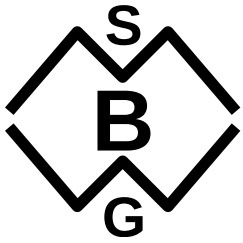


Newsletter

BELGIAN MATHEMATICAL SOCIETY

125, November 15, 2019

Comité National de Mathématique CNM

NCW Nationaal Comité voor Wiskunde

Newsletter of the Belgian Mathematical Society and the National Committee for Mathematics

ULB Campus Plaine, C.P. 218/01,
Bld du Triomphe, B-1050 Brussels, Belgium

Website: bms.ulb.ac.be
Newsletter:
wendy.goemans@kuleuven.be

Contents

The next edition of this newsletter will appear on January 15th, so from now till January 10th all content is welcomed very much at wendy.goemans@kuleuven.be.
Any information that you qualify as interesting to be spread among the Belgian Maths community is very much welcomed! Examples of such information are: PhD defenses, seminars, conferences, workshops, meetings, interaction with other sciences or business companies, popular lectures, school initiatives, math exhibitions, job opportunities, . . .

The President's Foreword

Dear members of the BMS, dear colleagues,

As you all know our esteemed colleague Jean Bourgain passed away 11 months ago, on Saturday 22nd December 2018. He was one of Belgium's most famed mathematicians, with international recognitions of the highest order including a Fields medal in 1994, the Shaw prize in 2010 and a Breakthrough prize (a.k.a. "the Oscars of maths") in 2017. He was also made a Barron by King Philippe of Belgium in 2015.

Born in Ostend in 1954, he studied at the VUB where he obtained his PhD in 1977 under the supervision of Freddy Delbaen. After a short stint as professor at VUB, he obtained appointments at University of Illinois, the IHES at Bures-sur-Yvette and IAS in Princeton.

Jean Bourgain was a hard working and prolific mathematician. He wrote over 500 papers (513 references on Mathscinet) during his lifetime and his work on analysis brought progress not only to his field of practice, but also to a variety of other mathematical disciplines such as number theory, combinatorics, group theory or computer science. Bourgain is hailed as an incredible problem solver whose contributions are, to say the least, deep. Quoting the obituary written for him in Nature [1]:

> "In the papers he co-authored, [...], it is easy to spot which sections Bourgain wrote. As with his solo papers, they are impenetrable thickets, making giant conceptual leaps with little by way of explanation. One page of a Bourgain paper might take weeks for the uninitiated to decipher. But the deep ideas and techniques within were ample reward for the persevering reader."

The success and importance of Jean Bourgain's research on what may appear at first to be esoteric and far flung questions of pure mathematics are yet another testimony to the beauty, power and dare I say pertinence of mathematics in today's society.

Although many well-deserved honours were rightfully bestowed upon Jean Bourgain during his lifetime and at the occasion of his passing, it is only natural that we at the BMS would also wish to celebrate this great spirit. This is why, together with the mathematics Department of the VUB, we organized a "Bourgain day" at the Academy Palace on Thursday October 31st. During that "day of analysis" we had the opportunity to hear fascinating talks on topics close to Jean Bourgain's interests by Stefaan Vaes (KU Leuven), Emmanuel Breuillard (University of Cambridge), Jean Van Schaftingen (UCLouvain) and Mariusz Mirek (University of Wrocław and Rutgers University). We thank these four speakers who made us the honour of accepting our invitation to share their science with us and help us reach closer, if only for a short while, to the heights at which Bourgain's genius elevated mankind.

Yvik Swan,
BMS President

1 News from the BMS & NCM

1.1 Heidelberg Laureate Forum 2019

Last September Hadewijch De Clercq, PhD Fellow in Mathematics of the Research Foundation Flanders (FWO) at Ghent University, participated at the Heidelberg Laureate Forum 2019. She was nominated by the NCM and then selected by the scientific committee of the Heidelberg Laureate Forum to

participate in this annual networking conference for mathematicians and computer scientists, hosted by the Klaus Tschira Foundation. Read about her experience of this unique opportunity for early career researchers to interact with recipients of the most prestigious mathematical awards at the end of this newsletter!

1.2 Bulletin of the Belgian Mathematical Society - Simon Stevin

In September 2019 Volume 26, Number 3 of the Bulletin of the Belgian Mathematical Society - Simon Stevin appeared with the following table of contents:

- **Marie-Amélie Lawn, Miguel Ortega** Associated Families of Surfaces in Warped Products and Homogeneous Spaces. 321–339.
- **Songxiao Li, Yecheng Shi** Some Characterizations of Composition Operators on Weighted Dirichlet Spaces. 341–353.
- **Andrei Grecu** The simplicity of the first eigenvalue for an eigenvalue problem involving the Finsler p-Laplace operator and a nonlocal term. 355–363.
- **Gregor Weingart** Moduli Spaces of Affine Homogeneous Spaces. 365–400.
- **Hanfeng Wang, Wei He** On compactly-fibered coset spaces. 401–411.
- **Monique Chicourrat, Bertin Diarra, Alain Escassut** Finite codimensional maximal ideals in subalgebras of ultrametric uniformly continuous functions. 413–420.
- **Shiroyeh Payrovi, Sakineh Babaei, Esra Sengelen Sevim** On the compressed essential graph of a commutative ring. 421–429.
- **Sadegh Amiri** Some drift exponentially fitted stochastic Runge-Kutta methods for solving Itô SDE systems. 431–451.
- **Othman Ech i, Adel Khalfallah** Order theoretic and topological Characterizations of the Divided Spectrum of a Ring. 453–467.
- **Eduardo Scarparo** On the C^*-algebra generated by the Koopman representation of a topological full group. 469–479.

For the table of contents of previous issues, see https://projecteuclid.org/all/euclid.bbms.

Remember, as a member of the BMS you can ask for electronic access to all electronically available issues of the bulletin, if you don't have a login yet, contact pcara@vub.ac.be.

2 News from the EMS

2.1 Call for input for EMS e-news

The editor of "EMS e-news" of the European Mathematical Society announces that Issue 33 will be sent at the end of November 2019.

If you have recent news suitable for the e-news, please send a short informative notice no later than November 22nd 2019 to: Mireille.Chaleyat@math-info.univ-paris5.fr, Mireille Chaleyat-Maurel (Université Paris Descartes, Paris, France), Editor of EMS e-news http://www.euro-math-soc.eu/e-news.

3 Meetings, Conferences, Lectures, ...

3.1 November 2019

Homage to Paul Mansion (1844-1919)

November 30, 2019

Marchin

Le Samedi 30 Novembre prochain aura lieu à Marchin une journée d'hommage au mathématicien Paul Mansion (1844-1919).

See the poster at the end of this newsletter.

3.2 January 2020

Faculty Research Day of the Faculty of science

January 15, 2020

Universiteit Antwerpen

For all information, see

https://www.uantwerpen.be/en/about-uantwerp/faculties/faculty-of-science/research/research-day/

3.3 February 2019

14thWorkshop on Symplectic Geometry, Contact Geometry, and Interactions (CAST 2020)

February 6-8, 2020

Universiteit Antwerpen

This is the 14th workshop in the series of 3-day-workshops on Symplectic Geometry, Contact Geometry and Interactions. See all information at

https://www.uantwerpen.be/nl/personeel/sonja-hohloch/private-webpage/conference-workshop/workshop/

3.4 Seminars and colloquia

The Nobel Prize in Physics 2019 - 'One world with many houses'

November 27, 2019

KU Leuven

A colloquium lecture by by Prof. Christoffel Waelkens, for third year bachelor students in physics onwards . . . to all colleagues interested in science. For all information, see

https://fys.kuleuven.be/colloquia_folder/colloquium-27-november-2019-14-30-the-nobel-prize-in-physics-2019-one-world-with-many-houses.

Methusalem colloquium lecture

December 2, 2019, 16:15-17:15

KU Leuven

Gil Cavalcanti of the University of Utrecht will give the next Methusalem colloquium lecture at KU Leuven. For all information, see https://wis.kuleuven.be/methusalem-pure-math/activities/.

3.4.1 Analysis & Geometry Seminar of UAntwerpen

For the upcoming seminars, see the calender at

https://www.uantwerpen.be/nl/personeel/sonja-hohloch/private-webpage/seminars/analysis—geometry-/

4 Job announcements

4.1 From VUB

Professor Mathematics/Algebra (full time)

Teaching: The candidate will contribute to the bachelor and master program of mathematics, teaching 2 bachelor courses and 2 master courses: Inleiding Groepentheorie (1Ba, 6SP), Ring- en moduultheorie (2Ba, 6SP), Associatieve algebra (Ma, 6SP), Representatietheorie van algebra's (Ma, 6SP, 2yearly), Niet-commutatieve algebra (Ma, 6SP, 2yearly).
Over time the candidate will also be involved with teaching mathematics courses for students from other disciplines. It is also expected that the candidate will supervise bachelor, master and Ph.D. theses.

Research: We are looking for a candidate with expertise in the domain of algebra, in particular relating to the following subdomains: Noncommutative algebraic geometry, Representation theory, Groups and grouprings, Hopf algebras, Linear algebra over finite fields, Yang-Baxter equation and (skew) braces.
The candidate is required to have a strong research track record in one or more of the above disciplines, as proven by publications in high-ranking journals within the discipline. The candidate is also expected to have experience in obtaining research funding. Experience in computational algebra as well as algebraic software packages (such as GAP, Magma, ...) is especially valued.

Deadline for application: 01/12/2019. More details and how to apply on

https://jobs.vub.be/job/Elsene-Professor-MathematicsAlgebra/560448701/

4.2 From KU Leuven

The Department of Mathematics at KU Leuven is advertising several PhD and postdoc positions in pure mathematics, with a special focus on the following fields of research.

- Algebraic geometry
- Classical analysis
- Differential geometry
- Functional analysis
- Group theory

For further information, we refer to https://wis.kuleuven.be/methusalem-pure-math/jobs.

The application deadline for the postdoc positions is 1 December 2019. The application deadline for the PhD positions is 8 January 2020.

4.3 PhD fellowships in Madrid

A call has been opened for 35 PhD fellowships in the framework of the program INPhINIT 2020, under the Incoming frame. ICMAT (Institute of Mathematical Sciences in Madrid) is one of the Host Institutions in the programme.

The application period is from November 7th, 2019 until February 4 th, 2020 (at 2 p.m., Central European Time - CET).

For all information see https://www.icmat.es/resources/employment/INPhINIT_La-Caixa.

5 History, maths and art, fiction, jokes, quotations ...

5.1 Adhemar's corner

To conclude this newsletter follow two reviews of Adhemar. The first one is on a book about some historical mathematicians. The second one is on a book about Kleibers scaling law applied to biology, sociology and economy.

My impressions of the Heidelberg Laureate Forum 2019

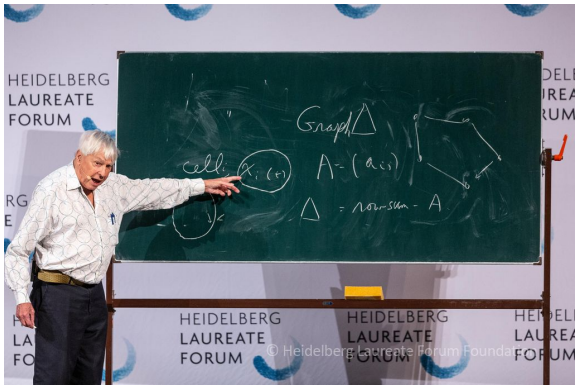
The Heidelberg Laureate Forum is an annual networking conference for mathematicians and computer scientists, hosted by the Klaus Tschira Foundation, in the beautiful German city Heidelberg. It creates a unique opportunity for early career researchers to interact with recipients of the most prestigious mathematical awards, such as the Fields medal, the Abel Prize and the ACM A.M. Turing Award. The seventh edition was organized from September 22nd to 27th 2019. PhD candidate Hadewijch De Clercq (Ghent University) was one of the lucky 200 young researchers to be chosen for participation out of more than 800 preselected candidates. She is delighted to share her thoughts and experiences with the readers of the Newsletter of the Belgian Mathematical Society.

The scientific program

Under compelling tones of piano music during the vibrant opening ceremony, 200 selected young researchers meet for the first time with 23 of the world's most distinguished mathematicians and computer scientists. The impressive list of invited laureates includes recent prize winners, such as Caucher Birkar (Fields Medal 2018) and Yoshua Bengio (ACM A.M. Turing Award 2018), as well as awardees of respectable age, like Stephen Smale (Fields Medal 1966). All are equally enthusiastic to engage with the youngsters in conversation and share their experience and anecdotes.

The scientific program, which runs from Monday morning to Friday afternoon, offers a broad variety of academic lectures prepared by the laureates. These can be rather technical and advanced in nature, with topics ranging from deep learning for artificial intelligence (John Hopcroft) over the mathematics of the heart beat (Stephen Smale) to algorithms for finding the connected components of a graph (Robert Tarjan). There is also room for somewhat lighter themes, such as applying the mobile phone for healthcare sensoring (Shwetak Patel) and future challenges in artificial intelligence (Raj Reddy). My favorite was Caucher Birkar's heartwarming and inspirational lecture "A personal journey into the world of mathematics", in which he explains how his youth in Kurdistan has influenced his academic career.

Provoking themes of societal relevance are never far away. A predominant light is shed on the climate crisis, this year's hot topic. The forum also raises fundamental questions about the consequences of scientific progress, like "Can we trust autonomous systems, such as self-driving cars?" and "How does technological evolution determine our ethical standards?". Through panel discussions on the academic publishing process and the gender gap in academia, the organizers stress the importance of critical thinking. When studying such a specialized field as mathematics, it is sometimes necessary to question the context in which we are working.



89-year-old Fields medalist Stephen Smale gave a blackboard lecture entitled "The mathematics of the heart beat"

Social activities

After a long day of debating and in-depth thematic studies, there is room for casual chatting over a delightful dinner, often served at remarkable locations. Dining alongside a Fields medalist, between ancient vehicles and aircraft in the Speyer Museum of Technology, or in the splendid ballroom of Heidelberg's medieval castle, it must be a dream to many mathematicians. Other social events, like a guided city tour and a boat trip on the Neckar river, offer the ideal opportunity to get to know the laureates on a personal level. This way, I discovered that 2015 Turing Award laureate Martin Hellman shares with me his passion for opera. He had me listen to his favorite Mozart piece on his phone, while asking me advice for a touristic visit to Belgium.

Most memorable were the contacts with fellow participants. At no other mathematical conference have I seen such a variety of nationalities and cultures represented. The organizers aim to reach all potential candidates, also those in developing countries, and with success. For 21-year-old Matheus, it was the first time to travel outside of Brazil. I vividly remember discussing quantum groups with Blessing from Nigeria, Lie algebras with Erlend from Norway, and orthogonal polynomials with Mahvish from India. The fellow young researchers are also a grateful audience to ask for academic advice and experiences, all within an exceptionally stimulating and yet informal atmosphere. The Heidelberg Laureate Forum embraces interdisciplinary collaboration and intercultural exchange, and what better way to do so than by bringing together a diverse field of participants and having them interact?

Young researchers in discussion with Turing Award winner Shwetak Patel

For who and how to apply

The forum is open to researchers in mathematics and computer science at three different stages in their career: undergraduates (Bachelor and Master level students), graduates (PhD students) and postdocs. There are two ways to be selected for participation. One applies either directly, or through nomination by a partner institution, such as the Belgian National Committee for Mathematics. Nominations will carry more weight for an application, but all candidates will go through the same selection process. Once selected, participants will be granted full financial covering of their accommodation for a week. Transport to and from Heidelberg is not included, but additional financial support can be requested.

The next edition

Convinced that the Heidelberg Laureate Forum might be something for one of your students? Then do not hesitate and encourage them to apply for the next edition, which will take place from September 20^{th} to 25^{th} 2020. Would you rather live the HLF experience from home? Then you might want to check out the recordings of past editions' lectures at `https://www.newsroom.hlf-foundation.org/`.

I would like to thank the Belgian National Committee for Mathematics for my nomination, the scientific committee of the Heidelberg Laureate Forum for selecting me for participation, and the Klaus Tschira Foundation for its financial support. It has been an extraordinary, inspirational week, an unforgettable journey. I warmly recommend all young mathematicians to take their chances and apply!

About the author

Hadewijch De Clercq is a PhD Fellow in Mathematics of the Research Foundation Flanders (FWO) at Ghent University, under supervision of Prof. Hendrik De Bie. She is interested in representation theory of quantum groups, special functions and integrable systems. Her current research focuses on quantum symmetric pairs and q-Onsager algebras. Feel free to contact her at hadewijch.declercq@ugent.be.

Photo credits

All photos are courtesy of the Heidelberg Laureate Forum Foundation.

Adresse du jour
Athénée Royal Prince Baudouin
Rue Fourneau, 40 - 4570 Marchin

Organisation
Commune de Marchin

Renseignements et réservations repas
Christine Hantz
(085 270 416 - christine.hantz@marchin.be)

Prix du repas : 20 euros
à verser sur le compte communal BE75 0910 0043 8751
(BIC : GKCC BE BB) avant le 26 novembre.

Communication : Votre nom + Hommage Mansion.

Le paiement vaut réservation.

Informations complémentaires
Hervé Le Ferrand (Université de Bourgogne)
leferran@u-bourgogne.fr

COMMUNE DE
MARCHIN

SAMEDI 30 NOVEMBRE 2019

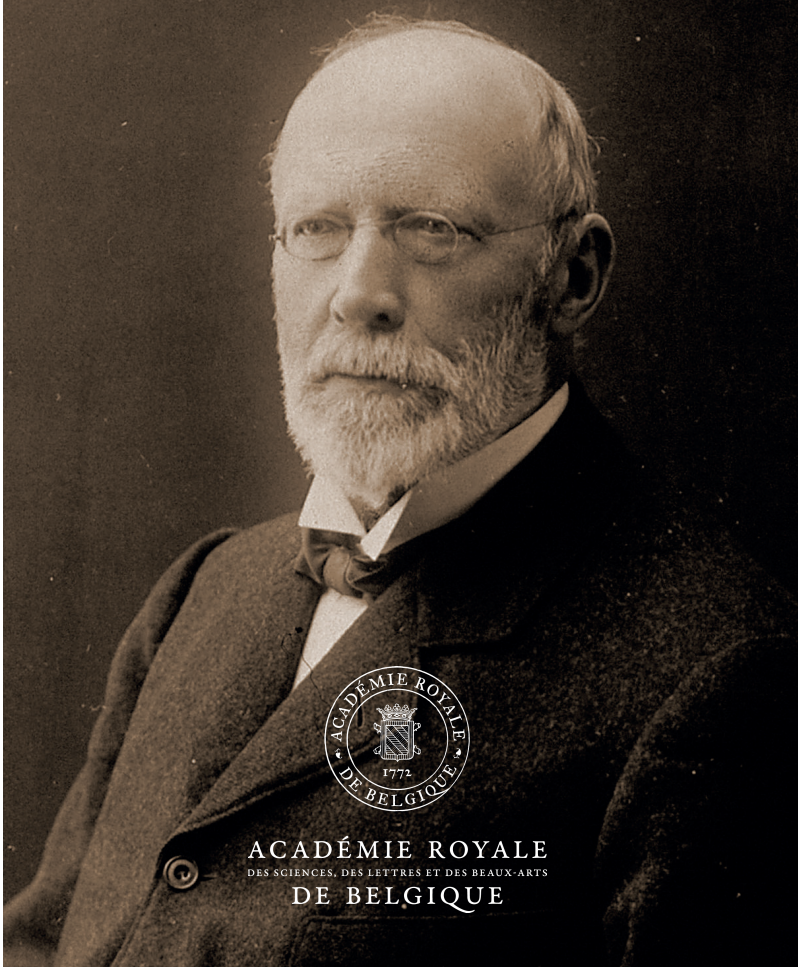
Sous le haut patronage de l'Académie royale de Belgique

100

JOURNÉE D'HOMMAGE À PAUL MANSION

Mathématicien, professeur à l'Université de Gand, membre de l'Académie royale de Belgique

(né à Marchin le 3 juin 1844 — décédé à Gand le 16 avril 1919)

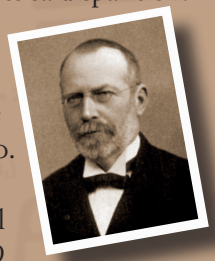


ACADÉMIE ROYALE
DES SCIENCES, DES LETTRES ET DES BEAUX-ARTS
DE BELGIQUE

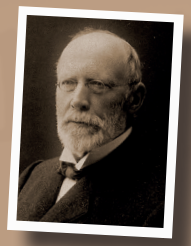
Le 16 décembre 1927, le mathématicien belge Alphonse Demoulin (1869-1947) prononçait devant la Classe des Sciences de l'Académie Royale de Belgique un éloge de son ancien professeur puis collègue à l'Université de Gand, Paul Mansion. Alphonse Demoulin débuta son hommage par ces mots :

« Paul Mansion a été, pendant de longues années, membre de l'Académie, professeur à l'Université de Gand, président du Conseil de perfectionnement de l'enseignement moyen, secrétaire général de la Société Scientifique de Bruxelles, directeur de Mathesis. Auteur de très nombreux travaux sur l'analyse mathématique, le calcul des probabilités, la géométrie non euclidienne, l'histoire et la philosophie des sciences, il a occupé une place éminente dans le monde scientifique belge ».

Ces quelques phrases d'Alphonse Demoulin nous donnent pratiquement le programme de la journée d'hommage à Paul Mansion, cent ans après sa disparition.



Paul Mansion est né le 3 Juin 1844 à Marchin (« Marchin-lez-Huy », disait-on à l'époque). À vingt-trois ans, il débute une longue carrière à l'Université de Gand. L'œuvre et le rayonnement scientifiques de Paul Mansion sont exceptionnels. Paul Mansion s'éteint à Gand le 16 avril 1919. Nous allons retracer ce parcours hors du commun à travers quatre conférences. Nous évoquerons tout d'abord Paul Mansion, l'homme, illustre Marchinois. Nous montrerons ensuite l'étendue de son œuvre scientifique et son inlassable activité. Puis nous examinerons plus en détail certains aspects de ses travaux mathématiques. Sa grande activité éditoriale sera, pour conclure, analysée.



Cette journée d'hommage se terminera par la pose d'une plaque sur la maison natale de Paul Mansion.

PROGRAMME

9h30
Accueil
par M. Eric Lomba, Bourgmestre de Marchin

10h
Le mot du
Cercle Royal d'Histoire et de Folklore de Marchin-Vyle

10h30
« Portrait de Paul Mansion »
Conférence suivie de questions-réponses
par M. Philippe Dejaive, historien

11h15
« L'œuvre scientifique de Paul Mansion »
Conférence suivie de questions-réponses
par M. Hervé Le Ferrand
(Université de Bourgogne – Institut de Mathématiques)

12h
Repas (sur réservation uniquement – voir verso)

14h
« Paul Mansion, artisan infatigable, éclectique et éclairé des mathématiques, de son enseignement et de son histoire »
Conférence suivie de questions-réponses
par M. Jean Mawhin (Université Catholique de Louvain),
Membre de l'Académie Royale de Belgique

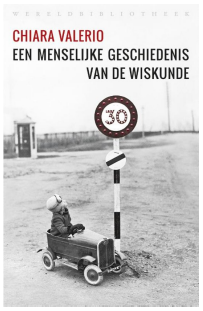
14h45
« Paul Mansion et la Société scientifique de Bruxelles »
Conférence suivie de questions-réponses
par M. Jean-François Stoffel (Haute École Louvain en Hainaut),
rédacteur en chef de la Revue des Questions Scientifiques

de **15h30** à **16h**
Table ronde et conclusions

16h30
Pose de la plaque commémorative
à la maison natale de Paul Mansion

17h
Clôture de la journée – Verre de l'amitié

Storia umana della matematica by *Chiara Valerio*. Giulio Einaudi, 2016,
Een menselijke geschiedenis van de wiskunde Wereldbibliotheek, 2017, isbn 978 90 284 2714 3



Chiara Valerio

At the moment of writing this review, I could only find a Dutch translation, no French or English edition seems to exist (yet). Nevertheless, this is a very curious... book (I hesitate to classify it as a novel, a mathematical history book, a collection of essays, or whatever), so I just call it a book to be on the safe side.

Valerio, born in 1978 got a PhD in mathematics from the Università degli Studi di Napoli Federico II in Rome about a mathematical approach to natural neurons. She chose mathematics because she failed admission to the faculty of literature (her father was a physicist). But literature remained her first love. She published her first novel in 2003, and after a postdoc in Cambridge in 2009, she left mathematics and became fully involved in literature as an author, an editor, a blogger and related activities.

The book is indeed partially about math history, but it is not 'just that'. In the first six chapters she focusses on some historical mathematicians, and she tells about herself in the seventh chapter.

The first chapter is giving some biographical facts about father and son Farkas and János Bolyai. Farkas spent much time in trying to prove the parallel postulate from Euclidean geometry. He was not successful, but János succeeded and so 'invented' non-Euclidean geometry. When the father proudly showed the results of his son to Gauss, the latter presumably answered: "To praise it [the work of János] would amount to praising myself. For the entire content of the work...coincides almost exactly with my own meditations which have occupied my mind for the past thirty or thirty-five years". Nevertheless the idea was quickly picked up by others and it changes geometry forever. Valerio adds to these facts her own experiences and links them with work by Poincaré, Kant and others.

Riemann is the subject of the second chapter, with the associated theme 'dimensions'. An extensive discussion is devoted to Abbott's *Flatland* and again following different detours, to eventually arrive at curvature on n-dimensional Riemannian manifolds.

With Laplace, probability is introduced in chapter 3. But many other mathematicians feature as well: John Napier, Galilei, Mersenne, d'Alembert.

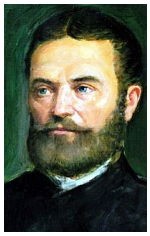
Mauro Picone (1885-1977) is an Italian mathematician that may be less known. In 1916, he improved ballistic computations during the war against the Austrian-Hungarian army. He composed tables that took the air resistance and difference of heights in the mountains into account, which prevented the artillery from shelling their own infantry. Later he founded one of the first institutes of applied mathematics.

Lev Landau was a Russian physicist who was involved in a car accident in 1962, the year when he was awarded the Nobel Prize. He spent some time in a coma from which he recovered, but his scientific career was over. A reason for Valerio to contemplate life and death. Landau the man who died twice, and also lived twice.

The aspects of Norbert Wiener that are highlighted are cybernetics and communication theory.

Each chapter has some biographical details about these mathematicians, but they are certainly not intended as a complete biography. They focus on the person as a human being, as far as this is known (hence the title), but Valerio relates this to many experiences from her personal life and family too. The chapters are thematic and sometimes are zigzagging to different topics occasionally turning them into a philosophical essay. At other points there are some tongue-in-cheek remarks which can be experienced as funny anecdotes.

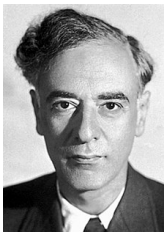

F. Bolyai
1775-1856

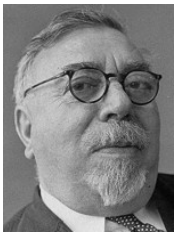

J. Bolyai
1802-1860


B. Riemann
1826-1966


P.-S. Laplace
1749-1827


M. Picone
1885-1977


L. Landau
1908-1968


N. Wiener
1894-1964

Valerio is obviously very well read and she relates with ease mathematical topics with Dostoevski, Shakespeare, and many other less known authors. Sometimes she is retelling stories and sketching the characters and relationships between characters of novels to ponder why they made certain choices. Numerous pointers to films and books are just mentioned quickly in passing or in parenthesis. They can easily escape attention if the reader is not familiar with the movie, book, or the television series.

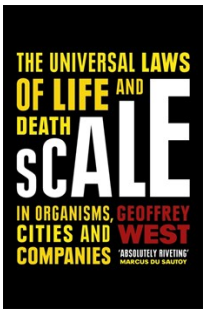
Let me take as a typical example the flow of chapter 4 about Mauro Picone. It starts with a description of an Italian colonel Baistrocchi defending a bridge during the war in 1916. This is an occasion to refer to José Saramago's *Memorial do Convento* (translated as *Baltasar and Blimunda*). Then she reflects how she played cowboy and indian as a child with her father. When Picone arrives at the 1916 battle field as 'the mathematics professor from Turin', Valerio gives some of his biographical background, which allows her to discuss James Blackadder, a character in A.S. Byatt's *Posession*. Picone recognizes and solves the ballistic problem of the colonel and becomes a war hero. The computations of Picone are a reason to mention Niccolo Fontana, better known as Tartaglia (the stutterer) who found a closed formula to solve a cubic equation and who also wrote a book on ballistics. Via Youcenaar's *L'Œuvre au noir* Valerion is reflecting on life and death and on cats who are said to have seven lives, which makes her think of the cat she had as a child and about the cats that were thrown from heights to study gravitation, which leads her to Archimedes, Peano, Kepler, and Galilei (with a discussion of a fragment of his *Discorsi*) and the planetary motion. This brings her back to Picone and the tables he computed. After the war Picone is meeting Volterra, to discuss the founding of the first computing center ever and an institute of applied mathematics, long before Turing. The chapter ends with Valerio's father falling from a ladder, as a consequence of gravity, and by a praise of Baistrocchi who gave Picone the possibility to apply his mathematics and save many lives, hence recognizing the power of a book over weapons.

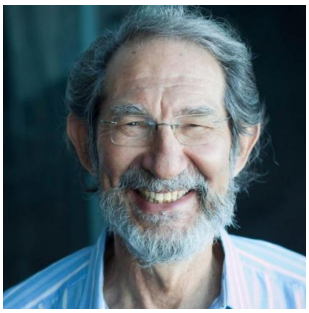
The other chapters have similar meandering constructs. They are not always easy to read because Valerio writes long sentences with sub-phrases and parentheses, following a thread that is not always linear. A mathematical reader will probably not learn much new about mathematics but on the other hand, if the reader has no mathematical background, some of the mathematics only mentioned in passing will probably not be clear. Also some of the literature and references to the media are very Italian and may not be so familiar to non-Italians.

The first sentence of the introduction says 'Everything that Euclid talks about does not exist'. This means that mathematics is about abstract concepts that do not physically exist, and a bit further we read: 'To prove the Pythagorean theorem, it requires more imagination than to bring the death back to life, because the latter existed once. Lines, points and geometrical objects never existed'. Perhaps she means to say that it is easier to talk about mathematics by using elements from the biographies of mathematicians, because that is exactly what she did.

Adhemar Bultheel

Scale by *Geoffrey West*. Weidenfeld & Nicolson, 2017, (496 p.) isbn 978-0-297-60947-6





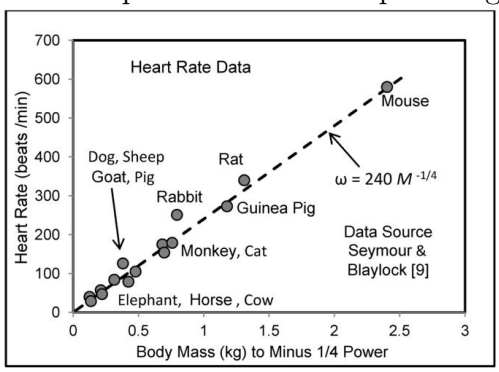
Geoffrey West

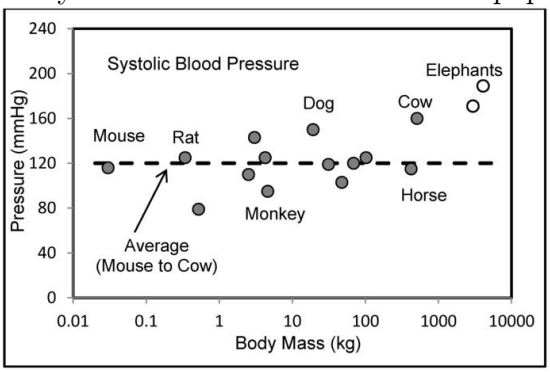
Geoffrey West is a theoretical physicist who had a research group at Los Alamos and Stanford, but he turned his mind on discovering mathematical laws behind biological data. His first paper on this subject appeared in *Science* in 1997. He joined the Santa Fe Institute, a nonprofit theoretical research institute founded in 1984 dedicated to the multidisciplinary study of the fundamental principles of complex adaptive systems. In the period 2005-2009 he was the president of the institute.

In this popular science book he summarizes the insights he gained about complex systems. It reduces all in essence to an exponential growth that he observed in these systems: in biology (mammals and plants), in sociology (cities), and economy (companies). The appetising questions that he formulates in the beginning are certainly catching the attention of a general reader: Why can we not live longer dan about 120 years while elephants and whales do? Why do we stop growing at some point? Why do mice grow more cancer tumors than we do, and why do elephants get almost none? Why do companies have a short life while cities can survive major debacles? etc.

He claims to answer them all and he repeatedly explains that all this is due to exponential relationships. Set on the x-axis the volume of an animal and on the y-axis its daily energy requirements to survive (metabolic rate), and you will see this is an exponential relation. Using a log scale on both axes, this will result in a straight line, and its slope will explain the economy of scaling up. If the relation were linear, then doubling the volume would require doubling the energy. However, it turns out that a bigger volume is more efficient to maintain because the energy required is only increasing with 75% if the volume is doubled. This is known as Kleiber's law (1932).

The reason for this economy is that the energy is brought to all the cells in the body via the oxygen in the blood that exchanges energy in the mitochondria on the surface of the vessels. Since the cells form a 3D body while the vessel surface is only 2D, one would expect a ratio of 2/3 and not the 75%. But the blood vessel system from the aorta to the fine capillarities forms a fractal tree that is space filling, and it has therefore a theoretical Hausdorff dimension 3, but of course in practice the number of bifurcation levels will be finite and thus the fractal dimension is between 2 and 3. Moreover evolution has arranged that when a blood vessel bifurcates in thinner blood vessels, then the sum of their cross sections is equal to the one before the bifurcation, so that in the end, there is no extra energy required to pump the blood into the final capillaries. Bringing all this together explains the factor 3/4. In this book West says that his arguments 'lead to organisms functioning as if they are operating in four dimensions', which I could not understand. West probably borrowed this idea from his past research in superstring theory. One should read his Science paper of 1997





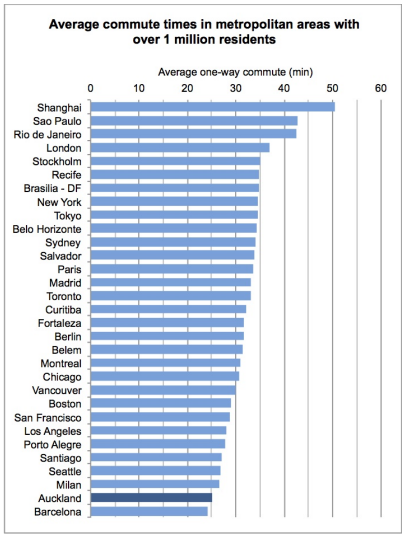
where he and his co-authors properly explain their model leading to this 3/4 ratio. Evolution has resulted in a systolic blood pressure that is approximately independent of body mass, which

imposes constraints on the cross section of aorta as well as capillarities.

Heat production (3/4) is directly related to metabolism and heart rate is slowed down (−1/4) because of the more efficient metabolism. The fact that the heart rate of an elephant is much less than that of a mouse means that an elephants lives longer because it lives much slower than a mouse. These, and many other parameters are all related to the above observation and thus all scale like a simple multiple of 1/4. Other examples are brain mass (3/4) and life span (1/4). At some point the energy that is brought to the cells are used to grow and some to repair, but in the end a majority goes to repairing until nothing is left for growing, which limits the length, and even more drastically leads to death in the end.

The discrepancy between a volume (3D) and the cross sections of a skeleton (2D) has led Galileo already much earlier to the conclusion that really giant Gozilla-like animals cannot exist because they would collapse under their own weight. There is an inherent mechanism that will prevent the development of giant mammals.

Everything said above about mammals can be repeated with proper rephrasing for trees and plants. These biological conclusions are rather well supported by data and are generally accepted. A large part of the book is however devoted to analogous arguments for cities and companies that not everybody agrees with. Correlation does not imply causality. For cities there is some urban metabolism in the form of physical input of pipes, wires, streets, railways,... to provide gas, electricity, water, food,... but there is also a socioeconomic component that scales like 1.15 and is thus growing much faster than 0.75. For that West counts the number of patents produced, amount of health care, height of salaries, productivity, but also the negative aspects like pollution, waste, crime, diseases,.. People in cities just live 15% faster than elsewhere. West attributes this remarkable scaling factor to the increase of multidisciplinarity in the highly connected social network that he measures for example by telephone communication.



There is natural limit to the size of a city which depends on the commuting time that people are willing to spend every day, which seems to be remarkably constant (about half an hour both ways). If larger, the city decomposes into somewhat independent enclaves, and become nodes in the larger global fractal socioeconomic network. The output of cities grows however at a super exponential rate, which requires proportional input while resources are finite and that inevitably leads to a catastrophic finite time singularity. This can only be avoided by innovation (we have known enlightenment, industrial revolution, and more recently the digital revolution). However these innovations need to come at an ever increasing speed. Hence the problem of sustainability to avoid the total collapse of the socioeconomic fabric. Time for a grand unifying theory of all possible disciplines and models from biology, sociology, environment, economy, technology,...

Finally for companies, the scaling rate is not 25% but only 10%. As they grow they work themselves more into a niche while diversity is precisely what is needed for innovation. So for companies, the behaviour is much like that of the biological systems, a decrease in growth and a finite life which West claims to be on average not more than about 10 years. This does not mean that the company goes bankrupt, bit it might have been merged into another one or split up in several subsidiary companies.

I think this is an interesting read. Mathematics are at a very low key though and West is repeating himself a bit too often to keep the reader focussed, but he makes it up with several interesting digressions and personal anecdotes.

Adhemar Bultheel