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Event Award ceremony N.G. de Bruijn Prize

Laudation for Marius Crainic

At the BeNeLuxMC 2016, on 23 March, the N.G. de Bruijn Prize has been awarded to Professor M.N. (Marius) Crainic. At this event the chairman of the jury, Henk Broer, delivered this speech in which he gives a brief review of De Bruijn's life and work, describes the background of the prize and explains why Crainic is awarded this prize. Marius Crainic received the prize from Frans de Bruijn, son of N.G. de Bruijn.

Nicolaas Govert (Dick) de Bruijn 1918–2012 was a prominent and broad Dutch mathematician who was pioneering and leading in various directions, ranging from Analysis, Number Theory & Discrete Mathematics to Proof-Checking (in particular the Automath project), Logic & Computer Science. A Special issue

Jan Willem Klop, Rob Tijdeman and Jan Wiegerinck (eds.), *Indag. Math.* 24/4 (500 pages): *In Memory of N.G. (Dick) de Bruijn*

was published in 2013. This issue contains a biography authored by Klop, followed by an extensive bibliography.

Start of the career

I will now tell a few things from his life. Dick de Bruijn's career initially ran via acquiring a number of teacher certificates, a route that was quite common for Dutch mathematicians at the time (Kloosterman, Van Dantzig, Van der Waerden, Dijksterhuis).

Thesis

In 1943 De Bruijn's ceremonial PhD defence (cum laude) on the thesis *Over Modulaire Vormen van meer Veranderlijken* ('On Modular Forms of Several Variables') took place under Koksma (at the VU Amsterdam). The set-up had already been approved of by

Kloosterman at Leiden University, which at that time was closed down by the German occupiers.

Summary of De Bruijn's career

In De Bruijn's own words (on the TU/e website): "At the TU/e I always was a kind of outlier. When I was appointed here in 1960, I had already had gone through quite a career. I had been a professor in Delft for six years and after that in Amsterdam for eight years (at that time the Mecca of the Dutch mathematics). To everyone's astonishment, I left for a tiny 'TH', looked down upon by everyone. But I made the move anyway and I have greatly enjoyed it. I was more or less grabbed by Professor Jaap Seidel. He offered special facilities, although never written down. He promised that I would never have to teach elementary courses and also never would have to do any administration. In fact, nowadays such a position would be called *research professor*. I have had relatively few master students and only about ten PhD students, also not particularly much. In my position I could easily switch to other topics. This also has to do with the structure of my character. I have a relatively bad memory. Then one never can become a real scholar, in the sense that one controls an entire field and keeps track of all literature. I have done a lot of pioneering work and often have started on new subjects.

I then made a lot of progress and next dived into something else which interested me. This operating procedure did have some success."

The latter sentence I would definitely call an understatement. In addition to this, I mention here that De Bruijn was an active member of the Royal Netherlands Academy of Arts and Sciences (KNAW) and a honorary member of the Royal Dutch Mathematical Society (KWG). As he already said himself, he was a professor at the Technical University Delft, the University of Amsterdam and, for many years, at the Technical University of Eindhoven.

The prize

The biennial N.G. de Bruijn Prize was installed in 2015 by the Royal Dutch Mathematical Society (KWG). It has been made available by Elsevier to the Dutch mathematical community in the light of the successful Elsevier–KWG cooperation regarding the mathematics journal *Indagationes Mathematicæ*. I should mention that the KWG, as the owner of the journal, greatly benefits from the ensuing royalties. The prize is awarded for the first time at the BeNeLuxMC 2016.

I like to mention here that Dick de Bruijn himself has published a lot of his work in this journal during the 1940's–70's. For those who like to know more details on this subject, I refer to the paper

Jaap Korevaar and Rob Tijdeman, *De geschiedenis van Indagationes Mathematicæ*, *Nieuw Archief voor Wiskunde* 5/14, March 2013.

Candidates for the N.G. de Bruijn Prize should have the Dutch nationality, live in the Netherlands or be associated with a Dutch university. This, first, N.G. de Bruijn Prize is awarded to the author of the best mathematical work that appeared in refereed journals over the years 2011–2014. It consists of a certificate, a medal in remembrance of N.G. de Bruijn and a certain amount of money, which will be awarded after the lecture. The jury of the 2016 N.G. de Bruijn Prize consisted of Professors Rob Tijdeman, Michel Dekking and myself, installed by the KWG Board. Since I acted as the chairman I have to deliver this speech. We were fortunate to have four excellent candidates for this occasion.

Marius Crainic

Marius Crainic, born February 3, 1973 in Aiud, Romania, obtained his masters degree in mathematics in 1996 from the Radboud University, Nijmegen. He received a number of distinctions, among them the André Lichnerowicz Prize in Poisson Geometry in 2008. His research interests lie in the broad area of (differential) geometry and (algebraic) topology.

Further scientific information

From 1996–2000 Crainic was a PhD student at Utrecht University, under the direction of Ieke Moerdijk. The thesis was entitled *Cyclic Cohomology and Characteristic Classes for Foliations*. After that he held various positions, e.g. at the University of California at Berkeley and at the Institut Henri Poincaré in Paris. Between 2002–2007 Crainic was a Research Fellow of the Royal Netherlands Academy of Arts and Sciences (3 + 2 years), after which he became a permanent staff member at Utrecht University. Since 2012 Marius Crainic is professor at the Mathematics Department of Utrecht University, leading the Poisson Geometry Group that contains a lot of enthusiastic PhD students. He is a member of the NWO research cluster Geometry and Quantum Theory (GQT), of which he also is the acting director.

Awards

Moreover he obtained several awards, like both an NWO Vidi in 2007 and an NWO Vici grant. The latter was awarded in 2013 for the proposal entitled ‘Poisson Geometry Inside Out’. For the period 2011–2016 an ERC starting Grant was obtained and several NWO Vrije Competitie scholarships.



Prizewinner Marius Crainic flanked by N.G. de Bruijn's daughter J. A. Dool-de Bruijn and son F. W. de Bruijn

Special Issue *Indagationes Mathematicae*

I also like to mention the 2013 Special Issue

Marius Crainic and Ori Yudilevich (eds.), *Indag. Math.* 25/5 (300 pages): *Poisson Geometry in Mathematical Physics*,

which was linked to the conference and summer school ‘Poisson 2012’, where Crainic chaired the organizing committee.

Management

He moreover was the scientific organizer or co-organizer of various other national and international activities, like a 2007 Oberwolfach meeting ‘Poisson Geometry and Applications’, the meeting ‘Poisson 2010’, the workshop ‘Alan’s Day’ in honour of Alan Weinstein’s honorary doctorate at Utrecht University, a ‘Conference Geometry and Quantum Theory’, to mention a few.

I very well remember Marius as the inspiring co-ordinator of the *MRI master classes*, where I recall that in the past the Mathematical Research Institute was a co-operation of the Universities of Groningen, Nijmegen, Twente and Utrecht.

For more details see Marius’s CV.

Why the prize is given

All the above has nothing to do with obtaining the N.G. de Bruijn Prize. To explain what it has to do with I continue by quoting from the report from a referee, whose name obviously has to remain secret here, but who is a highly influential mathematician and mathematical physicist. I apologize that the text now becomes a bit more technical.

“Among the papers which were published in the period 2011–2014, I believe that the most influential has been, and will be,

A.C. Abad, M. Crainic, Representations up to homotopy of Lie groupoids, *J. Reine Angew. Math.* 663 (2012), 91–126,

along with the follow-up paper

A.C. Abad, M. Crainic, Representations up to homotopy and Bott’s spectral sequence for Lie groupoids, *Adv. Math.* 248 (2013), 416–452,

both of them joint work with Crainic’s (now former) student Camilo Arias Abad.

Representations up to homotopy have become *the* essential tool for understanding the deformation theory of Lie algebroids and Lie groupoids, objects of continually increasing interest in Poisson geometry, field theories in mathematical physics, and deformation theory itself.

The deformation theory of Lie *algebras* relies on cohomology with coefficients in the adjoint representation. There is no corresponding representation in the ordinary sense for Lie algebroids, because of the term involving the differential d_f in the formula for $[X, fY]$, where X and Y are sections of a Lie algebroid and f is a smooth function.

In a 2008 paper, Crainic and Moerdijk had found, by a rather special construction, a replacement for the adjoint representation which enabled them to begin a study of deformations of Lie algebroids. But it was not until the work of Abad and Crainic that this construction was put in its natural setting, that of representations up to homotopy, which may be seen as a natural extension of the notion of representation in which vector spaces are replaced by complexes. Thus, this work fits into the currently hot field of ‘infinity algebra’, where (sometimes infinite) complexes are used to understand the algebra of situations where basic identities like linearity or the Jacobi identity are satisfied only up to correction terms involving differentials.

The major conceptual advance given by the notion of representation of homotopy has resulted already in important progress in deformation theory, as well as in further work extending the notions of differential geometry (such as foliations) from the tangent bundle of a manifold to a general Lie algebroid. I expect this subject to continue and develop, with the work of Abad and Crainic at its heart.”

For me it is an honour and a pleasure to invite Marius Crainic now to deliver the 2016 N.G. de Bruijn lecture. ☛