Prizes in mathematics, 2020

by

Nitsa Movshovitz-Hadar (Technion - Israel Institute of Technology)

Did you know? - Over 125,000 new items are added each year, to the international database managed by the American Mathematical Society called **MathSciNet®**[1] A vast majority of these items contain new results, continuously enriching the ever-growing discipline known as Mathematics[2]. To celebrate these tremendous achievements, all to be credited to the incredible creativity of mathematicians, several valuable awards have been established. This vignette is about a few of the more prestigious ones. It opens with the two that nowadays are often described as the Nobel Prize in mathematics[3]: the Fields Medal and the Abel Prize.

The Fields Medal

The Fields Medal is one of two awards often described as the Nobel Prize of mathematics. It consists of a gold medal bearing the profile of Archimedes and a cash amount of 15,000 Canadian dollars (or roughly $11,540). It is awarded to 2-4 mathematicians every four years at the opening ceremony of the ICM - International Congress of Mathematicians, to recognize outstanding mathematical achievement for existing work and the promise of future achievement. A candidate's 40th birthday must not occur before January 1st of the year of the Congress at which the Fields Medals are awarded. (Recall, Andrew Wiles, who proved the long-standing Fermat's Conjecture, missed it as he was slightly over 40 when he and Taylor took care of the final polish of the proof.[4])

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[1] MathSciNet is a database of reviews of the current published literature, abstracts and bibliographic information for much of the mathematical sciences literature. See more here: https://mathscinet.ams.org/mathscinet/help/about.html?version=2

[2] Most of the items are classified according to the so called Mathematics Subject Classification (MSC) which is broken down into over 5,000 two-, three, and five-digit classifications, each corresponding to a discipline of mathematics, e.g. 11 = Number theory; 97 = mathematics education; 11B = Sequence and sets; 97D = Education and instruction in mathematics; 11B05 = Density, gaps, topology; 97D30 = Goals of mathematics teaching and curriculum development. See more here: https://mathscinet.ams.org/mathscinet/msc/msc.html?t=&s=&ls=Ct&btn=Clear

[3] Although there are several key differences, including frequency of award, number of awards, and age limits, the Fields Medal and Abel Prize are commonly compared to the Nobel Prize in the level of prestige. See more here: https://en.wikipedia.org/wiki/List_of_prizes_known_as_the_Nobel_of_a_field). For A few explanations as to why there is no Nobel Prize in mathematics (some with a flavor of gossip about Alfred Nobel…) see https://cs.uwaterloo.ca/~alopez-o/math-faq/mathtext/node21.html

[4] In 1998, at the ICM, Andrew Wiles was presented by the chair of the Fields Medal Committee, Yuri I. Manin, with the first-ever IMU silver plaque, in recognition of his proof of Fermat's Last Theorem. Accounts of this award frequently mention that at the time of the award Wiles was over the age limit for the Fields medal. Nevertheless, Wiles was awarded the 2016 Abel Prize and many other prestogous recognitions. See https://en.wikipedia.org/wiki/Andrew_Wiles

The Fields Medal Committee is chosen by the Executive Committee of the International Mathematical Union (IMU) about two years before the next congress. The IMU President is usually the chairperson of the committee. The names of other members of this committee remain anonymous until the ceremony that takes place at the Congress. Nominations are submitted to the Prize Committee Chair, they are confidential, and must not be disclosed to the candidate. Self-nominations are strongly discouraged. The committee is free to consider mathematicians not nominated.

The medal, whose value is approximately 5,500 Canadian dollars, is made of 14KT gold, its diameter is 63.5 mm, its weight is 169 gram, its finish is sandblasted, engraved, gold plated &lacquered. The head showing on the obverse represents Archimedes facing right, with his name in Greek capitals: ΑΡΧΙΜΗΔΟΥΣ on the right side, and the initials of the designer R(obert) T(ait) M(cKenzie) on the left side with the year 1933, the year of the design approval following a resolution to establish the prize adopted at the 1924 ICM. All around it, there is a Latin inscription of a quote attributed to Archimedes that reads: TRANSIRE SUUM PECTUS MUNDOQUE POTIRI, which means: "Rise above oneself and grasp the world."

The rim of the medal bears the name of the prizewinner.

On the reverse the inscription in Latin reads:
CONGREGATI EX TOTO ORBE MATHEMATICI OB SCRIPTA INSIGNIA TRIBUERE, which means: "The mathematicians having congregated from the whole world awarded (this medal) because of outstanding writings." In the background, behind an olive branch there is a representation of Archimedes' tomb, with the carving illustrating the theorem the proof of which Archimedes was reportedly most proud[5]: Given a sphere and a circumscribed cylinder of the same height and diameter, the ratio between their volumes is equal to ⅔.

The medal is named after Canadian mathematician John Charles Fields (1932-1863). He chaired the 1924 International Congress of Mathematicians in Toronto, invested much effort in realizing the resolution adopted then, but did not live to attend the premiere occasion in 1936 when two Fields medals were awarded for the first time. Fields was a pioneer and visionary who recognized the scientific, educational, and economic value of research in the mathematical sciences. He strongly felt that there should be an award comparable to the Nobel prize to recognize the most outstanding current research in mathematics. On his deathbed, Fields donated a considerable sum of his money to the fund he set up for the medals[6], which eventually were named in his honor, contrary to his directive. In 1966 it was agreed that, in light of the great expansion of mathematical research, up to four medals could be awarded at each Congress. The medals and cash prizes are funded by a trust established by J. C. Fields at the University of Toronto.

Sixty mathematicians won the Fields medal since 1936 and up to the time of writing (June

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[5] According to https://en.wikipedia.org/wiki/Archimedes#Biography

[6] For more fascinating details about J. C. Fields and the birth of the medal see
http://www.fields.utoronto.ca/aboutus/jcfields/fields_medal.html

2020), but only 59 received it. In 2006, Grigori Perelman, a Russian mathematician who proved the Poincaré conjecture, refused his Fields Medal and did not attend the ICM. In 2014, the American mathematician of Iranian descent Maryam Mirzakhani (1977-2017) became the first and so far only female Fields Medalist. Unfortunately, she passed away shortly afterward. The youngest winner of the Fields Medal is the French mathematician Jean-Pierre Serre (born 1926), who received it in 1954 when he was 27. In 2003 he also received the Abel prize (see below). In 2018 one of the four Fields medal awardees was Caucher Birkar, a mathematician of great originality and depth, a Kurdish Refugee, and a 30-Year-Old Professor at the University of Cambridge, UK. He received it at the 2018 ICM in Rio De Janeiro, a city struggling with soaring crime rates. The medal was stolen half an hour after the ceremony[7]. He now holds a replacement medal issued to him shortly after the congress ended.

For details about former Fields Medal winners and their variety of contributions to mathematics, see https://www.mathunion.org/imu-awards/fields-medal. Some more landmarks in the Fields Medal history appear here: https://en.wikipedia.org/wiki/Fields_Medal#cite_note-87.

Meeting the Medalists. The Fields Institute for Research in Mathematical Science Toronto, Canada, organizes the Fields Medal Symposium. The goals of this symposium are to present the work of a Fields Medalist and its impact, to explore the potential for future directions and areas of its influence, to provide inspiration to the next generations of mathematicians and scientists, as well as to present the Medalist to a broader public. The last Fields Medal Symposium opened on November 4th, 2019, featuring a general audience presentation entitled Dealing with Chaos by Artur Ávila (Fields Medalist 2014) as part of the scientific program honoring Ávila's work[8]. It was followed, as usual, by an informal student night on November 5th, providing the opportunity for interaction between students and Field Medallists - to inspire an appreciation of the beauty and scope of mathematics. The previous Fields Medal Symposium opened on November 5th, 2018 honoring the late Maryam Mirzakhani (Fields Medalist 2014) and explored the current and potential impact of her work. Alex Eskin from the University of Chicago, recipient of the 2020 breakthrough in mathematics prize (see below), gave the keynote address.[9]

The Abel Prize
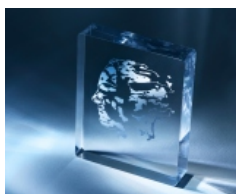
The Abel Prize is a prestigious award, conferred every year since 2003, in recognition of outstanding and extraordinary achievements in-depth and impact on mathematical sciences. The prize is presented with great ceremony by the King of Norway. It was named for Niels Henrik Abel 1802-1829, the renowned Norwegian mathematician, who at the age of 16, proved the binomial theorem for any complex number. At age 22, he proved that there was no general way to solve a polynomial equation of fifth-degree by radicals, thus solving (independently of Galois's parallel work) a problem that had been unsolved for centuries. Unfortunately, the mathematical genius died of tuberculosis at an early age. In 2002, the two hundredth anniversary of Abel's birth, a prize-giving fund was established in Norway and run by the Norwegian Academy of Sciences and Arts (as opposed to the Swedish Science Foundation which manages the Nobel Prize, not given in the field of mathematics). The prize

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[7] According to https://www.theguardian.com/world/2018/aug/01/fields-medal-award-stolen-brazil-maths-prize

[8] For more details see http://www.fields.utoronto.ca/activities/19-20/fieldsmedalsym

[9] For more details see http://www.fields.utoronto.ca/activities/18-19/fieldsmedalsym.

committee includes five mathematicians of international stature. For further reading see
http://www.abelprize.no/c69461/binfil/download.php?tid=69541
http://www.abelprize.no/nyheter/vis.html?tid=69588

In March 2020 the Norwegian Academy of Science and Letters named Hillel Furstenberg from the Hebrew University of Jerusalem, Israel, and Gregory Margulis from Yale University, the USA, as winners of the Abel Prize 2020. They shared the prize & the amount of 7.5 Million Norwegian Kroner (~USD 800,000) for their "pioneering the use of methods from probability & dynamics in group theory, number theory, and combinatorics."

The winners received this honor, not for work in one particular area of maths, but for finding surprising connections between several areas. "Part of the beauty of mathematics is the way that ideas from different fields come together," said Furstenberg in an interview upon the award of the prize. "There must be something behind all this, some greater harmony to which these things belong. The aspect of the beauty of mathematics is what has been attracting me to the subject and seems to be guiding me in some sense." (See more here https://www.nature.com/articles/d41586-020-00799-7).

Wolf Prize in Mathematics

The Wolf Prize in mathematics was considered an equivalent of the Nobel Prize for mathematics until 2003, when the Abel Prize was established. According to a reputation survey conducted in 2013 and 2014, the Wolf Prize in Mathematics is the third most prestigious international academic award in mathematics, after the Abel Prize and the Fields Medal (See more here https://en.wikipedia.org/wiki/Wolf_Prize_in_Mathematics). The prize in each of the six fields of the Wolf Prize consists of a certificate and a monetary award of $100,000. To date, 345 scientists and artists from all over the globe have been honored. The 2020 Wolf Prize in mathematics was shared by the English mathematician Simon Donaldson and the U.S. mathematician Yakov Eliashberg for their contributions to differential geometry and topology. (For more details see https://wolffund.org.il/the-wolf-prize/)

The Shaw Prize

The Shaw Prize is an international award to honor individuals who are currently active in their respective fields and who have recently achieved distinguished and significant advances, who have made outstanding contributions in academic and scientific research or applications, or who in other domains have achieved excellence. The award is dedicated to furthering societal progress, enhancing the quality of life, and enriching humanity's spiritual civilization. (See more here http://www.shawprize.org/en/shaw.php?tmp=1&twoid=1)

The Shaw Prize consists of three annual awards: the Prize in Astronomy, the Prize in Life Science and Medicine, and the Prize in Mathematical Sciences. Each prize carries a monetary award of one million two hundred thousand US dollars. It is considered the Chinese version of the Nobel Prize

The front of the Shaw Prize medal displays a portrait of Mr Run Run Shaw, next to which are the words and Chinese characters for the title of "The Shaw Prize." On the reverse, the medal shows the award category and year, the name of the laureate. In the upper right corner, there is an imprint of a saying due to Xun Zi (313 – 238 BCE), a thinker in the Warring States period of Chinese history: "制天命而用之," meaning "Grasp the law of nature and make use of it".

The Shaw Prize, established under the auspices of Mr Run Run Shaw in November 2002, is managed and administered by The Shaw Prize Foundation based in Hong Kong. The Shaw Prize website explains the importance of mathematics as follows: " Mathematics is the basic language of all natural sciences and all modern technology. In the twentieth century mathematics made tremendous strides both in opening new frontiers and in solving important and difficult old problems. Its influence permeates every creative scientific and technological discipline, and extends into the social science. With the developments in computer science, information technology, and statistics in the twentieth century, the importance of mathematics to mankind will be further enhanced in the twenty-first century." There are currently three Selection Committees, one for each category of The Shaw Prize, namely, Astronomy, Life Science and Medicine, and Mathematical Sciences. The latter is an international committee chaired by the British mathematician Professor Timothy Gowers.

The Shaw Prize in Mathematical Sciences 2019 was awarded to the French Mathematician Michel Talagrand for his work on concentration inequalities, on suprema of Stochastic processes and on rigorous results for spin glasses. (See more https://www.shawprize.org/prizes/mathematical-sciences). The 2020 Shaw Prize in Mathematical Sciences has been recently announced to be awarded in equal shares to Alexander Beilinson, David and Mary Winton Green University Professor at the University of Chicago, USA and David Kazhdan, Professor of Mathematics at the Hebrew University of Jerusalem, Israel, for their huge influence on and profound contributions to representation theory, as well as many other areas of mathematics. (See more here https://www.shawprize.org/prizes-and-laureates/mathematical-sciences/2020/press-release)

The Breakthrough Prize in Mathematics

The breakthrough prize in recognition of important achievements in the Life Sciences, Fundamental Physics, and Mathematics is known as "the Oscar" of science and mathematics. U.S. mathematician Alex Eskin won a $3 million of the Total of $21 Million awarded in 2020, for "revolutionary discoveries in the dynamics and geometry of moduli spaces of Abelian differentials, including the proof of the "magic wand theorem" with Maryam Mirzakhani." (See more here: https://blogs.ams.org/beyondreviews/2019/09/06/alex-eskin-wins-2020-breakthrough-prize-in-mathematics/). The founding sponsors of the Breakthrough Prize Foundation are Sergey Brin, Priscilla Chan and Mark Zuckerberg, Ma Huateng, Yuri and Julia Milner, and Anne Wojcicki. The new laureates were recognized at the eighth annual Breakthrough Prize gala awards ceremony that took place at NASA Ames Research Center in Mountain View, California, and broadcasted live on National Geographic. Each year, the program has a theme, and this year's topic – "Seeing the Invisible" – was inspired by the Event Horizon Telescope collaboration, which created the first image of a black hole, as well as the broader power of science and mathematics to reveal hidden, uncharted worlds. (See more here

https://breakthroughprize.org/News/54). See also Alon Amit's response to a question on @Quora: Why was Alex Eskin awarded $3 million? Did he solve something harder than millennium problems? https://www.quora.com/Why-was-Alex-Eskin-awarded-3-million-Did-he-solve-something-harder-than-millennium-problems?ch=99&share=297517c9&srid=3xqh7

The Schock prize

In his will, Dr. Rolf Schock, who died in 1986, specified that half of his estate should be used to fund four prizes in the fields of logic and philosophy, mathematics, the visual arts and musical arts. The prizes in logic and philosophy and in mathematics are awarded by the Royal Swedish Academy of Sciences, and those in the visual arts and musical arts by the Royal Academy of Fine Arts and the Royal Swedish Academy of Music respectively. The Rolf Schock Prizes are awarded once every three years in the fields mentioned above. Each prize is worth 400,000 Swedish kronor (about 40,000 dollars, in 2019).

In October 2014, the Japanese mathematician Yitang Zhang from the University of New Hampshire, USA, received the award "for his spectacular breakthrough concerning the possibility of an infinite number of twin primes" (See more here: https://en.wikipedia.org/wiki/Twin_prime.) In 2018, Saharon Shelah, Hebrew University of Jerusalem, Israel and Rutgers University, USA, received the Rolf Schock Prize in Logic and Philosophy. The citation reads "for his outstanding contributions to mathematical logic, in particular, to model theory, in which his classification of theories in terms of so-called stability properties has fundamentally transformed the field of research of this discipline." Ronald Coifman, Yale University, USA, was rewarded with the 2018 Rolf Schock Prize in Mathematics," for his fundamental contributions to pure and applied harmonic analysis." In 2020 Russian born Nikolai Makarov who lives in California "for his significant contributions to complex analysis and its applications to mathematical physics."

Other IMU awards

Rolf Nevanlinna Prize, Abacus Medal - honors distinguished achievements in mathematical aspects of information science. It will be awarded for the first time in 2022. It replaces the Rolf Nevanlinna Prize which has been awarded since 1982. (See more https://www.quantamagazine.org/tag/2018-fields-medal-and-nevanlinna-prize-winners/)

Carl Friedrich Gauss Prize: is awarded for outstanding mathematical contributions that have found significant applications outside of mathematics. It was first awarded in 2006. . Its last recipient, David Donoho, got the prize for revolutionising MRI scanning. Find out more in this short video https://t.co/3Q6f9YUh7P.

Chern Medal Award: is awarded to an individual whose accomplishments warrant the highest level of recognition for outstanding achievements in the field of mathematics. It was awarded for the first time in 2010.

Leelavati Prize - recognizes outstanding public outreach work for mathematics. The IMU awards the Prize since 2010. Since 2014 this Prize is sponsored by Infosys.

(For more details see here - https://www.mathunion.org/imu-awards/imu-awards-prizes-and-special-lecture)

Last but not least - The Communications Award of the Joint Policy Board for Mathematics (JPBM)

The Joint Policy Board for Mathematics (JPBM) Communications Award, established by the

JPBM in 1988, is given annually to reward and encourage communicators who, on a sustained basis, bring mathematical ideas and information to non-mathematical audiences. The JPBM is a collaborative effort of the American Mathematical Society, the American Statistical Association, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. (See more hehe http://www.ams.org/prizes-awards/paview.cgi?parent_id=20) The 2020 awardees were The British applied mathematician Christopher Budd and U.S. mathematician James Tanton. The ceremony took place at the 2020 Joint Mathematics Meeting in Denver, CO.

Christopher Budd received the award "for his passionate popularization of mathematics. Through his positions at Gresham College, the Royal Institution of Great Britain, and the Institute of Mathematics and its Applications, his books, and his work with science festivals and schools, he inspires audiences of all ages." In his response, Chris Bud said: "As an applied mathematician, I love both doing mathematics, and applying mathematics to the real world. But I think that it is equally important that we, as a community, communicate mathematics as widely as we possibly can."

James Tanton received the award "for global leadership in high school mathematics instruction. Through his "G'Day Math!" online courses, MAA Curriculum Inspirations, numerous textbooks, and the Global Math Project, he is inspiring millions to learn, and teach, math in wonderful new ways." In his response, James Tanton, who is currently serving as *MAA's mathematician-at-large,* said: "We each are part of a stunning global community united by the unbridled awe our beautiful subject can bring. Let's together help one and all on this planet, child and adult, personally experience the soaring joy, the human connection, and the uplifting wonder genuine mathematics offers!"