



Noether's Two Theorems

I enjoyed reading the article by Fadi Bardawil et al. on “Immigration, Freedom, and the History of the Institute for Advanced Study,” especially the substantial paragraph on Emmy Noether, in the November 2017 issue of the *Notices*. On the other hand, I regret that the Editor's Note giving a list of related *Notices* articles failed to reference Robyn Arianrhod's review¹ of my book, *The Noether Theorems: Invariance and Conservation Laws in the Twentieth Century*. My book is not a biography of Noether; yet it contains essential biographical information and also clarifies the slightly misleading affirmation in the *Notices* article, “Noether's theorem not only laid this controversy to rest...” As pointed out long ago by Peter Olver, Noether's 1918 article contained two theorems. It is not “Noether's [first] theorem” but her second theorem that explained and vastly generalized an assertion of Hilbert, and thus “laid to rest” the controversy concerning the conservation of energy in Einstein's general theory of relativity.

—Yvette Kosmann-Schwarzbach
École Polytechnique, retired
 Yvette.Kosmann-Schwarzbach@math.cnrs.fr

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¹*Notices, August 2013*, www.ams.org/notices/201307/rnoti-p916.pdf

²*Bull. Amer. Math. Soc., 2013*, www.ams.org/journals/bull/2013-50-01/S0273-0979-2011-01364-7/S0273-0979-2011-01364-7.pdf

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

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Why No Permanent Position for Noether at IAS?

I completely agree with Yvette's comments [above]. Further information can be found in my own review² of her book. One aspect that all such articles seem to skirt around, but should really be explored in much more depth, is why a mathematician of Noether's caliber was not offered a permanent position at IAS or a major research university in the US. She was clearly the equal to if not significantly better than many males from Europe who were offered permanent positions at that time. I doubt it is because of her being either Jewish or a pacifist, and so conclude that this was (primarily) due to her gender. But I would really like to see the details exposed in full.

—Peter Olver
University of Minnesota
 olver@umn.edu

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More on Gravitational Waves

The issue of August 2017 of the *Notices* presents introductory articles on gravitational waves, motivated by the detection of oscillatory gravitational signals coming from merging black holes. The texts sketch the history of the theory of gravitational waves. However, they do not mention an important episode: exact solutions of Einstein's equations which are interpreted as plane gravitational waves were discovered already in 1926 by the British physicists O. R. Baldwin and G. B. Jeffery [1]. Their paper disproves the linearization paradigm which says that the full equations are too complicated, only the linearized equations can be fairly handled. The paper also contributes to the discussion of coordinate conditions; such restrictions might be imposed here but need not be. Last but not least, the constructed solutions are free of singularities. The authors apply the usual decomposition of the metrical tensor into LL , LT , and TT parts, where L means longitudinal and T means transversal to the direction of propagation. It turns out that pure LL or LT waves are flat (Minkowskian) while the curvature of TT waves generally does not vanish. Einstein's equations for pure TT waves boil down to a single ordinary differential equation. Vacuum (where there is only gravitation) as well as plane electromagnetic waves fit to plane gravitational waves.

A broader class of gravitational wave fields was discovered even earlier in 1925, but in a mathematical context, and

²*Bull. Amer. Math. Soc., 2013*, www.ams.org/journals/bull/2013-50-01/S0273-0979-2011-01364-7/S0273-0979-2011-01364-7.pdf

therefore it remained unnoticed by physicists for a time: H. W. Brinkmann [2] constructed special Lorentzian metrics in the framework of conformal differential geometry which were later named plane-fronted gravitational waves with parallel rays, *pp*-waves for short. The history and prehistory of plane and *pp*-waves is told in the paper [3].

—Rainer Schimming
Institute of Mathematics
University of Greifswald, Germany

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References

- 1) O.R. BALDWIN/G.B. JEFFERY, The relativity theory of plane waves. *Proc. Roy. Soc. London A* **111** (1926), 95–104.
- 2) H. W. BRINKMANN, Einstein spaces which are mapped conformally on each other. *Math. Annalen* **94** (1925), 119–145.
- 3) R. Schimming, Zur Geschichte der ebenen Gravitationswellen, einer Lösungsklasse der Einsteinschen Gleichungen. *NTM Schr. für Geschichte Naturwiss. Tech. Medizin* **10** (1973), 21–31.

Contributing Journals to Institutions in Less-Developed Nations

Recently I decided that it is time to contribute the many back issues of journals (AMS, SIAM, IEEE) that are in my office. The African Institute for Mathematical Sciences (AIMS) seems like a worthy organization, so I wrote to Prof Foupouagnigni of AIMS-Cameroon, offering those journals. He responded:

“Yes, I am interested in the mathematical journal you would like to donate to us. These for sure will be very useful for our students specially during these periods during which we are now gradually shifting to bridge gap between us and industry.”

I then wrote to bookdonations@ams.org asking for AMS assistance, saying in part:

“As I am close to Providence I would like to bring them to you (boxed or unboxed, as you prefer) so you can ship them, and so that I can obtain a receipt for tax purposes.”

The AMS response came from Kim Kuda, Senior Program Coordinator, Professional Programs Department:

“Our book donation program has a procedure in place where potential schools/universities apply to receive the donations we have posted on our website. Their requests are then reviewed by the Book Donation Steering Committee, and if a match is made, then the donations are shipped directly from the donor to the recipient. We do not accept donations here at our facility. In addition, our program only accepts research books and monographs—journals are not accepted. And finally, we do not supply receipts for tax (or any other) purposes as the donation is not being made to the AMS but to the recipient.”

Unsatisfied with this bureaucratic response, I wrote to Catherine Roberts, AMS Executive Director:

“Is the policy enunciated by Kim Kuda written in stone? Frankly it seems rather arbitrary to me. For example, I am sure that there are many others who have journals that they would be happy to contribute, and many institutions in the less-developed world that could make good use of them.

“If it would help I could be convinced to make a contribution to the AMS to partially defray the shipping costs.”

Catherine’s response:

“Thank you for reaching out to the AMS with your idea to donate your old copies of several journals, including AMS journals, to your contact in Cameroon. Due to the logistics and expenses involved, the policy outlined in Kim’s email response to your inquiry does accurately reflect our Society’s approach. I am sorry we aren’t able to help. Perhaps you could alert Prof Foupouagnigni to the resources that Kim described?”

I strenuously question this policy. It seems ridiculous to me that the AMS is unwilling to assist in giving access to the valuable resource that such journals would provide to both students and faculty in the less-developed world. Per www.ams.org/about-us/about-us the mission of our Society is:

“To further the interests of mathematical research, scholarship and education, serving the national and international community through publications, meetings, advocacy and other programs.”

And our goals are:

1. Promote mathematical research, its communication and uses
2. Encourage and promote the transmission of mathematical understanding and skills
3. Support mathematical education at all levels
4. Advance the status of the profession of mathematics, encouraging and facilitating full participation of all individuals
5. Foster an awareness and appreciation of mathematics and its connections to other disciplines and everyday life”

How does this policy serve our mission? Doesn’t affording access to such journals assist with every one of these five goals?

Our website further states:

“The AMS encourages the solicitation and acceptance of gifts for purposes that will help it further and fulfill its mission.”

I urge the AMS to reverse this policy and thereby help enable the contribution of journals to mathematical institutions that wish to have them.

—Jim Byrnes
President Prometheus Inc.,
a Woman-Owned Small Business
jim@prometheus-us.com

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