21 Professor of Mathematics at the Williams College and Vice President of the American Mathematical Society. His research is on geometric measure theory and minimal surfaces. Professor Morgan is most famous for proving the double bubble conjecture on the minimum-surface-area enclosure of double bubbles. He is also well-known as the founder of SMALL, one of the largest and best known summer undergraduate mathematics research programs in the US. Professor Morgan has authored six books, including *The Math Chat Book 2000*, based on his live, call-in Math Chat TV show and Math Chat column. He will give a special guest lecture on “Isoperimetric Problems” and a public lecture on “Soap Bubbles in Mathematics”, and conduct two teachers'
workshops on "Teaching Geometry by Guessing What Soap Bubble Will Do" and "Soap Bubbles and Current Research" during his visit to Singapore during the first week of May, 2011.

Asian Initiative for Infinity

The Asian Initiative for Infinity (AII) is a program recently established at the Institute for Mathematical Sciences, National University of Singapore (NUS). The program is funded with a gift from the John Templeton Foundation.

The three-year AII program has a three-fold purpose: To produce innovative research specifically on Infinity, create a community of researchers on Infinity in Asia, and stimulate the discussion of Infinity among leading scholars. The vision of AII, located in Singapore, is to provide an incubator to broadly establish a robust and self-sustaining program in Mathematical Logic with an emphasis on Infinity in Asia. Since its initial phase, one of the Initiative’s major focus is on creating a critical mass of researchers on Infinity in Asia. This means educating and supervising a generation of gifted graduate students. The Asian Institute for Infinity will host three summer schools involving research and training. Each summer, AII will invite three senior participant lecturers to deliver series of lectures. These lectures are to be accessible to students who are poised to begin research and head the research frontier. The senior participants in the summer programs, including the lecturers, will be immersed in research. The anticipated breakthroughs are expected to create a unique conducive climate for all of the participants.

During the first year of the program, the AII Graduate Summer School (June 28–July 23, 2010) was held at the Institute for Mathematical Sciences and jointly organised by the Institute and the Department of Mathematics, NUS. The summer school had over sixty participants, including more than forty graduate students. The school featured three series of lectures delivered by Moti Gitik (Tel Aviv University), Denis Hirschfeldt (University of Chicago) and Menachem Magidor (Hebrew University of Jerusalem), as well as talks given by other participants. Among the participants were Theodore A. Slaman and W. Hugh Woodin of the University of California, Berkeley, who, together with Chi-tat Chong of NUS, had played a key role in conceiving and initiating the idea of the AII.

Upcoming activities of the program include the AII Graduate Summer School (June 15–July 13, 2011) and three workshops: Workshop on Set Theory (July 18–22, 2011), Workshop on Infinity and Truth (July 25–29, 2011), and Workshop on Recursion Theory (August 1–5, 2011). The third AII Graduate Summer School has been scheduled to take place in July 2012. Further information can be found at http://www2.ims.nus.edu.sg/prognsem.php

News from Taiwan

Taiwan Mathematical Society

The Taiwan Mathematical Society has invited Professor Kenji Fukaya of Kyoto University, an internationally well-known differential geometer, to be its first Hsu Chen-Jung Chair Professor. Professor Fukaya will give a series of lectures in differential geometry in a seminar which will be held in October 2011. The Hsu Chen-Jung Chair, donated by Hsu’s family, is sponsored by the Mathematical Society of Republic of China and the Institute of Mathematics, Academia Sinica. It is in memory of Professor Hsu for his effort in developing mathematical research and encouraging the young mathematicians in Taiwan.

Hsu, Sze-Bi Appointed MOE National Chair Professor (February 1, 2011–January 31, 2014)

Sze-Bi Hsu is a Professor of Mathematics at the National Tsing Hua University. Professor Hsu’s research field is applied mathematics, involving applying ordinary differential equations, partial differential equations, and dynamical systems to Mathematical Biology and Mathematical Physics. He has published more than eighty papers. He is well-known for his work in Mathematical Ecology, especially the competition theory of phytoplankton species for nutrients and light in chemostat and water column. He studies the conditions for the coexistence and extinction of competing species under the seasonal fluctuation and spatial effect.

Chen, Jung-Kai Received Morningside Medal of Mathematics, ICCM 2010

Jung-Kai Alfred Chen, a Professor of Mathematics at the National Taiwan University, has been awarded the 2010 Morningside medal in Mathematics by the International Congress of Chinese Mathematicians. Professor
Jung-Kai Alfred Chen and Professor Meng Chen have been jointly awarded the 2010 Morningside Silver Medal of Mathematics for their breakthrough in explicit birational classification of algebraic threefolds. In particular, they determined the effective optimal bound for the pluri-canonical system, giving rise to birational maps for threefolds of general types. It is the only complete result that has been obtained since Bombieri’s famous similar work for surfaces. They also successfully applied their theory to the study of Fano threefolds and got optimal boundedness.

**Li, Wen-Ching Awarded S. S. Chern Medal, ICCM 2010**

Wen-Ching Winnie Li, Director of the National Center of Theoretical Science, Taiwan and a professor of mathematics at Penn State University, has been awarded the 2010 Chern Prize in Mathematics by the International Congress of Chinese Mathematicians for her outstanding contributions to the field of number theory. The S. S. Chern Medal was established in 2001 in honour of Professor Shiing-Shen Chern. Li’s research focuses on number theory. She studies the theory of automorphic forms, applications of number theory to coding theory and spectral graph theory. In particular, she has applied her research results in automorphic forms and number theory to construct efficient communication networks called Ramanujan graphs and Ramanujan complexes. Her thesis work on the theory of modular forms was cited in Andrew Wiles’ historical paper in which the 350-year-old unsolved problem — “Fermat’s Last Theorem” — was proven. In recent years, Li has revitalised the research on a field of mathematics known as arithmetic of modular forms for noncongruence subgroups.

**News from Thailand**

**CIMP–UNESCO–MICINN–Thailand Research School on Spectral Triples and their Applications**

The CIMPA–UNESCO–MICINN–Thailand Research School on Spectral Triples and their Applications will be held at Chulalongkorn University, Bangkok, Thailand in May 15–18, 2011. The main aim of the school is to offer to a broad introduction of the metric aspects of noncommutative geometry with a more specific focus on spectral geometry in the language of A. Connes’ spectral triples, their several variants (in quantum groups and in modular theory) and their important applications in mathematics (spin geometry, index theory, number theory) and physics (quantum mechanics, quantum field theory, quantum gravity). Other aims of the research school include training of local researchers/students in the above mentioned topics and the establishment of strong regional research collaborations.

However, its main goal is to avoid isolation from the international research community, providing up to date courses on some the main current topics of interests in non-commutative geometry and a basis for future collaboration with colleagues, students and researchers from Europe/Australia/America/Asia. In the South East Asia region, (apart from the organisers in Thailand) there are already a few small research groups and individuals that are active/interested in the field of operator algebras and noncommutative geometry.

**News from Vietnam**

**Founding of VIASM**

The new institution “Vietnam Institute for Advanced Study in Mathematics” (VIASM) was founded on December 23, 2010. This is a government institute modelled after IAS at Princeton University. The main mission of this institute is to promote the development of Mathematics in Vietnam and in the region. Professor Ngô Bảo Châu of Chicago University, Fields medallist 2010, was appointed by the Minister of the Vietnam Ministry of Education and Training as the first scientific director of VIASM. Further governors will be appointed in a near future. It is expected that VIASM will start functioning in its entirety in 2012.

**19th Mathematical Olympiad**

The 19th Mathematical Olympiad for university students of Vietnam will be held at Quy Nhon University during April 12–16, 2011. It is a traditional competition and it attracts more than 700 students from more than 70 universities in Vietnam yearly.

**SMF and VMS Joint Congress**

A joint congress of the French Mathematical Society (SMF) and the Vietnamese Mathematical Society (VMS) will take place at the University of Hue on August 20–24, 2012.
Conferences in Asia Pacific Region

APRIL 2011

4 – 15 Apr 2011
SEAMS — Manila School on the Applications of Algebra and Analysis
Quezon City, Philippines

7 – 8 Apr 2011
ORS 2011 — Operational Research and Statistics
Penang, Malaysia
http://www.orstat.org/

7 – 22 Apr 2011
NCTS Lecture Series: “Finite Group Schemes over Rings of Integers of Number Fields”
Hsinchu, Taiwan

9 Apr 2011
NCATC 2011 — National Conference on Advanced Trends in Computing
Tirunelveli, India
http://www.itcian.com/Conference/index.html

11 – 15 Apr 2011
NCTS Lecture Series: “Introduction to the Sato-Tate conjecture for algebraic varieties”
Hsinchu, Taiwan

11 – 15 Apr 2011
Workshop in Complex and Algebraic Geometry
Beijing, China
http://www.math.ac.cn/WICAG2011/home.html

12 – 14 Apr 2011
ICMCB 2011 — International Conference on Mathematical and Computational Biology 2011
Malacca, Malaysia
http://einspem.upm.edu.my/icmcb2011

15 – 16 Apr 2011
RTAMST 2011 — National Conference on Recent Trends in Applications of Mathematics in Science and Technology
Visakhapatnam, India

15 – 17 Apr 2011
Chengdu, China
http://www.icdip.org/cfp.htm

16 – 17 Apr 2011
AAAC 2011 — The 4th Annual Meeting of Asian Association for Algorithms and Computation
Hsinchu, Taiwan

17 – 22 Apr 2011
EIMI 2011 — Conference on Polynomial Computer Algebra
St. Petersburg, Russia

19 – 21 Apr 2011
ICMSAO 2011 — 4th International Conference on Modelling, Simulation and Applied Optimisation
Kuala Lumpur, Malaysia
http://webk1.utm.my/icmsao2011/

22 – 24 Apr 2011
SMSEM 2011 — International Symposium on System Modelling, Simulation and Engineering Mathematics
Wuhan, China
http://www.issmsem.org/

23 Apr 2011
Gwalior, India
http://www.gecgwrl.org/PTMA-2011.htm

25 – 27 Apr 2011
ICMS2011 — The 4th International Conference on Modelling and Simulation
Phuket Island, Thailand
www.wjms.org.uk/icms2011

25 – 29 Apr 2011
Stochastic Partial Differential Equations and Related Topics
Tianjin, China
http://www.nim.nankai.edu.cn/activities/conferences/hy20110425/index.htm

27 – 28 Apr 2011
The 3rd Conference on Mathematical Sciences
Zarqa, Jordan
http://www.zpu.edu.jo/CMS/cms.htm

27 – 29 Apr 2011
Singapore

27 – 29 Apr 2011
ICI 2011 — 2nd International Conference on Informatics & Workshop on Machine Learning in Bioinformatics
Canakkale, Turkey
http://www.iciconference.org/conference

28 Apr – 1 May 2011
2011 2nd International Workshop on Pure and Applied Topology
Jeonju City, Korea
http://en.chonbuk.ac.kr

29 – 30 Apr 2011
ICAPM 2011 — 2011 International Conference on Applied Physics and Mathematics
Chennai, India
http://www.icapm.org/cfp.htm

30 Apr 2011
2011 Korean Mathematical Society (KMS) Spring Conference
Seoul, Korea
http://www.kms.or.kr/meetings/spring2011/home.htm

30 Apr – 4 May 2011
Fourth International Conference on the History of Mathematics and Mathematics Education
Shanghai, China
http://www.cms.org.cn/cms/

MAY 2011

2 – 4 May 2011
ICICI 2011 — 2011 International Conference on Network and Computational Intelligence
Zhengzhou, China
http://www.icici.org/cfp.htm

2 – 4 May 2011
NEDETAS 2011 — New Developments in Theory and Applications of Statistics: An International Conference in Memory of Professor Moti Lal Tiku
Ankara, Turkey
http://www nedetas.metu.edu.tr

2 – 5 May 2011
EPIREP2011 — T Cell Epitope Modelling and Their Effect on Viral Dynamics
Ramat Gan, Israel
2 – 5 May 2011
SAMPTA 2011 — The 9th International Conference on Sampling Theory and Applications
Singapore
http://sampta2011.ntu.edu.sg/

3 May 2011
2nd Singapore Mathematics Symposium
Singapore

5 – 8 May 2011
DIMACS’11 — International Conference on Discrete Mathematics & Computer Science
Mohammedia, Morocco
http://www.fstm.ac.ma/pageweb-DIMACS11-7-2-11/index.htm

12 – 14 May 2011
2011 CTS Conference on Dynamical Systems
Hsinchu, Taiwan

14 – 15 May 2011
CMSP ’11 — International Conference on Multimedia and Signal Processing
Guilin, China
http://ncis-cmsp2011.gxnu.edu.cn/

15 – 20 May 2011
Research Workshop on Ergodic Theorems, Group Actions and Applications
Beer Sheva, Israel
http://www.math.bgu.ac.il/~ergodic/

15 – 21 May 2011
Workshop on "Recent Developments in Nonlinear Partial Differential Equations: Part II"
Hong Kong, China
http://www.ims.cuhk.edu.hk/activities/conferences/20110515-21/

15 – 28 May 2011
CIMPA–UNESCO–MICINN–Thailand Research School on Spectral Triples and Their Applications
Bangkok, Thailand
http://www.cimpa-icpam.org/spip.php?article305

18 – 19 May 2011
4th International Conference of Iranian Operations Research Society
Rasht, Iran
http://research.guilan.ac.ir/or2011/index.php?i=1

18 – 21 May 2011
10th IMACS International Symposium on Iterative Methods in Scientific Computing
Marrakech, Morocco
http://www-lmpa.univ-littoral.fr/IMACS10/

19 – 22 May 2011
International Conference on Designs, Matrices and Enumerative Combinatorics
Taipei, Taiwan

20 – 21 May 2011
Mathematical Society of the Philippines (MSP)
2011 Annual Convention
Manila, Philippines
http://www.mathsocietyphil.org/MSPConvention.html

20 – 22 May 2011
Workshop: "The Method to Yield Analytical Solutions for Dynamic Systems"
Ochakov, Ukraine
http://selflab.com.ua/index2.htm

21 May 2011
Bhiwani, Haryana India
http://rtmc.titsbhiwani.org/

21 – 26 May 2011
The Sixth International Conference "Inverse Problems: Modelling and Simulation"
Antalya, Turkey
http://www.ipms-conference.org/index.html

21 – 27 May 2011
5th International Conference on Complex Analysis and Dynamical Systems
Akko, Israel
http://conferences.braude.ac.il/math/math2011/

22 – 27 May 2011
Prague, Czech Republic
http://www.icassp2011.com

22 – 27 May 2011
CCDC 2011 — Chinese Control and Decision Conference
Mianyang, China
http://www.ccdc.neu.edu.cn/

22 – 27 May 2011
TAMC 2011 — 8th Annual Conference on Theory and Applications of Models of Computation
Tokyo, Japan
http://www.tamc2011.com/

23 – 25 May 2011
MAMERN’11 — 4th International Conference on Approximation Methods and Numerical Modelling in Environment and Natural Resources
Saidia, Morocco
http://mamern11.ump.ma/

23 – 25 May 2011
AMS 2011 — 5th Asia International Conference on Mathematical Modelling and Computer Simulation
Kuala Lumpur, Malaysia (23 May) and Manila, Philippines (26 – 27 May)
http://ams2011.info

24 – 27 May 2011
High Dimensional Statistics: Advances and Challenges Conference
Singapore
http://www1.spms.ntu.edu.sg/~stats/

24 – 27 May 2011
The 15th Pacific–Asia Conference on Knowledge Discovery and Data Mining
Shenzhen, China
http://pakdd2011.pakdd.org/

24 – 28 May 2011
7th Shanghai Conference on Combinatorics
Shanghai, China
http://math.sjtu.edu.cn/conference/?shcc/

25 – 27 May 2011
ICAMSC 2011 — International Conference on Applied Mathematics and Scientific Computing
Tokyo, Japan
http://www.waset.org/conferences/2011/tokyo/icamsc/

25 – 27 May 2011
ICCM 2011 — International Conference on Computational Mathematics
Tokyo, Japan
http://www.waset.org/conferences/2011/tokyo/iccm/

25 – 27 May 2011
ICCSDA 2011 — International Conference on Computational Statistics and Data Analysis
Tokyo, Japan
http://www.waset.org/conferences/2011/tokyo/iccsda/

25 – 27 May 2011
ICFSNC 2011 — International Conference on Fuzzy Systems and Neural Computing
Tokyo, Japan
http://www.waset.org/conferences/2011/tokyo/icfsnc/

25 – 27 May 2011
ICMBE 2011 — International Conference on Mathematical Biology and Ecology
Tokyo, Japan
http://www.waset.org/conferences/2011/tokyo/icmb/

25 – 27 May 2011
ICMCS 2011 — International Conference on Mathematics and Computational Science
Tokyo, Japan
http://www.waset.org/conferences/2011/tokyo/icmcs/

26 – 28 May 2011
12th International Symposium on Econometrics, Operations Research and Statistics
Denizli, Turkey

26 – 28 May 2011
NCTS Workshop on Fluid-Structure Interaction Problems
Hsinchu, Taiwan
JUNE 2011

1 – 2 Jun 2011
ICOMLAI 2011 — International Conference on Machine Learning and Artificial Intelligence
Penang, Malaysia

1 – 3 Jun 2011
ICCS 2011 — 11th International Conference on Computational Science
Tuskuba, Japan
http://www.iccs-meeting.org/

1 – 3 Jun 2011
ICCS 2011: "The Ascent of Computational Excellence"
Singapore
http://www.iccs-meeting.org/iccs2011/

1 – 3 Jun 2011
First International Workshop on Advances in High-Performance Computational Earth Sciences: Applications and Frameworks (IHPCES)
Tuskuba, Japan
http://nlccu.u-tokyo.ac.jp/ihpces2011/

1 – 3 Jun 2011
Second International Workshop on Computational Stochastics
Singapore

1 – 4 Jun 2011
Aydin, Turkey

2 Jun 2011
ICACCN 2011 — International Conference on Advanced Computing, Communication and Networks
Chandigarh, India
http://icaccn.uacee.org

2 Jun 2011
Mathematics Teachers’ Conference 2011 — Communications, Reasoning & Connections
Singapore
http://math.nie.edu.sg/ame/mtc11/

3 – 5 Jun 2011
5th International Conference on Mathematical Biology
Nanjing, China
http://www.cms.org.cn/cms/

3 – 5 Jun 2011
ICMG 2011 — International Conference on Mathematics and Geosciences
Lasi, Romania
http://www.icfsc.org/icmg/

3 – 6 Jun 2011
ICMB 2011 — The 5th International Congress on Mathematical Biology
Nanjing, China
http://web.nuist.edu.cn/slxy/ICMB2011

4 – 5 Jun 2011
The 9th Takagi Lectures
Kyoto, Japan
http://www.ms.u-tokyo.ac.jp/~toshi/takagi/

6 – 8 Jun 2011
ICEMath 2011 — The International Conference on Numerical Analysis and Optimisation
Yogyakarta, Indonesia
http://icecmath2011.ual.ac.id/wp

6 – 10 Jun 2011
International Workshop on Representation Theory and Harmonic Analysis
Tianjin, China
http://www.ssr.nankai.edu.cn/

6 – 11 Jun 2011
NCTS Taiwan-Norway workshop in Analysis and Applications
Hsinchu, Taiwan

6 – 11 Jun 2011
NCTS Taiwan-Norway workshop in Analysis and Applications
Hsinchu, Taiwan

6 – 11 Jun 2011
NCTS Taiwan-Norway workshop in Analysis and Applications
Hsinchu, Taiwan

7 – 11 Jun 2011
Workshop on Finite Groups and Their Automorphisms
Istanbul, Turkey
http://istanbulgroup.metu.edu.tr

10 – 12 Jun 2011
ICEMP 2011 — International Conference on Engineering Mathematics and Physics
Chengdu, China
http://www.icemp.org

10 – 18 Jun 2011
Seminar on the Pretreatment of Algebraic Equations and Iterative Algorithm
Lanzhou, China
http://www.cms.org.cn/cms/

13 – 16 Jun 2011
2011 International Conference on Applied Mathematics and Interdisciplinary Research
Tianjin (13 – 15 Jun), Beijing (16 Jun), China
http://www.isam.nankai.edu.cn/
27 Jun 2011
DCDV 2011 — The 1st International Workshop on Dependability of Clouds, Data Centres and Virtual Computing Environments
Hong Kong, China
http://www.cse.ust.hk/DCDV2011/cfp.html

27 – 29 Jun 2011
EASI 2011 — The 7th East Asia SIAM Conference
Tokyo, Japan
http://oishi.info.waseda.ac.jp/~easi2011/

27 – 30 Jun 2011
FUZZ 2011 — IEEE International Conference on Fuzzy Systems
Taipei, Taiwan

27 Jun – 1 Jul 2011
2nd Istanbul Design Theory, Graph Theory and Combinatorics Conference
Istanbul, Turkey

27 Jun – 2 Jul 2011
2011 Conference on Graph Theory and Combinatorics & Sixth Cross-Strait Conference on Graph Theory and Combinatorics
Hsinchu, Taiwan
http://jupiter.math.nctu.edu.tw/~comb/druupal/

27 Jun – 15 Jul 2011
Sino–French Summer Institute 2011 in Arithmetic Geometry
Tianjin, China
http://www.nim.nankai.edu.cn/activites/workshop201107/index.htm

28 – 29 Jun 2011
DMO’11 — 3rd Conference on Data Mining and Optimisation
Putrajaya, Malaysia
http://dmo.ukm.my/dmo11

28 – 29 Jun 2011
International Conference on Pattern Analysis and Intelligent Robotics
Putrajaya, Malaysia
http://www.ftsm.ukm.my/icpair/

29 Jun – 1 Jul 2011
ICSDM 2011 — IEEE International Conference on Spatial Data Mining and Geographical Knowledge Services
Fuzhou, China
http://www.icsdm2011.org/

29 Jun – 2 Jul 2011
ICAAA 2011 — International Conference on Applied Analysis and Algebra
Istanbul, Turkey
http://www.icaa1.1.yildiz.edu.tr

30 Jun – 2 Jul 2011
CSIIS 2011 — The 5th International Conference on Complex, Intelligent, and Software Intensive Systems
Seoul, South Korea
http://dslab.cs.seikei.ac.jp/conf/csis2011

JULY 2011

1 – 5 Jul 2011
Suzdal 2011 — International Control on Mathematical Control Theory and Mechanics
Vladimir, Russia

3 – 6 Jul 2011
The 2nd IMS Asia Pacific Rim Meetings
Tokyo, Japan
http://www.sonic-city.or.jp/modules/english/

3 – 7 Jul 2011
Alice Spring, Australia

4 – 8 Jul 2011
2011 Taiwan International Conference on Geometry (Special Lagrangians and Related Topics)
Taipei, Taiwan

4 – 8 Jul 2011
Econometric Society Australasian Meeting, Adelaide, Australia
http://www.alloccasionsgroup.com/ESAM2011

4 – 8 Jul 2011
Workshop on The Arithmetic Geometry of Shimura Varieties and Rapoport-Zink Spaces
Kyoto, Japan
http://www.math.kyoto-u.ac.jp/~tettsushi/workshop201107/

4 – 10 Jul 2011
ICTA 2011 — International Conference on Topology and Its Applications
Islamabad, Pakistan
http://www2.citl.eduit.pk/icta/

5 – 12 Jul 2011
2011 8th International Algebraic Conference
Luhansk, Ukraine
http://iacouna2011.luguniv.edu.ua

6 – 8 Jul 2011
ICMFE 2011 — International Conference on Mathematical Finance and Economics
Istanbul, Turkey

8 – 9 Jul 2011
Conference in Honor of the 60th Birthday of Chang-Shou Lin
Taipei, Taiwan

10 – 13 Jul 2011
ICWAPR 2011 — International Conference on Wavelet Analysis and Pattern Recognition
Guilin, China
http://www.icmlc.com

10 – 15 Jul 2011
IFORS 2011 — Conference for the International Federation of Operational Research Societies
Melbourne, Australia
http://www.ifors2011.org/

10 – 15 Jul 2011
PME35 — 35th Conference of the International Group for the Psychology of Mathematics Education
Ankara, Turkey

10 – 16 Jul 2011
International Conference on Analysis and Its Applications
Aligarh, India
http://www.amu.ac.in/conference/icaa2011/

10 – 16 Jul 2011
International Conference on Rings and Algebras in Honour of Professor Pjek-Hwee Lee
Taipei, Taiwan

11 – 13 Jul 2011
ISSME 2011 — International Seminar in Science and Mathematics Education
Johor, Malaysia

11 – 13 Jul 2011
NDT 2011 — 3rd International Conference on Networked Digital Technologies
Macau, China
http://www.dif.org/nrd

11 – 15 Jul 2011
A Conference in Honor of the 70th Birthday of S. R. Srinivasa Varadhan
Taipei, Taiwan

12 – 15 Jul 2011
Australasian Applied Statistics Conference
North Queensland, Australia

12 – 15 Jul 2011
The 6th SEAMS–GMU 2011 International Conference on Mathematics and Its Applications
Yogyakarta, Indonesia
http://seams2011.fmipa.ugm.ac.id/index.htm

14 – 18 Jul 2011
International Conference on Ring Theory Dedicated to the 90th Anniversary of A. L. Shirshov
Novosibirsk Akademgorodok, Russia
http://math.nsc.ru/conf/rtc
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
<th>Website</th>
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</thead>
<tbody>
<tr>
<td>18 – 22 Jul</td>
<td>Workshop on Non-abelian Class Field Theory</td>
<td>Pohang, Korea</td>
<td><a href="http://math.postech.ac.kr/~minhyong/nacfts.htm">http://math.postech.ac.kr/~minhyong/nacfts.htm</a></td>
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<tr>
<td>20 – 26 Jul</td>
<td>12th National Lie Algebra Meeting</td>
<td>Huzhou, China</td>
<td><a href="http://www.cms.org.cn/cms/">http://www.cms.org.cn/cms/</a></td>
</tr>
<tr>
<td>25 – 27 Jul</td>
<td>ASONAM 2011 — The 2011 International Conference on Advances in Social Networks Analysis and Mining</td>
<td>Kaohsiung, Taiwan</td>
<td><a href="http://asonam.im.nuk.edu.tw">http://asonam.im.nuk.edu.tw</a></td>
</tr>
<tr>
<td>8 – 10 Aug</td>
<td>IC3 2011 — 4th International Conference on Contemporary Computing</td>
<td>Noida, India</td>
<td><a href="http://www.jit.ac.in/jit/ic3">http://www.jit.ac.in/jit/ic3</a></td>
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<tr>
<td>15 – 16 Aug</td>
<td>Annual International Conference on Quantum and Molecular Computing and Communications</td>
<td>Singapore</td>
<td><a href="http://www.qmcomputing.org/">http://www.qmcomputing.org/</a></td>
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<tr>
<td>6 – 8 Sep</td>
<td>MOL 12 2011 — 12th Meeting on Mathematics of Language</td>
<td>Nara, Japan</td>
<td><a href="http://sites.google.com/site/mol12nara/">http://sites.google.com/site/mol12nara/</a></td>
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### AUGUST 2011

### SEPTEMBER 2011
<table>
<thead>
<tr>
<th>Date</th>
<th>Conference Title</th>
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<tbody>
<tr>
<td>7 – 9 Sep 2011</td>
<td>International Conference on Brain Informatics (BI 2011)</td>
<td>Lanzhou, China</td>
<td><a href="http://wi-consortium.org/conferences/amtbi11/">http://wi-consortium.org/conferences/amtbi11/</a></td>
</tr>
<tr>
<td>12 – 21 Sep 2011</td>
<td>The 4th MSJ-51 — Non-linear Dynamics in Partial Differential Equations</td>
<td>Fukuoka, Japan</td>
<td><a href="http://www2.math.kyushu-u.ac.jp/~tohru/msj51/">http://www2.math.kyushu-u.ac.jp/~tohru/msj51/</a></td>
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<tr>
<td>26 – 29 Sep 2011</td>
<td>The 5th Sino–Japan Optimisation Meeting</td>
<td>Beijing, China</td>
<td><a href="http://isecc.ac.cn/~sjom/index.htm">http://isecc.ac.cn/~sjom/index.htm</a></td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td>Location</td>
<td>Details</td>
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<tr>
<td>22 – 24 Oct 11</td>
<td>ICREMS — The 5th International Conference on Research and Education in Mathematics</td>
<td>Bandung, Indonesia</td>
<td><a href="http://www.math.itb.ac.id/~nanang/topic.html">http://www.math.itb.ac.id/~nanang/topic.html</a></td>
</tr>
<tr>
<td>7 – 11 Nov 11</td>
<td>The 6th International Conference on Numerical Optimisation and Numerical Linear Algebra</td>
<td>Xiamen, China</td>
<td><a href="http://isc.cc.ac.cn/~iconlcn/index.htm">http://isc.cc.ac.cn/~iconlcn/index.htm</a></td>
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<tr>
<td>16 – 18 Nov 11</td>
<td>FCST 2011 — The 6th International Conference on Frontiers of Computer Science and Technology</td>
<td>Changsha, China</td>
<td><a href="http://trust.csu.edu.cn/conference/fcst2011/">http://trust.csu.edu.cn/conference/fcst2011/</a></td>
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<tr>
<td>19 – 21 Nov 11</td>
<td>International Conference on Analysis and Its Applications</td>
<td>Aligarh, India</td>
<td><a href="http://www.amu.ac.in/conference/icao2011/">http://www.amu.ac.in/conference/icao2011/</a></td>
</tr>
<tr>
<td>19 – 23 Nov 11</td>
<td>International Workshop on Advanced Computational Intelligence and Intelligent Information</td>
<td>Suzhou, China</td>
<td><a href="http://www.ewh.ieee.org/soc/eds/imw/">http://www.ewh.ieee.org/soc/eds/imw/</a></td>
</tr>
<tr>
<td>9 – 11 Dec 11</td>
<td>CISE 2011 — International Conference on Computational Intelligence and Software Engineering Wuhan, China</td>
<td>Wuhan, China</td>
<td><a href="http://www.ciseng.org/2011/">http://www.ciseng.org/2011/</a></td>
</tr>
<tr>
<td>14 – 16 December 2011</td>
<td>IICAI 2011 — 5th Indian International Conference on Artificial Intelligence Tumkur, India</td>
<td>Tumkur, India</td>
<td><a href="http://www.iconference.org">http://www.iconference.org</a></td>
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**January 2012**

<table>
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<tr>
<th>Date</th>
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**February 2012**

<table>
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<tr>
<th>Date</th>
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**March 2012**

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<tr>
<th>Date</th>
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**June 2012**

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<th>Date</th>
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<tr>
<td>4 – 8 Jun</td>
<td>Arithmetic Geometry Week in Tokyo</td>
<td>Tokyo, Japan</td>
<td><a href="http://www.ms.u-tokyo.ac.jp/~t-saita/conf/agwtodai/agwtodai.html">http://www.ms.u-tokyo.ac.jp/~t-saita/conf/agwtodai/agwtodai.html</a></td>
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**July 2012**

<table>
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**August 2012**

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<th>Date</th>
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<tr>
<td>20 – 24 Aug</td>
<td>SMF–VMS Joint Congress</td>
<td>Hue, Vietnam</td>
<td><a href="http://smf.emath.fr/content/smf-vms-joint-congress">http://smf.emath.fr/content/smf-vms-joint-congress</a></td>
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**September 2012**

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<tbody>
<tr>
<td>MONTH</td>
<td>DATE</td>
<td>EVENT</td>
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</tr>
</tbody>
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OCTOBER 2011

11 – 14 Oct 2011
Topics in Combinatorial Representation Theory
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

12 – 14 Oct 2011
New Developments in Study of Nonlinear Wave Phenomena
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

17 – 19 Oct 2011
General and Geometric Topology and Its Applications
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

19 – 21 Oct 2011
Aspects of Descriptive Set Theory
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

24 – 26 Oct 2011
Analysis on Non-Equilibrium Nonlinear Phenomena – From the Evolution Equations
Point of View
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

25 – 27 Oct 2011
The Latest Developments in Theory and Application on Scientific Computation
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

28 – 30 Oct 2011
Mathematical Economics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

31 Oct – 2 Nov 2011
Analytic Number Theory — Related Multiple Aspects of Arithmetic Functions
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

31 Oct – 2 Nov 2011
Recent Developments in Geometric Mechanics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

9 – 11 Nov 2011
Progress in Qualitative Theory of Functional Equations
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

14 – 16 Nov 2011
Structural Study of Operators via Spectra or Numerical Ranges
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

15 – 18 Nov 2011
Recent Development of Micro-Local Analysis for the Theory of Asymptotic Analysis
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

15 – 18 Nov 2011
Theory of Biomathematics and Its Applications
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

21 – 25 Nov 2011
Frontiers in Dynamical Systems and Topology
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

28 Nov – 2 Dec 2011
Algebraic Number Theory and Related Topics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

28 – 30 Nov 2011
Model Theory of Fields and Its Applications
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

29 Nov – 2 Dec 2011
Singularity Theory, Geometry and Topology
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

DECEMBER 2011

7 – 9 Dec 2011
Computer Algebra — The Algorithms, Implementations and the Next Generation
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

7 – 16 Dec 2011
RIMS Project Research 2011 — Winter School on Operator Algebras
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

12 – 16 Dec 2011
Analysis and Geometry of Discrete Groups and Hyperbolic Spaces
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

14 – 16 Dec 2011
Spectral and Scattering Theory and Related Topics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

JANUARY 2012

9 – 13 Jan 2012
RIMS Project Research 2011 — Von Neumann Algebras and Related Topics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

11 – 13 Jan 2012
Universality and Individuality of Turbulence: Universe from a Point of View of Fluid Turbulence
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

16 – 20 Jan 2012
Automorphic Forms and Automorphic L-Functions
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

23 – 25 Jan 2012
Inverse Problems of Partial Differential Equations and Related Topics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

23 – 27 Jan 2012
Integrated Research on Complex Dynamics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

FEBRUARY 2012

30 Jan – 1 Feb 2012
New Trends in Algorithms and Theory of Computation
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

20 – 22 Feb 2012
Algebraic Systems and Theoretical Computer Science
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

MARCH 2012

5 – 7 Mar 2012
Research into Finite Groups and Their Representations, Vertex Operator Algebras, and Combinatorics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

NOVEMBER 2011

7 – 9 Nov 2011
Mathematical Decision Making Under Uncertainty and Ambiguity, and Related Topics
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

7 – 11 Nov 2011
Geometry of Interaction, Traced Monoidal Categories and Implicit Computational Complexity
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html

19 – 21 Dec 2011
Mathematical Studies on Independence and Dependence Structure — Algebra Meets Probability
http://www.kurims.kyoto-u.ac.jp/~kyodo/workshop-en.html
Mathematical Societies in Asia Pacific Region

**Australian Mathematical Society**
President: P. G. Taylor  
Address: Department of Mathematics and Statistics, The University of Melbourne, Parkville, VIC, 3010, Australia  
Email: President@austms.org.au  
Tel.: +61 (0)3 8344 5550  
Fax: +61 (0)3 8344 4599  

**Bangladesh Mathematical Society**
President: Md. Abdus Sattar  
Address: Bangladesh Mathematical Society, Department of Mathematics, University of Dhaka, Dhaka - 1000, Bangladesh  
Email: bdmathsec@yahoo.com  
Tel.: +880 17 11 86 47 25  
http://bdmathsociety.org/

**Cambodian Mathematical Society**
President: Chan Roath  
Address: Khemarak University, Phnom Penh Center Block D  
Email: camb.res.journal@gmail.com  
Tel.: (855) 642 68 68  
(855) 11 69 70 38  
http://www.cambmathsociety.org/

**Chinese Mathematical Society**
President: Zhiming Ma  
Address: Zhongguan Road East No. 55, Beijing 100080, China  
Email: mazm@amt.ac.cn  
Tel.: 0086 62562362  
http://www.cms.org.cn/cms/

**Hong Kong Mathematical Society**
President: Tao Tang  
Director of Joint Research Institute for Applied Mathematics, Department of Mathematics, The Hong Kong Baptist University  
Address: Department of Mathematics, The Hong Kong Baptist University, FSC1102, Fong Shu Chuen Building, Kowloon Tong, Hong Kong  
Email: ttang@hkbu.edu.hk  
Tel.: 852 3411 5148  
Fax: 852 3411 5811  
http://www.hkms.org.hk/

**Mathematical Societies in India:**

**The Allahabad Mathematical Society**
President: D. P. Gupta  
Address: 10, C S P Singh Marg, Allahabad - 211001, UP, India  
Email: ams10marg@gmail.com  
http://www.amsallahabad.org/

**Calcutta Mathematical Society**
President: B. K. Lahiri  
Address: AE-374, Sector I, Salt Lake City, Kolkata - 700064, WB, India  
Email: calmathsoc@yahoo.com  
Tel.: 0091 (33) 2337 8882  
Fax: 0091 (33) 376290  
http://www.calmathsoc.org/

**The Indian Mathematical Society**
President: R. Sridharan  
Address: Department of Mathematics, University of Pune, Pune - 411007 India  
Email: rsridhar@cmi.ac.in  
http://www.indianmathsociety.org.in/

**Ramanujan Mathematical Society**
President: M. S. Raghunathan  
Address: School of Mathematics, Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai, India  
Email: msr@math.tifr.res.in  
http://www.ramanujanmathsociety.org/
Vijnana Parishad of India  
**President:** V. P. Saxena  
**Contact:** R.C. Singh Chandel  
Secretary, Vijnana Parishad of India  
D.V. Postgraduate College,  
Orai - 285001, UP, India  
**Email:** rc_chandel@yahoo.com  
**Tel.:** + 91 11 27495877  
http://vijnanaparishadofindia.org/

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Indonesian Mathematical Society  
**President:** Widodo  
**Address:** Fakultas MIPA Universitas Gadjah Mada,  
Yogyakarta, Indonesia  
**Email:** widodo_math@yahoo.com  
http://www.indoms-center.org

---

Israel Mathematical Union  
**President:** Louis H. Rowen  
**Address:** Israel Mathematical Union,  
Department of Mathematics,  
Bar Ilan University,  
Ramat Gan 52900, Israel  
**Email:** rowen@macs.biu.ac.il  
**Tel.:** +972 3 531 8284  
**Fax:** +972 9 7418016  
http://www.imu.org.il/

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The Mathematical Society of Japan  
**President:** Takashi Tsuboi  
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