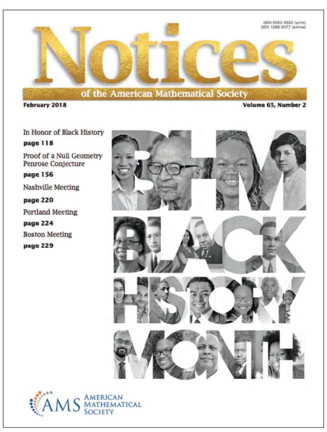
LETTERS TO THE EDITOR

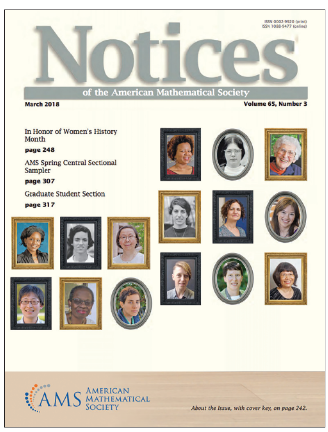
Thanks for Black History Month and Women's History Month

Thank you so very much for the last two issues of the AMS *Notices* in honor of Black History Month and Women's History Month. These have been my two favorite *Notices* issues ever. These two issues not only recognized outstanding mathematicians, but they conveyed in a very powerful way that both mathematics and the AMS are for people from all backgrounds. I have shared these two editions with friends, particularly some who teach in high schools. Even personally, these two editions have made me feel even more a part of the AMS and made me very proud to be a member.

—Susan Kelly
University of Wisconsin - La Crosse
`skelly@uwlax.edu`

(Received March 9, 2018)





Admission Predictors for Success in a Mathematics Graduate Program

The process of pursuing/granting a PhD degree involves significant costs for both the individual students and the institutions; as a result, there is a need for universities to identify applicants who are most promising in their PhD program. In addition, understanding the predictors of success could potentially help institutions with the early identification of students who are encountering more challenges, and designing ways to better support them. Female and underrepresented minorities comprise an especially vulnerable population in graduate programs across the STEM fields, and in mathematics in particular. An effort is underway to understand the causes of underrepresentation and implement measures to mitigate them. In a recent study,[1] we gathered and analyzed data from about 200 students in a graduate program in mathematics at a public Tier I university in southern California. We were particularly interested in detecting any discrepancies between the success rates of different groups, which could not be explained by differences in their undergraduate record.

According to our analysis, GRE scores correlate with success, but interestingly, the verbal part of the GRE score has a higher predictive power for Math PhD, compared to the quantitative part. Further, we observe that undergraduate GPA does not correlate with success (there is even a slight negative slope in the relationship between GPA and the probability of success). This counterintuitive observation is explained once undergraduate institutions are separated by tiers: students from "higher tiers" have undergone a more rigorous training program; they on average have a slightly lower GPA but exhibit a slightly higher probability to succeed. Finally, a gender gap is observed in the probability to succeed with female students having a lower probability to finish with a PhD despite the same undergraduate performance, compared to males. This gap is reversed if we only consider foreign graduate students. It is our hope that our study will encourage other universities to perform similar analyses, in order to design better admission and retention strategies for math PhD programs.

—Timmy Ma, Karen E. Wood, Di Xu,
Patrick Guidotti, Alessandra Pantano,
and Natalia L. Komarova
UC Irvine
`komarova@uci.edu`

(Received March 5, 2018)

**We invite readers to submit letters to the editor at* `notices-letters@ams.org`.

[Ma] `arxiv.org/abs/1803.00595`

No Ancient Scottish Evidence of Fifth Platonic Solid

I read with dismay the inclusion of the oft-repeated claim in Mohammed Ghomi's article "Dürer's Unfolding Problem for Convex Polyhedra" (*Notices*, January 2018) that the Platonic solids "were already known to the ancient people of Scotland some 4,000 years ago." George Hart[1] and Lieven Le Bruyn[2] independently noted that the picture apparently showing the five Platonic solids (reproduced by Ghomi) in fact only gives four of them, with modern additions to give the impression that two near-identical objects are dual polyhedra. Thus either the dodecahedron or the icosahedron is missing from the photo, depending on one's conventions regarding what the 'knobs' correspond to. Bob Lloyd, in his study[3] on the matter, writes:

> No dodecahedral form with [20 knobs] has yet been found. There is therefore no evidence that the carvers were familiar with all five Platonic Solids. Even for the four which they did create, there is nothing to suggest that they would have thought these in any way different from the multitude of other shapes which they carved.

where the "other shapes" consist of over 400 carved stone objects with between 3 and 160 knobs. Lloyd's article was chosen to be part of the volume *The Best Writing on Mathematics 2013*, so deserves to be better-known.

—David Michael Roberts School of Mathematical Sciences, The University of Adelaide
david.roberts@adelaide.edu.au

(Received January 31, 2018)

Roberts1 www.georgehart.com/virtual-polyhedra/neolithic.html

Roberts2 www.neverendingbooks.org/the-scottish-solids-hoax, *see also the follow-up* www.neverendingbooks.org/scottish-solids-final-comments

Roberts3 *DR Lloyd "How old are the Platonic Solids?"* BSHM Bulletin: Journal of the British Society for the History of Mathematics 27*(3) (2012)*, doi.org/10.1080/17498430.2012.670845

Native Script and Right-to-Left Languages

I enjoyed Allyn Jackson's article about Donald Knuth and native script in the January 2018 *Notices*. However, in the examples shown the right-to-left languages didn't come out correctly. At least in the ones using Hebrew and Arabic letters, the names are (almost) individually correct but are in the wrong order. For example, Elon Lindenstrauss' Hebrew name might be described as ssuartsnedniL nolE, using Hebrew characters instead of Latin ones. But it appeared as nolEssuartsnedniL with no space between the names, and Elon was misspelled in Hebrew. The correct rendering is אילון לינדנשטראוס. The same idea applies to Al-Khowārizmī's name.

—Alan Shuchat
Wellesley College
ashuchat@wellesley.edu

(Received February 23, 2018)

Women's History Month Advice Applies Also to Young Men

I'm not usually a fan of "special-interest-group in such-and-such-a-profession" promotions, but I came to appreciate your Women in Mathematics issue in March, 2018. The reason? Almost all of the "Advice to Young Women" sections could apply just as well to young men. A fact you might find it illuminating to reflect upon.

—W. F. Smyth
McMaster University
bill@arg.cas.mcmaster.ca

(Received March 9, 2018)

Print and Electronic Versions of the *Notices*

The print version of *Notices* arrives near the end of the month, several weeks after the electronic version is available. This delay must be deliberate since it now arrives by mail much later than in the Olden Days when there were no e-versions. Is this an attempt to put the print version out of business? If the extra cost of printing and mailing is an issue then why not deliver a timely product but charge members more for the option of receiving the hard copy?.

—Erik Talvila
University of the Fraser Valley
Erik.Talvila@ufv.ca

(Received February 14, 2018)

EDITOR'S NOTE. We love both the print and electronic *Notices*. Each issue is posted and mailed out as soon as it is ready, about the middle of the previous month.

More References

The article "Ad Honorem Charles Fefferman" in the December 2017 issue of the *Notices* is an otherwise excellent piece, ruined by a lack of journal references for the many mentioned results and papers.

I am sure that experts in the field know precisely where to look for each of the mentioned results. But non-experts who wish to read further are stymied by the lack of full references and are reduced to guesswork to find relevant papers in the literature.

This is not the first occurrence of this problem in the *Notices*. It reflects a disturbing trend, which has been growing for at least a year. Other articles in the same issue display this problem to varying degrees.

Lack of space should not be any form of excuse. The *Notices* is and should remain fundamentally a scholarly journal, and not a disposable infotainment magazine.

—Gerard Jungman
Los Alamos, New Mexico

(Received February 1, 2018)

EDITOR'S NOTE. The current editorial guideline is for contributions to list at most five references of most interest to the casual reader. The Editor in Chief determines the content and form of *Notices* articles during their tenure.

ERRATUM. The following letter printed in the May 2018 *Notices* with two references accidentally omitted. We reprint the letter in full below and apologize to the letter writers.

Notices Reprint Omits Important Mathematical Background of 2016 Nobel Prize in Physics

We are writing about an article on the 2016 Nobel Prize in Physics, which appeared in the *Notices of the American Mathematical Society*, **64**, Number 6, 557–567, (2017). The work for which this prize was awarded has an important mathematical component. We thus applaud the decision by the editors of the *Notices* to publish an article about it. However, we are dismayed by some aspects of the presentation.

The article reprinted in the *Notices* was compiled by the "Class for Physics of the Royal Swedish Academy of Sciences"; (names of authors are not listed). It describes the groundbreaking work of F. Duncan Haldane, J. Michael Kosterlitz, and David J. Thouless on a "topological phase transition," the so-called Kosterlitz-Thouless transition, and on "topological states of matter." It was excerpted from a longer article authored by the Academy. Unfortunately, the *Notices* chose to selectively include only *nine* of *fifty-five* references in the original article. We would like to know why the editors of the *Notices* chose to eliminate so many references to important work, and why they did not include any references to mathematical results that had already strangely been missing in the original article released by the Royal Swedish Academy.

We wonder whether the article published in the *Notices* was refereed. It appears that knowledgeable mathematicians were not contacted in this matter. Although the article may be well suited to a physics audience, it neglects to mention a significant body of mathematical research closely related to the work of Haldane, Kosterlitz, and Thouless, some of which we have been involved in. We believe that the editors of the *Notices* should have consulted the mathematical physics community before publication of this article. Addition of a mathematical perspective would have enriched the article and made it more relevant for the readership of the *Notices*. It might also have inspired further mathematical research. Below, we include references to some of the important mathematical work related to the 2016 Nobel Prize that we feel are useful to a mathematical readership.

I. Papers on Spin Chains:

1) E. H. Lieb, T. D. Schultz, and D. C. Mattis, Two Soluble Models of an Antiferromagnetic Chain, *Ann. Phys.* **16**, 407 (1961).

The authors prove that the spin-1/2 chain is gapless.

2) I. Affleck, T. Kennedy, E. H. Lieb, and H. Tasaki, Rigorous Results on Valence-Bond Ground States in Antiferromagnets, *Phys. Rev. Lett.* **59**, 799 (1987).

This work is mentioned in the *Notices*, but no reference is provided.

3) T. Kennedy and H. Tasaki. Hidden $Z_2 \times Z_2$ symmetry breaking in Haldane-gap antiferromagnets, *Phys. Rev. B*, **45**, 304 (1992).

This paper is cited in the original article of the Academy.

Also, A. Polyakov's fundamental prediction of the gap in the two-dimensional classical Heisenberg model should have been mentioned in connection with Haldane's work on spin chains: A. Polyakov, *Phys. Lett.* **59B**, 79 (1975).

The results in this paper are closely related to the gap in the integer spin chain. It is cited in the original article of the Academy.

II. Papers on Phase Transitions:

4) J. Fröhlich, B. Simon, and T. Spencer, Phase Transitions and Continuous Symmetry Breaking, *Phys. Rev. Lett.* **36**, 804 (1976). Details appear in: Infrared Bounds, Phase Transitions and Continuous Symmetry Breaking, *Commun. Math. Phys.* **50**, 79 (1976).

This work contains the first proof of "infrared bounds" and applies them to prove the existence of phase transitions accompanied by continuous symmetry breaking in classical spin systems.

5) F. J. Dyson, E. H. Lieb, and B. Simon, Phase transitions in quantum spin systems with isotropic and nonisotropic interactions, *J. Stat. Phys.* **18**, 335 (1978). See also: T. Kennedy, E. H. Lieb, B. Shastry, Existence of Néel Order in Some Spin-1/2 Heisenberg Antiferromagnets, *J. Stat. Phys.* **53**, 1019 (1988).

In these papers, symmetry breaking and Néel order are established for anti-ferromagnetic quantum magnets.

6) J. Fröhlich and T. Spencer, The Kosterlitz-Thouless Transition in the Two-Dimensional Plane Rotator and Coulomb Gas, *Phys. Rev. Lett.* **46**, 1006 (1981). Details appear in: The Kosterlitz-Thouless-Transition in Two-Dimensional Abelian Spin Systems and the Coulomb Gas, *Commun. Math. Phys.* **81**, 527 (1981).

This work contains the first rigorous proof of existence of the Kosterlitz-Thouless transition; (it actually settled a controversy on this question).

A more detailed analysis of this transition appears in: P. Falco, Kosterlitz-Thouless Transition Line for the Two-Dimensional Coulomb Gas, *Commun. Math Phys.* **312**, 559–609 (2012).

III. Papers on topological states of matter:

7) D. J. Thouless, Mahito Kohmoto, MP Nightingale, and M Den Nijs, Quantized Hall conductance in a two-dimensional periodic potential, *Phys. Rev. Lett.* **49**, 405 (1982).

The relation of this work to homotopy groups of certain natural vector bundles is pointed out in: J. E. Avron, R. Seiler, and B. Simon, Homotopy and quantization in condensed matter physics, *Phys. Rev. Lett.* 51, 51 (1983).

8) B. Simon, Holonomy, the Quantum Adiabatic Theorem, and Berry's Phase, *Phys. Rev. Lett.* **51**, 2167 (1983).

This article establishes a connection between Berry's work and that of Thouless et al. quoted above. This connection allows the author to use Berry's ideas to interpret the integers of Thouless et al. in terms of eigenvalue degeneracies.

9) Jean Bellissard, Noncommutative Geometry and Quantum Hall Effect, in: *Proc. of ICM'94*, S. D. Chatterji (ed.), Basel, Boston, Berlin, Birkhäuser Verlag 1995.

J. E. Avron, R. Seiler, B. Simon, Charge deficiency, charge transport and comparison of dimensions, *Commun. Math. Phys.* **159**, 399 (1994).

Berry's phase for fermions (which has a quarternionic structure) was studied in: J. Avron, L. Sadun, J. Segert, and B. Simon, Chern numbers and Berry's phases in Fermi systems, *Commun. Math. Phys.* **124**, 595 (1989).

10) J. Fröhlich and U.M. Studer, Gauge Invariance and Current Algebra in Non-Relativistic Many-Body Theory, *Rev. Mod. Phys.* 65, 733 (1993).

To our knowledge, the "spin Hall effect" in time-reversal invariant topological insulators with chiral edge spin currents has been described in this paper for the first time.

11) J. Fröhlich et al., The Fractional Quantum Hall Effect, Chern-Simons Theory, and Integral Lattices, in: *Proc. of ICM'94,* S.D. Chatterji (ed.), Basel, Boston, Berlin: Birkhäuser Verlag 1995.

J. Fröhlich, U.M. Studer, and E. Thiran, Quantum Theory of Large Systems of Non-Relativistic Matter, in: *Proc. of Les Houches LXII, Fluctuating Geometries in Statistical Mechanics and Field Theory,* F. David, P. Ginsparg and J. Zinn-Justin (eds.), Amsterdam: Elsevier Science 1995.

In these papers (and refs. to original papers given therein), results on the Fractional Quantum Hall Effect and other phenomena related to topological states of matter are described. Topological Chern-Simons (field) theory and current algebra are applied to problems in condensed matter physics.

—Jürg Fröhlich
ETH Zürich
juerg@phys.ethz.ch

—Barry Simon
Caltech
bsimon@caltech.edu

—Thomas Spencer
Institute for Advanced Study
spencer@ias.edu

(Received January 18, 2018)