FINAL REPORT ON THE PROGRAMME 'MODERN HISTORY OF MATHEMATICS' HELD AT THE ISAAC NEWTON INSTITUTE FOR MATHEMATICAL SCIENCES, CAMBRIDGE 8 JANUARY–2 MAY 2025

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SUMMARY. This four-month programme brought together mathematicians and others working in the history of twentieth-century mathematics, with a focus on three areas: algebra, dynamical systems, and computing and data science. At the heart of the programme was the theme 'diversity of people, context and content': looking beyond the 'big names' to the broader communities of people engaged in research; considering mathematical contexts beyond academia, such as government and industry; and investigating mathematical innovation and impact beyond mathematics itself.

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1. Introduction and summary

The history of mathematics is an internationally active field of research, inherently multidisciplinary, with links to many fields, not least mathematics itself. The title of this programme, 'Modern History of Mathematics', admits two interpretations: contemporary approaches to the study of the history of mathematics, and the study of the history of recent mathematics. Both aspects were represented in the programme, the first history of mathematics programme to be held at the INI. In doing so, it combined research excellence with sustained interdisciplinary engagement, particularly through interaction and collaboration with mathematicians, which was crucial to the second interpretation of the title and amply facilitated during the four months in Cambridge. Other connections forged included a joint event with the parallel EHT programme (see §2.1.5), and extensive interactions with Cambridge Mathematics, Computer Science, History and Philosophy of Science, and museums (see §§2.5, 4). As the first programme in the history of mathematics to be hosted at the INI, the MHM programme demonstrated how historically informed scholarship can contribute directly to contemporary mathematical culture and research environments.

The programme opened with a workshop concerning lacunae in the study of the history of mathematics (§2.1.1), and closed with a workshop to identify future directions in the field (§2.1.2). At the closing workshop, the direction was set by early-career researchers, some of whom had been able to stay for the whole programme. The strong presence of ECRs throughout, together with the many successful social and career-development activities they organised, contributed significantly to capacity building and community development within the field. Social excursions included a trip to Bletchley Park and the Centre for Computing History (§4).

Over its four months, the programme hosted 117 scholars who delivered a total of 83 talks (described throughout §2), reflecting substantial international reach and sustained scholarly activity. Significant strands concerned the American geometer Oswald Veblen (§2.2.1), the classification of finite simple groups (§2.2.2), the 1894 Brill–Noether report on algebraic functions (§2.2.3), G. D. Birkhoff and topological dynamics (§2.2.5), twentieth-century 3-manifolds (§2.2.6), and the history of computing and data science (§2.2.7). Satellite events included a joint meeting with the London Mathematical Society on the value that historians of mathematics can bring to mathematics departments (§2.1.3), a workshop on using history to promote diversity in mathematics education (§2.1.4), an event at the Department of Computer Science and Technology entitled 'Where did AI come from?' (§2.3.2), and a play about Emmy Noether (§2.3.4). Programme participants were also involved in wider INI activities, such as a meeting of the IMU Executive Committee (§2.3.1).

Participants in the programme seized upon the opportunity to explore the rich archives in Cambridge, adding a further exciting aspect to the research environment, as people discussed unexpected discoveries (§3). Many participants will be building upon these archival findings for years to come, demonstrating the programme's longer-term impact and legacy.

Attendees provided overwhelming positivity in the post-programme survey; all rated the programme excellent (97.5%) or good; over half opened new research directions; and over

60% opened new collaborations. Comments praised the interactions, high-quality seminars, and chance to focus seriously on written work. In the report that follows, we discuss the content of the programme, and give an indication of some of its outcomes (§5).

2. Programme content

2.1. **Workshops.**

2.1.1. *Modern History of Mathematics: Emerging Themes (MHMW01).* 20–24 January; organiser: Adrian Rice (Randolph-Macon College).

To set the tone for the very first research programme on the history of mathematics at the Isaac Newton Institute, this opening workshop featured presentations from nineteen historians of mathematics from several different areas of the discipline, who were all asked to address the following question:

> *"What do you consider to be the most significant open question, or lacuna, in your area of the history of mathematics?"*

Speakers were asked to give the background to their chosen question or lacuna, outline the challenges that lie ahead for current research, suggest some possible strategies and approaches that could be applied, and possibly speculate on potential or anticipated findings. The full list of speakers and presentations is given in Appendix B.

It was anticipated that by the end of the workshop, the resulting presentations and the discussions arising from them would generate a number of complementary and contrasting topics and ideas—in accordance with the workshop's subtitle, 'Emerging Themes'—and this was indeed the case. In fact, in a productive discussion during the workshop's closing session, the organisers identified the following common themes that had emerged from the talks given during the workshop:

- The essentiality of archival research came through strongly in presentations throughout the week, and the need for scholars to attain a balance between the study of content and context was also a recurring theme. Other related matters included the question of determining which archives can be considered to be 'mathematical'.
- The need to critically re-evaluate canonical sources (both primary and secondary) was particularly pronounced during the first day of the conference, devoted primarily to historical studies of Isaac Newton, in which standard works of reference—such as Whiteside's well-known edition of Newton's mathematical papers—came under the spotlight.
- The need to (further) challenge the Eurocentric and male-centric historiography of mathematics also figured prominently. In addition to talks on mathematicians of great influence, many of the papers in this workshop examined the roles and contributions of lesser-known actors behind (and sometimes alongside) the so-called 'great men' of mathematics.
- The need to build bridges between the history of mathematics and the histories of other areas such as statistics, computer science, political science, economics,

sociology, labour, and technology arose from several of the presentations. In particular, it was recognised that a better understanding of how mathematics develops in response to socio-cultural conditions would be advantageous for further work.

- Overlap with other disciplines and the skills required for interdisciplinary research underscored another theme: namely, the challenge of exploring the history of applied mathematical areas, such as mathematical biology. How do we overcome the difficulties of writing interdisciplinary histories of subjects which are inherently multi-faceted? This intersected with the question of how to write technical histories of mathematics (particularly those involving 20th-century developments) while balancing the need for sufficient detail with the necessity of achieving some level of accessibility in order to reach a suitable audience.
- The role of 'story-telling' in science and mathematics emerged from presentations highlighting, on the one hand the relationship (or non-relationship) between mathematics and the popularisation of science, and on the other, myths and myth-making in the history of mathematics. This served to reinforce an earlier theme of the need for historians of mathematics to critically re-evaluate their sources for greater accuracy and reliability.
- Finally, looking ahead, the role of artificial intelligence emerged as a noticeable theme, both for its potential in assisting future research in the history of mathematics, as well as shedding light on our understanding of mathematical practice.

In addition to highlighting some of the latest research in the history of mathematics, the goal of this opening workshop was to generate a number of topics and ideas that would provide the impetus for further discussions and developments, for example, in subsequent seminars and mini-workshop collaborations. It is thus hoped that the themes identified during this workshop helped to focus ideas and clarify objectives for researchers in the history of mathematics, both during the MHM programme and beyond.

2.1.2. *Modern History of Mathematics: Looking Ahead (MHMW02).* 28 April–2 May; organiser: Christopher Hollings (University of Oxford).

In contrast to the opening workshop MHMW01, which took the identification of open questions in the Modern History of Mathematics as its focus, this closing workshop invited speakers to reflect upon the themes of the preceding four months, to suggest possible avenues and directions of further research, and in particular to suggest practical ways in which these might be taken forward. In some cases, the workshop enabled scholars to present research undertaken during the programme itself, together with ideas generated over the preceding weeks, as well as to discuss new questions and problems.

Whereas the opening workshop gave the floor predominantly to established historians of mathematics, the closing workshop placed greater emphasis on the contributions of the early-career researchers. The overarching goal of this closing workshop was to ensure that the projects and collaborations sparked in Cambridge extend beyond the end of the programme.

In addition to formal presentations (for a list of which, see Appendix C), the workshop included a less formal discussion session in which participants shared interesting and important items that they had found in archives while in Cambridge (see also §3). The workshop was rounded off by a panel session (the members of the panel being June Barrow-Green, Christopher Hollings, and Deborah Kent) which aimed to identify some of the themes of the week. These included:

- The importance of historians of mathematics engaging with *mathematical* history of mathematics—a point that was particularly apt in the surroundings of the INI. This is connected with the perennial question of who historians of mathematics are writing for, and the need to reinforce connections with mathematicians. The question was raised here of the appropriateness of different modes of publication.
- The richness and diversification of methodologies that are brought to the history of mathematics by drawing connections with other areas of study. The workshop featured talks, for example, that linked the history of mathematics to philology, natural history, philosophy, climate science, and computing.
- The social responsibility of public engagement in (the history of) mathematics.
- The value of questions relating to how archives are preserved and constructed, and also the benefits of using a diversity of sources, such as oral histories.
- Attention to shifting attitudes about what constitutes mathematics and who counts as a mathematician. Issues of place and scale are also relevant here; for instance, the identification of mathematics in commercial settings.
- Attention to diagrammatic, inscriptive, and other practices.
- The immediacy of issues relating to AI and data.

2.1.3. *History of Mathematics for Mathematical Leadership (MHMW03).* 14 April; organisers: June Barrow-Green (The Open University) and Deborah Kent (University of St Andrews).

This one-day meeting brought together stakeholders in the mathematical community (Heads of Department, Directors of Research, representatives of Learned Societies and Funding Bodies); organisations using history of mathematics in high-level public engagement such as broadcasters and museums; and leading international mathematical historians of mathematics. The meeting showcased the role, contribution, and potential of modern history of mathematics in mathematical research, teaching, public outreach and impact.

The day began with a lecture on why the history of mathematics matters; further talks covered examples of current research in the history of mathematics, the ways in which historians of mathematics can add value to a mathematics department, and questions about the position of the history of mathematics in relation to undergraduate curricula and the REF. For a full list of speakers and titles, see Appendix D. The day concluded with a panel discussion featuring Cathy Hobbs (Heilbronn Institute), Tim Gowers (Cambridge), Sarah Hart (Birkbeck), and Minhyong Kim (ICMS) on 'The role of history of mathematics in mathematics today'.

2.1.4. *History of Modern Mathematics in HE Mathematics Teaching (MHMW04).* 4–5 February; organiser: Isobel Falconer (University of St Andrews).

This workshop was a collaboration with another INI-funded effort, the History for Diversity in Mathematics Education Network.[1] The network had already existed for about a year and this workshop afforded further mixing of mathematicians and mathematics educators, who largely comprise the network, and historians, who largely comprised MHM attendees. This network investigates topics in the contributions of non-western cultures or underrepresented groups to modern mathematics, and discusses how these might be embedded in HE mathematics teaching to enhance inclusion and diversity in the curriculum.

The workshop was held in hybrid format with participants online led by Troy Astarte, and in-person by Isobel Falconer. Four talks were delivered (see Appendix E for details of these), each of which gave ideas or inspiration from history that could be used in the classroom, or provided examples of existing practice in this area. Each speaker brought a series of resources related to their topic of choice and these were shared with participants through a cloud storage folder, allowing their use in ongoing practice development.

Following each talk, small-group sessions worked on discussions of how each contribution could be adapted or shaped to fit within the participants' current teaching and learning environment. A key focus of the group formation was to mix mathematicians and historians so that relevant knowledge and experience could be shared across the disciplinary boundaries. In addition to the topic or practice themes highlighted by speakers, each working discussion session had a focus on a particular aspect of teaching context: assessment, project supervision, reflection on mathematics (for example, ethics, or mathematics in society), and technical mathematics. The workshop also featured two social events: a reception and pizza party on the first evening, and a potluck on the second.

2.1.5. *Joint event with EHT programme.* The MHM programme took place in parallel with the 'Equivariant homotopy theory in context' (EHT) programme, which provided an opportunity for a joint event on 19 March marking the centenary of the birth of Christopher Zeeman. Members of both programmes gathered for a seminar by Jemma Lorenat (Pitzer College), entitled *Two illustrated episodes in the history of drawing knots*, followed by a screening of Zeeman's 1978 Royal Institution Christmas Lecture on Linking and Knotting.

2.2. **Research strands.**

2.2.1. *Oswald Veblen.* The organisers Sloan Despeaux (Western Carolina University), Della Dumbaugh (University of Richmond), Jemma Lorenat (Pitzer College) report:

The INI hosted a Mini-Workshop on the Work of Oswald Veblen from January 8–17, 2025 as part of the broader MHM programme. This gathering offered many of the participants an opportunity to continue work on projects begun in December, 2022 at a Mathematisches Forschungsinstitut Oberwolfach (MFO) workshop on 'Toward a Composite Portrait of Oswald Veblen'. In particular, this group completed, edited, and submitted papers that will form an upcoming special issue of the *Bulletin of the American Mathematical Society* (see §5.1).

[1] `https://mathshist4edi.wp.st-andrews.ac.uk/` (EP/V521929/1).

Overview. Oswald Veblen played a pivotal role in the history of American mathematics in the twentieth century. His life, however, remains largely unstudied. Sloan Despeaux, Della Dumbaugh, and Jemma Lorenat designed and organized a conference at the MFO in December, 2022 to begin to redress this issue by exploring Oswald Veblen and his contributions to the history of American and international mathematics. The Veblen Papers from the US Library of Congress served as a foundational and shared resource for this interactive workshop. With this frame, the conference raised queries and discussed issues related to Veblen, his mathematical contributions, and his collaborative initiatives, including his critical work aiding refugee mathematicians in WWII that helped establish long standing programs at American institutions that continue to advance mathematics at the highest level. The workshop echoed Veblen's collaborative focus and brought together historians of mathematics and mathematicians to work alongside one another during the conference. This content and collaborative approach combined to advance our understanding of Veblen's collaborations and the history of twentieth-century mathematics more broadly.

Oswald Veblen earned his PhD in mathematics in 1903 from the University of Chicago under the direction of E. H. Moore. He was, then, among the first internationally-recognized American mathematicians educated in his home country. Woodrow Wilson invited Veblen to Princeton as a Preceptor in 1905 and Veblen remained at the institution and advanced through the ranks, ultimately becoming the first H. B. Fine Professor. While at Princeton, he served the broader American mathematical community in his role as AMS President (1923–1924) and in his work to secure funds for mathematics (most notably in the form of National Research Council Fellowships). In 1932, he left Princeton University, but not the town, to join the newly formed Institute for Advanced Study as its second faculty member. Saunders Mac Lane has described Veblen's contributions to the Institute as 'legendary'. Veblen helped hire the initial faculty members at the Institute, including Albert Einstein, Hermann Weyl, and James Alexander. He served as a fierce advocate for immigrant scholars. He recognized the value of young scholars and helped establish structures at the IAS that allowed these mathematicians a regular and ongoing place there. He remained on the IAS faculty until 1950 when he segued to Professor Emeritus. As with many mathematicians, this title was a shift in name only, as he continued to pursue his interest in the development of mathematics. He died in 1960, having lived a life fully devoted to mathematics, advancing colleagues through various initiatives and mathematical ideas in geometry and topology.

This workshop consisted of four components: Project group work, seminars, discussion sessions, and field trips.

Project group work. The vast majority of our workshop focused on project work. During this time, participants continued to research, write, and edit the projects they began in Oberwolfach in December, 2022.

Seminars. We had three seminars on related topics to inspire broader conversation around the history of mathematics in the late 19th and early 20th centuries:

- Karen Parshall, 'Tainted by Association: The State Department's Case Against Oswald Veblen';
- Della Dumbaugh, 'Iron Sharpening Iron: Oswald Veblen and His Associates';
- Caroline Ehrhardt, 'Calculating Prodigies in the Nineteenth Century: Science as Spectacle or Real Skill?'

Discussion Sessions. Participants gathered to discuss progress on the various projects and explore common threads and collective ideas. For the final two discussion sessions, each research team shared their paper with the group in advance and received insights about the content and style when we met. Most importantly, Karen Parshall, the Associate Editor at the *Bulletin of the American Mathematical Society* responsible for the Special Issue on Veblen, attended these sessions and offered feedback.

Field Trips. The group ventured out into Cambridge for two field trips:

- Museum of Technology Printshop (January 12). Our group enjoyed a private demonstration of print culture and techniques around the turn of the century.

- Endless Stories, Cambridge University Library (January 8).[2] Our group had a private tour of this exhibition with its 'extraordinary collection of manuscripts in a dazzling array of languages, including Arabic, Hebrew, Persian and Malay'.

Outcomes. The participants submitted the final versions of their papers to the *Bulletin of the American Mathematical Society* in July, 2025. The articles have all been peer reviewed, revised, and accepted for publication in a forthcoming issue. The titles of the papers may be found in §5.1.

In the future, given the success of the style of the workshop and the collaborations, this group of colleagues plans to situate Veblen in a broader context and explore new avenues in the history of mathematics, including some of the themes and ideas discussed at the MHM conference.

INI Facilities. The amenities and resources of the INI were particularly conducive for this collaborative workshop strategy. In particular, workshop participants appreciated the ability to access the INI library's physical and online resources, the University of Cambridge library and archives, the space to meet as a whole as well as in subgroups at any time, beautiful blackboards and chalk, and, of course, tea and coffee. The organizers would like to extend a generous thank you to the INI staff for their support of this workshop.

Participants: Juan Carvajalino, Sloan Despeaux, Della Dumbaugh, Helena Durnová, Caroline Ehrhardt, Emmylou Haffner, Christopher Hollings, Steve Kennedy, Deborah Kent, Jemma Lorenat, Erika Luciano, Nicolas Michel, Adrian Rice, and Karen Parshall.

2.2.2. *The history of the classification of finite simple groups.* The organisers Volker Remmert (Bergische Universität Wuppertal) and Rebecca Waldecker (Martin-Luther-Universität Halle-Wittenburg) report:

Volker Remmert, Rebecca Waldecker, and Atle Höhne spent almost five weeks at the INI, with a focus on research on the history of the Classification of Finite Simple Groups (CFGS). For Höhne (Halle), this was directly related to his PhD thesis, where he studies in much detail the historical context of the discovery of the modern sporadic simple groups. All of us benefitted greatly from the extensive library and the opportunities for deep discussions on special aspects of our work, but for Atle Höhne, this was particularly relevant. At his home university, he is part of a research group in group theory and he does not often have the opportunity to speak with so many historians of mathematics. At the INI, it was possible for him to discuss everything in as much detail as he wanted, be it purely mathematical or historical. He also took the opportunity to connect with other PhD students or postdocs who work in the history of mathematics and to listen to research talks by participants.

Three students from the University of Halle joined the programme for two (Lean Rohlfs) or three weeks (Jonas Findeisen, Kim Spar), respectively. It was the first time for them to visit such a prestigious research institution and to be exposed to so much expertise in mathematics and the history of mathematics. They worked on special aspects of our research programme, together or individually: refining databases, designing visualisations for talks or publications, working on the transcripts of interviews in order to collect specific information and follow-up questions.

All of them also attended talks, participated in guided tours and explored the extensive library. We recorded a podcast episode (in German) about our research project and the different perspectives that we have on our work. The interactions with the students made us more aware of many more aspects of our project that we had not yet investigated (like diversity in even more aspects and the dynamics in the research community), we discussed in depth our interviews and the chances and limits of our methods, and we talked about unusual ways of dissemination for our work. In addition to podcasts and videos, we thought about creating an interactive website with archive material that we collected, links to publications, to interviews, to original articles or photos from important conferences.

[2] `https://www.lib.cam.ac.uk/whats/introduction-endless-stories`

Remmert and Waldecker prepared and gave several talks on their project (see below), accompanied by extensive discussion with other MHM programme participants. Our concept 'Big mathematics' was often a prominent feature in our talks and we received many questions and much feedback on it. The critical questions and remarks, and also the possible misunderstandings around this concept sparked fruitful discussions that will be helpful for the further development of this concept as well as for a more detailed discussion in our next grant proposal. Often, it is a challenge to take the criteria and find a suitable interpretation in the context of the time (in particular 1950s–1980s), without it becoming too unspecific. The next challenge is to look for evidence for or against criteria. In this respect, it was helpful to have access to original PhD theses and to conference proceedings in the library. Often, this gave us new information about the use of computers or financial funding. We also finally had the time to study interviews with the main players of the CFSG in detail. Reading the old interviews that had been conducted by Joseph Gallian, some of them very long, take a lot of time and focus which we usually do not have during our busy academic lives. It was extremely interesting and rewarding to be able to read these interviews, follow up on information there and discuss our thoughts immediately with each other. Together with discussion with other MHM programme participants, this gave us additional insights into another important aspect of our project, namely self-historicisation around the CFSG. We were also able to speak to Kenneth Falconer, Dave Benson and (by video chat) to Geoff Mason about their experiences with and impressions of the CFSG. Finally, we wrote and submitted two articles during our time at the INI, both of which were extensively discussed during our stay, leading to much valuable feedback for us. Future plans include an article specifically on self-historicisation, the submission of a follow-up grant proposal and more interviews, to only name a few. The stay at the INI has also led to many more invitations to give talks about our work.

There were two special seminar days on 'New Structures' that we organised as part of our Mini-Workshop. We had presentations by J. P. Ascher, Michael Barany, Lukas Schievelbusch (see below), David Rowe, Norbert Schappacher, and Christophe Eckes, with fascinating perspectives on 'New structures', a theme that we chose specifically because of its openness and several meanings. We contributed ourselves, in the context of our CFSG project, and we learned about clerical structures, sociable structuralism, specific aspects of Cold War Mathematics, Felix Klein's 'Erlangen Program', outsiders of the mathematical community and Bourbaki's *Eléments de mathématique*. Again, the extensive discussions shed new light on aspects of our CFSG project, and we enjoyed having such a nice mixture of experienced and early stage researchers together for a few days.

Attending talks by other programme participants, joining guided tours and watching the Emmy Noether play were among the highlights of our stay, but maybe the strongest impact came from the retreat-like character of our time at the INI and the plentiful resources, including the many other participants and their time and expertise. We want to thank everyone involved in applying for the programme and organising it, and we are particularly grateful that several academically young people got the opportunity to stay at the INI and take a deep dive into the research community and culture.

Talks delivered at the INI:

- *Could the Classification of Finite Simple Groups be an example for 'Big mathematics'?* (Remmert/Waldecker);
- *The CFSG: A gentle mathematical introduction* (Waldecker);
- *Historicizing the Classification of Finite Simple Groups, 1970s onwards* (Remmert);
- *History of the CFSG: How big is it?* (Remmert/Waldecker);
- *Three approaches to the history of 20th century mathematics* (Remmert; see §2.3.1).

A further talk, 'The Classification of Finite Simple Groups: History, applications and many open questions' was delivered in the Mathematical Colloquium at the University of St Andrews (Waldecker).

Lukas Schievelbusch (Wuppertal) reports further:

In early March 2025, an invitation was extended to me to deliver a presentation at the INI on the subject of my master's thesis, whose focus was the establishment of a network of mathematicians in the Classification of Finite Simple Groups, a process that spanned nearly three decades. At the time, I was employed as a student assistant on the DFG-funded project 'Big Mathematics? The Classification of Finite Simple Groups'.

As a constituent element of a broader research initiative, the focus of my master's thesis was on the twenty core mathematicians who were at the core of the mathematical classification project. Over the course of several months, I collected data on the communication between these twenty individuals, both in official (e.g., collaboration, publication) and private (e.g., exchange of letters, information from interviews) contexts. In the course of the presentation, I presented my findings, which had been divided into multiple networks based on the different sources of the data that had been collected and analysed.

At this juncture, my thesis had already been completed, thus enabling the presentation of the total findings to the workshop members.

This also represented a significant opportunity for me. I had previously submitted an application and been accepted into the Graduate School: Transformation of Science and Technology, with a dissertation project on the History of Mathematics in the Cold War US. Consequently, the opportunity to engage with experts in the field of History of Mathematics and to present the findings of my thesis would be of immense benefit to my future research endeavours.

The post-presentation discussion contributed to a more comprehensive understanding of the intricacies and methodologies of the discipline. Due to the absence of a formal mathematical education, the project I assisted in and my master's thesis constituted the inaugural foray into this historical discipline. The workshop I partook in, in turn, served to affirm my choice of dissertation project. The workshop also provided a valuable opportunity to attend the other talks and to participate in the general discussions. A social gathering was organised on the evening of my presentation, which provided an opportunity for networking with the other historians of mathematics in attendance. Through personal interaction with a number of individuals, I was able to gain insight into the projects they are currently engaged in, as well as the methodologies they employ. This has significantly enriched my understanding of the subject matter and has been instrumental in enhancing my professional expertise.

It is noteworthy that, more than half a year later, the work of one of the other presenters has become highly relevant and important for my research. I was able to reconnect with this individual with relative ease. The completion of this endeavour would not have been feasible without the invaluable support of the ICHM and their Travel Grant, for which I express my profound gratitude.

2.2.3. *Brill–Noether.* The organisers Karine Chemla (University of Edinburgh; CNRS), Nicolas Michel (formerly INI Postdoctoral Fellow, now Université Claude Bernard Lyon 1), and Paul-Emmanuel Timotei (Université Paris Cité) report:

The Isaac Newton Institute hosted the translation and research group working on the historical report written by Alexander Brill and Max Noether, *Die Entwicklung der Theorie der algebraischen Functionen in älterer und neuere Zeit*, published in 1894. Our workshop took place over two weeks, from 24 February to 7 March 2025, and involved 19 participants.

During these two weeks, we had the opportunity to organise three types of sessions.

The first type, and the one that took most of our time, were 'translation sessions'. We organised 19 translation sessions, each lasting 1.5 hours. The group usually split into two subgroups, giving us a total of around 38 translation sessions. Here is the list of the translations presented (let us point out that the sections presented could not be fully translated, due to the difficulty of the texts and the rich discussions they lead to): Karine Chemla, Sections I.D, I.E (on 18th-century approaches to algebraic curves), Bruno Belhoste and David Waszek, Section II.C (on Cauchy), Norbert Schappacher and Ivahn Smadja, Section III.B (on the reception of Abel's work), Peter Ullrich, Sections III.E, VII.A (on Weierstrass), Nicolas

Michel, Section V.A (on algebraic geometry before Riemann), Paul-Emmanuel Timotei, Sections VI. B, VI.C (on singularities), Michael Friedman, Section VIII (on invariant theory).

The format of these sessions was as follows: a member of the group presented their translation, i.e., they read the German version of the passage they wished to present and then read their English translation. We discussed the translation in terms of mathematical meaning, of vocabulary, grammatical structure, and also of faithfulness to the original text. Discussing the mathematical content often required going back to Brill and Noether's primary sources, in order to give the most comprehensible translation, with appropriate annotations; we also analysed the relationship between the historical narrative and the sources, i.e., to understand the structure of the historical account and to understand how Brill and Noether make history.

These exchanges led us to the second type of session that we held, that is, the 'general discussions'. During these discussions, we usually shared our different results on the historical report, whether they concerned translation or historiography. This workshop gave us the opportunity to discuss our project for an annotated edition of the translation, in terms of a paper as well as an online edition. We also addressed questions about the organisation of the group, the people involved in the project, and where next to meet to go on with our research, etc.

The last type of session held consisted of 'presentation around the *Bericht*'. These presentations were given by members of the group or by outside guests; they dealt with mathematical subjects, the history of mathematics, and also with problems we are facing, such as the practice of translation and the relationship between our project and projects similar to ours. We had 8 presentations during the two-week workshop: Tim Hosgood (Topos Institute, Oxford), 'Open translations in mathematics'; Mireia Martínez i Sellarès (University of Utrecht), 'Sources and Narratives: A Historiographical Look at the I. Abschnitt in Brill and Noether's *Bericht*'; Jeremy Gray (Open University, Milton Keynes), 'What Brill and Noether could not see, and Macaulay could'; Jesper Lützen (University of Copenhagen), 'The history of the function concept and Brill–Noether's account of it'; Jeremy Gray (Open University, Milton Keynes), 'Jesse Douglas, minimal surfaces, and the first Fields Medal'; Mark Gross (University of Cambridge), 'Algebraic geometry in Brill and Noether's Report'; Elena Scalambro (University of Turin), 'Traces of Brill and Noether's *Entwicklung* in Fano's work: a case study in German-Italian mathematical dialogue'; David Rowe (University of Mainz), 'Max Noether as Mathematical Scholar and his Role as Co-Author of the Brill–Noether Report'. All of them gave us a new perspective on the text, the context in which it was written and its reception, as well as on our own relationship with the text and its translation. These 8 presentations fuelled many questions, and also opened up new perspectives (the idea of an online edition, a reflection on the absence of any theory of surfaces or of skew curves in the historical report, etc.).

These two weeks at the INI and the 'Modern History of Mathematics' programme enabled us to make significant progress in our translation of the historical report by Brill and Noether, as well as in our historiographical reflections on the *Bericht*. In addition, the presence of a large number of researchers in mathematics, history and philosophy of mathematics gave us the opportunity to share our enthusiasm for our project, to feed our reflections and to broaden our group.

Participants: Bruno Belhoste, Karine Chemla, Michael Friedman, Jeremy Gray, Mark Gross, Tim Hosgood, Ralf Krömer, Nana Liu, Jesper Lützen, Mireia Martínez i Sellarès, Nicolas Michel, David E. Rowe, Elena Scalambro, Norbert Schappacher, Ivahn Smadja, Brigitte Stenhouse, Paul-Emmanuel Timotei, Peter Ullrich, David Waszek.

2.2.4. *Poncelet Project.* Karine Chemla reports:

In addition to taking part in the two weeks of the Brill–Noether project (see §2.2.3), we have pushed forward a project concerning the notebooks of Jean-Victor Poncelet on projective geometry (9 March–3 April 2025).

We have focused on the manuscript of his notebook 5, 'Essai sur les propriétés projectives des sections coniques' (Essay on the projective properties of conic sections), which was the memoir presented to the

Académie des Sciences on 1 May 1820, and a first version of the 1822 *Traité des Propriétés Projectives des Figures*. Our main aim was to understand better the evolution of Poncelet's ideas on the principle of continuity. We have also worked to understand his mathematics better.

This notebook 5 is crucial for the principle of continuity. Poncelet claimed to have reproduced it without substantial changes when, at the end of his life, he published his archive (*Applications d'analyse et de géométrie qui ont servi de principal fondement au* Traité des propriétés projectives des figures, vol. 2, 1864).

Since this is one of the three notebooks out of ten for which the manuscript still exists, it gives an opportunity to analyze how Poncelet published his own archive in the 1860s.

First, we established that Poncelet changed some aspects of the manuscript, in ways that have hidden some of his intellectual developments. Interestingly, some of these changes are related to criticisms that Cauchy formulated in the report on the memoir that he produced for the Académie des Sciences in 1820. Retrieving the original document allows us to understand better how Cauchy's criticisms in fact influenced Poncelet's views — a point that has never been made in the historiography.

Secondly, this last fact is all the more important since the manuscript contains several kinds of passages that are crossed-out. Some were crossed out lightly, in relation to the fact that, for the 1864 publication, Poncelet slightly shortened the memoir. In fact, part of the passages crossed out in 1864 feature in the 1822 treatise. Other passages were crossed out much more heavily, and they correspond to nothing in the book published in 1822, nor that published in 1864. At the INI, we spent quite some time trying to decipher what was behind the thick black lines crossing out the text. We could read part of it, and this allowed us to make a major leap forward: these lines show how Poncelet first understood the principle of continuity, in line with the analysis of the 18th century — in particular, Euler's treatment of continuity. These passages that we could restore connect with other pages of notes that Poncelet published in the 1864 volume and they reveal aspects of his reflections that were never even imagined. This conclusion is supported by other references that Poncelet made to the same effect and that were not deleted from the treatise. Following Cauchy's criticism, Poncelet rethought the analytical roots of his principle of continuity, and his first reflections and the sources of his notion of continuity were thereby hidden.

This has led us to work on the history of how Poncelet's principle of continuity has been shaped as deriving from Leibniz. We have explored this episode of the historiography of mathematics, in particular in the wake of the neo-Kantian authors.

Finally, we could establish that Poncelet had used the very document submitted to the Academy in 1820 (whose manuscript still exists) as a basis to prepare his 1822 treatise. The treatise attests to a major reshaping of the ideas in the 1820 memoir, and the manuscript of the memoir retains traces of how Poncelet carried out this reshaping.

We have started to write an article on these findings, which we intend to submit to *Historia Mathematicia*, but we are still in the process of completing it.

Spending this time at the INI has allowed us to have multiple conversations with colleagues, and especially early career colleagues, which were very important for our work. Moreover, we could renew contacts and have very good conversations with many colleagues from Cambridge (mathematicians, classicists, sinologists, in particular).

2.2.5. *George D. Birkhoff and topological dynamics.* A mini-workshop was organised by June Barrow-Green (The Open University), who reports:

The other participants were Andrew Burbanks, Dan Rust, and Reem Yassawi. The participants met together for several days at the INI during February and March. Before the workshop all participants had studied Birkhoff's unpublished manuscript of 1941 on unsolved problems in dynamics (of which an abbreviated version had appeared in *Science* in 1941), and Barrow-Green's 2022 ICM paper on the genesis

of the manuscript. The goals of the workshop were to find out whether any of Birkhoff's 17 problems had been solved, if so how and if not why, and to what extent, if at all, these problems influenced subsequent developments in the field of topological dynamics. The INI provided an unparalleled opportunity for us to work together on this project, and considerable progress was made, aided by journals from the Betty and Gordon Moore Library, and material from the University Library. Work on the project is ongoing, and we hope to have a paper completed next summer. We shall be speaking about the project at the INI/BSHM joint meeting on 16 May 2026.

2.2.6. *History of 3-manifolds and related topics.* A mini-workshop was organised on this subject by John McCleary (Vassar College) and David Rowe (Johannes Gutenberg-Universität Mainz) on 3–21 March; attendees included Michael Friedman, Jeremy Gray, Henning Heller, Hannes Junker, Jesper Lützen, Donal O'Shea, and Daniel Otero. The organisers report:

During these three weeks the group engaged in discussion sessions based on selected readings and took in talks on various topics. Before coming to the INI, several of us had read Don O'Shea's book, *The Poincaré Conjecture: In search of the shape of the universe.* After discussing it, we took up the controversial paper by Arthur Jaffe and Frank Quinn, '"Theoretical mathematics": Toward a cultural synthesis of mathematics and theoretical physics' (*Bulletin of the AMS* 29(1), 1993). In a subsequent issue of the *Bulletin of the AMS* a host of distinguished mathematicians reacted to their argument, often quite critically. Of most interest to us was Bill Thurston's independent response, 'On proof and progress in mathematics' (*Bulletin of the AMS* 30(2), 1994), in which he described his manner of working on mathematics. We wanted to recall the specific issues that were raised in this debate, and to take a close look at how Thurston's philosophy of mathematics complemented his great influence on the theory of 3-manifolds.

Four members of the group presented informal talks (none were recorded). These dealt with the following topics: Gray on Riemann's approach to function theory, Rowe on the role of deformations in classical surface theory, McCleary on Poincaré's papers on 3-manifolds, O'Shea on Thurston's program for classifying 3-manifolds.

2.2.7. *Computing and data science.* Participants Steven Abbott-Williams (Swansea University) and Eva Kaufholz-Soldat (Universität Koblenz) report:

As part of this two-week workshop, the seminar 'Bridging Histories: Literacy, Computer Science and Mathematics in the 20th and 21st Centuries', was organized by Liesbeth de Mol and Michael Friedman. Taking place over March 25th and 26th, 2025, presentations explored how literacy, a concept traditionally understood as the ability to read and write that has more recently been extended to computing, might be reinterpreted in the context of expert knowledge. Rather than focusing on everyday users, the seminar examined how literacy applies to mathematicians, historians, and computer scientists, offering a lens through which to understand the complex and intertwined developments that have shaped computing and mathematics over the last century. The discussions opened a wide range of perspectives, highlighting the depth and flexibility of the literacy concept in this broader intellectual setting. Some lectures and discussion panels dealt with very modern developments, including the interaction between natural languages and neural machine learning (Gianni Gastaldi), the coding of 'clean' grammars (Anne Copestake), and the semantics of programming languages, examining, from a linguistic perspective, the use of metaphors, analogies and illustrative language (Troy Astarte). Karine Chemla, however, made it clear that literacy did not become relevant only with the advent of the first computers. Using sources from the early Chinese

imperial period, she showed how expressions used to describe mathematical operations illustrate the possible use of tools such as counting rods to perform calculations for which no 'operating instructions' are available today.

The sources Erica Meszaros referred to in another session on the history of data and statistics were even older, namely Mesopotamian clay tablets with an astronomical focus. This session, organized by Jemma Lorenat and Deborah Kent, not only highlighted the strong links between data and various forms of applied mathematics, especially before the 20th century; it also discussed how the history of data and statistics can be taught at universities. As Deborah Kent convincingly argued, such courses should by no means be intended exclusively for students of STEM. Courses in which students have only limited prior knowledge of mathematics can use an interdisciplinary approach, she noted, incorporating historical or sociological methods. The topic of data is not limited to technical and mathematical questions but also offers interesting insights into broader cultural history.

The breadth of the topics was also reflected in other presentations, which ranged from mathematical calculations of clouds in the late 19th century (Hannes Junker) to Soviet artificial intelligence (Ekaterina Babintseva), data exchange and computational modelling (Barbara Hof), and the mathematical theory of epidemics (June Barrow-Green) to programs as literary objects (Mark Priestley). Finally, questions about agency, literacy, power, and responsibility in an increasingly technologized world and the emergence of so-called technical elites played an important role in numerous discussions.

Reinhard Siegmund-Schultze gave an overview of his decades of groundbreaking research on mathematicians who fled the Nazi regime in his Rothschild Public Lecture. Here, he asserted that historians should take a stand on contemporary issues. He did so by raising the question of whether historical research is not always intrinsically political, i.e., whether it implicitly contains the demand and obligation to take a clear political position in current situations based on knowledge about the past.

But it wasn't just the wide range of topics discussed that stimulated lively intellectual exchange on the individual areas of interest and periods studied. A variety of exciting excursions brought the participants together, including a trip to The Centre for Computing History in Cambridge.

Overall, the two weeks were a great opportunity for learning, discussion, and networking. With only some of the time taken up by set activities, there was ample opportunity for people to connect with others and discuss their research on computing technologies, mathematical practices, notions of style or logical thinking and their respective cultural, sociological, and philosophical influences throughout human history. Facilitating these exchanges is exactly why the Isaac Newton Institute funds these programs; it is worth noting this was the first time it supported a history-focused program. We all hope it will not be the last!

2.2.8. *Provincialising Mathematics.* This pop-up workshop took place on 15–16 April and was organised by Michael Barany (University of Edinburgh), who reports:

Within the INI MHM programme, this two-day hybrid pop-up event linked MHM participants on-site to a globe-spanning network of researchers to consider how to tell the story of modern mathematics from vantage points outside of the most influential nations and institutions of Europe and North America. We took as a point of departure the provocation from Dipesh Chakrabarty ('Provincializing Europe') about the role of European history and scholarship in universalist approaches to the history of non-European places and people. The sessions were timed to facilitate zoom participation across a wide range of timezones. We were grateful to the INI technical team for enabling the hybrid setup.

The agenda opened with a moderated panel of historians of subjects other than modern mathematics (early modern books, colonial medicine, and internationalism and globalisation) to help frame the event's thematic and methodological questions. The remaining sessions had an informal structure, with a mixture of informal presentations of varying lengths from participants both on-site and online, and wide-ranging open discussion. We began with a session focused on outsiders, diasporas, and migrants, looking especially at migrant mathematicians from smaller nations within larger political and academic systems. We

then proceeded in an order respecting timezones for zoom participants through the BRICS nations and associated regions, centring (in order) South Africa, Brazil, China, India, and Russia.

Participants joined us online from South Africa, Brazil, India, China, and America, and expertise online and in-person covered an invigoratingly broad range of geographies and archives. The discussions examined connections between places as well as the distinctive histories of specific places in a global context. There was special interest in archives and record-keeping, and how the histories of different places related to the challenges confronting their historians today. We were also interested in how to sustain research discussions like this given the coordination challenges of our different locations and circumstances. We took notes and collected references in a shared document, which was edited and shared with participants following the meeting.[3]

2.3. **Related events.**

2.3.1. *Meeting of the IMU Executive Committee.* During the MHM programme, the IMU Executive Committee met at the INI on 6–7 March.[4] During this meeting, participants in the MHM programme contributed to a panel on the history of mathematics, chaired by Christoph Sorger, IMU Secretary General. The session featured

- June Barrow-Green of The Open University, who discussed 'Findings from the archives: The wartime diary of a senior wrangler and an unpublished manuscript of George Birkhoff';
- Niccolò Guicciardini from the University of Milan, who presented 'Digitising Isaac Newton: An online edition of the *Principia*'; and
- Volker Remmert from the University of Wuppertal, who lectured on 'Three approaches to the history of 20th-century mathematics'.

2.3.2. *Where did AI come from?* This INI 'Open for Business' event took place at the Department of Computer Science and Technology on 3 April 2025; there were 75 attendees. It was organised by Sofia Del Sanz Pino and Harriet Lusty (Newton Gateway to Mathematics) and Ursula Martin (University of Oxford). Its objective was to provide a meeting ground for mathematicians, historians and computer scientists to communicate and discuss how history of computing can aid current research in the rapidly evolving areas of machine learning and AI.

Over the past 70 years 'Artificial intelligence' has gone from a niche research interest to being part of everyday conversation, and a matter of public concern. In this event a historian, a computer scientist, and a museum curator looked at different aspects of the origins of AI. Historian Thomas Haigh described how the AI brand has included a variety of technologies, with a still-distant goal of human-like intelligence, and how AI thinking has had a broad influence on contemporary computing. Cambridge's Ann Copestake described some of the remarkable work of Karen Spärck Jones whose work is acknowledged as foundational for information retrieval and internet search and who was also one of the very first people to experiment with the distributional approach which underlies modern

[3] `https://sigma.mathsworlds.org/activities/brics-icms/2025-04-16-provincializing-transactions/`

[4] `https://www.newton.ac.uk/news/ini-news/imu-executive-committee-meets-at-the-ini/`

language-based AI systems. David Dunning, a curator at the Smithsonian, described how artefacts can help us understand AI in the context of longer histories, and grounded in material activity rather than pure abstraction. There was also a small display of artefacts from Cambridge's own computing history.

2.3.3. *Other INI events.* In addition to those mentioned above, programme participants also contributed to other events held at the INI:

- Deborah Kent gave a lecture entitled 'Inclusion in the UK mathematical infrastructure: Resources and Approaches from History of Mathematics' at the INI–ICMS Correspondents Network Day, held at the INI on 27 January.[5]
- June Barrow-Green gave a talk entitled 'Using History of Mathematics to Promote Equality, Diversity and Inclusion' at the INI Graduate Training Workshop in February, and will repeat this at the next iteration of the workshop in early 2026.

2.3.4. *Emmy Noether play.* A performance of this play was held at the Centre for Mathematical Sciences on 11 March 2025. It was produced by Portrait Theater Vienna in co-operation with Freie Universität Berlin, directed by Sandra Schueddekopf, and featured Anita Zieher as Emmy Noether. David E. Rowe (Mainz), a programme participant, was a scientific advisor, and was interviewed for the INI's podcast.[6]

2.4. **Seminars.** A number of additional seminars were held within the MHM programme that did not belong to any of the events listed above. Details of these, together with links to the recordings, may be found at: `https://www.newton.ac.uk/event/mhm/`.

2.5. **Lectures elsewhere.** Programme participants gave a number of lectures across the UK and beyond, including:

- Della Dumbaugh,
  - *Creating a Life: Emil Artin in America*, delivered at both Université Paris Cité and Universität Hamburg;
  - *Open to Possibility: Pioneers who Promoted Women in Math and Science*, Diversity and Decolonization in Mathematics Conference, University of Warwick;
  - *Open to Possibility: Giving Students a Chance in the Mathematics Classroom*, University of Leeds;
  - *The Publication Process in Mathematics*, Lucy Cavendish College, Cambridge;
  - *Expect the Unexpected: Pioneers who Promoted Women in Math and Science*, Cardiff University;
- Michael Friedman, *Friedrich Fröbel's Mathematics: From Crystallography at the University to Mathematics in the Kindergarten at the 19th century and Back*, University of Manchester;
- Niccolò Guicciardini, *The Status of Mathematics in Sixteenth-Century Europe*, University of East Anglia;

[5] `https://www.newton.ac.uk/outreach/ongoing-initiatives/correspondents-network/ini-icms-correspondents-network-day-2025/`

[6] `https://www.newton.ac.uk/media/podcasts/post/65-diving-into-maths-with-emmy-noether/`

- Thomas Haigh, *Artificial Intelligence: The brand that wouldn't die*, Universities of Manchester and Newcastle.

Seminars were also delivered in other settings within Cambridge:

- June Barrow-Green and Brigitte Stenhouse both spoke at the event 'Pioneering British Women in Mathematics', held at Newnham College on 28 February;
- Ekaterina Babintseva (Purdue University) delivered a lecture entitled 'Creativity for the information age: making up minds and machines in the United States and the Soviet Union' at the Department of History and Philosophy of Science;
- Isobel Falconer spoke at the Cambridge Philosophical Society's event 'The Unknown Maxwell' on 28 March.[7]

2.6. **Public lectures.**

- Sarah Hart, 'Life in Lilliput — The Mathematics of Fictional Realms', lecture delivered at Cambridge Festival,[8] with associated interview for the Plus podcast;[9]
- Reinhard Siegmund-Schultze, 'Refugee mathematicians from Nazi Germany with an emphasis on the U.K.', Rothschild Public Lecture, 27 March.[10]
- Clemency Montelle, 'The Ocean of Numbers: How India Shaped the Way We Calculate', Kirk Public Lecture, 12 March 2026.[11]

3. Archive work

The opportunity to undertake extended archival research was, for several participants, one of the principal attractions of the MHM programme. The four-month residential format offered a rare freedom from the constraints that typically shape shorter research visits, allowing sustained engagement with primary sources and the time to reflect carefully on unexpected discoveries. Participants made substantial use of Cambridge's rich archival resources, consulting materials at the University Library and at several college libraries. For some, this represented the first opportunity to work for an extended period alongside the sources central to their projects, transforming what might otherwise have been hurried document-gathering into a more reflective and productive phase of scholarship. Participants from overseas in particular took the opportunity to make research visits to other nearby collections, such as the British Library, the Royal Society, and the Royal Astronomical Society. In addition, the programme fostered intensive engagement with manuscript and printed sources within collaborative settings, most notably in the Brill–Noether translation project (§2.2.3). In an informal session during the closing workshop (§2.1.2), participants discussed the challenges and rewards of working with archives, and shared some of the materials that they had been studying during their time in Cambridge.

[7] https://www.cambridgephilosophicalsociety.org/files/events/maxwell-program.pdf

[8] https://www.newton.ac.uk/news/ini-news/the-mathematics-of-fictional-realms-at-cambridge-festival/

[9] https://www.newton.ac.uk/media/podcasts/post/66-a-conversation-with-sarah-hart/

[10] https://www.newton.ac.uk/seminar/43857/

[11] https://www.newton.ac.uk/seminar/50066/. Although delivered in 2026, this lecture came under the MHM banner, and within its first three weeks on the INI YouTube channel accrued 103,000 views.

4. ECR-led activities

The organisers of many of the ECR activities at MHM, Brigitte Stenhouse (The Open University) and Nicolas Michel (formerly INI Postdoctoral Fellow, now Université Claude Bernard Lyon 1) report:

A vibrant schedule of scholarly and social events was organised to foster collaboration and connection between attendees of the Modern History of Mathematics programme, with a special focus on supporting early-career researchers. A weekly tea and coffee hang-out for ECRs took place on Thursdays at 4pm, and a dedicated WhatsApp group was set up for those who wished to keep in closer contact. Regular drinks and nibbles evenings took place to coincide with the workshops and seminars within the MHM programme, providing additional opportunities for discussion and exchange following the formal sessions. Below is a list of the one-off events that were organised, which included museum visits tailored to participants' historical and scholarly interests alongside career-enhancing workshops. With thanks to those who assisted in the organization of these events, including Dave Barnes, Meg Briers, Deborah Kent and Elisabetta Mori.

12 Jan	Museum of Technology visit, with guided tour of the Print Shop
15 Jan	*Wallace & Gromit: Vengeance Most Fowl* (film screening with snacks)
27 Jan	Burns Night Dinner
2 Mar	Uncomfortable Cambridge, historical walking tour of the city
12 Mar	Wren Library at Trinity College: A guided tour by librarian Nicolas Bell, including a curated display of mathematical archival materials held by the library.
17 Mar	*Wicked* (film screening with pizza)
19 Mar	Knot Theory Social: A joint social with the Equivariant Homotopy Theory in Context programme. Jemma Lorenat gave a short lecture, followed by a screening of Christopher Zeeman's 1978 Royal Institution Christmas Lecture.
27 Mar	Centre for Computing History visit and guided tour
29 Mar	Bletchley Park & The National Museum of Computing visit (joint with the British Society for the History of Mathematics; also featured a partial solar eclipse viewing).
1 Apr	Escape Room social
4 Apr	*Ross and Hudson: A collaboration on the mathematical theory of epidemics*: An evening lecture by June Barrow-Green, preceded by drinks.
1 May	Book Publishing Workshop, with Frida Trotter (Birkhäuser)

These activities played a significant role in integrating early-career researchers into the international community of historians of mathematics and fostering professional confidence and visibility.

5. Outcomes

The MHM programme generated substantial and tangible research outputs, reflecting the INI's commitment to sustained, high-level scholarship within a residential environment. During the four months, participants completed or advanced publications across a wide range of formats, including monographs, journal articles, book chapters, reference works, and preprints. Major book projects with international publishers were progressed, new and revised editions of established texts were prepared, and peer-reviewed articles were completed or submitted following discussions in Cambridge.

5.1. **Oswald Veblen.** The visit to the INI by the Veblen group enabled members to substantially complete the papers that are to comprise a special issue of *Bulletin of the American Mathematical Society* concerning Oswald Veblen. The papers to be included are:

- Ellen Abrams, Benjamin Braun, and Sloan Despeaux, '"Dear Miss Seely": Dr. Caroline Seely, Oswald Veblen, and the transformation of American mathematics';
- Juan Carvajalino and Della Dumbaugh, 'Cooperation and conflict: Oswald Veblen and Abraham Flexner';
- Helena Durnová, Caroline Ehrhardt, and Laura Turner, 'Building mathematics in Princeton: Veblen in the early twentieth century';
- Christopher D. Hollings, Stephen F. Kennedy and Erika Luciano, 'The informal diplomacies of Oswald Veblen';
- Jemma Lorenat, Nicolas Michel, and Emmylou Haffner, 'Modernistic mathematics in American classrooms: Axioms, seminars, and informal collaboration at the University of Chicago, 1900–1905'.

In addition, a lecture given by Karen Hunger Parshall at the opening workshop MHMW01 has subsequently appeared as an article: 'Toward a History of American Mathematics', *Notices of the American Mathematical Society* 73(1) (2026), 28–37.

5.2. **The history of the classification of finite simple groups.** An article entitled 'Big mathematics?' has been submitted to the series 'Snapshots' of the Mathematisches Forschungsinstitut Oberwolfach. In addition, Atle Höhne has subsequently submitted and successfully defended his PhD dissertation.

5.3. **G. D. Birkhoff.** A paper coming out of this mini-workshop is expected to be completed in 2026.

5.4. **Other publications.** One of the programme's Ramanujan Fellows, Mike Ogiugo (Yaba College of Technology, Nigeria), prepared a survey article which has subsequently appeared in print: 'The development of fuzzy algebra and its applications: A chronological perspective', *London Mathematical Society Newsletter*, no. 517 (December 2025), 40–44. Other publications arising from the programme, both completed and in progress, include:

- Troy Kaighin Astarte, 'Conceptualising programming language semantics', *Philosophies* 10(4) (2025), 90;
- June Barrow-Green, 'The founding of the *Journal of the London Mathematical Society* and its first volume', *Journal of the London Mathematical Society* 113 (2026) e70381;
- Megan Briers, progress on a forthcoming co-authored paper 'A global history of eclipse reckoning';
- Liesbeth De Mol,
  - progress on a forthcoming volume about Emil Post;
  - finalisation of the revision of the entry 'Turing machine' for the *Stanford Encyclopedia of Philosophy*;

- Della Dumbaugh and Torrey M. Gallagher, Historical Notes: 'An Introduction to Solomon Lefschetz via Two Archival Documents', *Mathematics Today* 61(4) (August 2025), 104–106;
- Michael Friedman, progress on a book project concerning the history of metaphors in mathematics;
- Niccolò Guicciardini,
  - 'La naissance de la mécanique analytique dans le réseau épistolaire de Pierre Varignon (1690–1710): nouvelles pistes de recherche', in *Pierre Varignon, un géomètre «professionnel» à l'aube des Lumières* (Jeanne Peiffer and Sandra Bella, eds.), Birkhäuser, 2025, pp. 169–184;
  - 'On the invisibility and impact of Robert Hooke's theory of gravitation', in *The view from within from without: On changing one's normative framework* (Noah Efron and Ariel Furstenberg, eds.), Mohr Siebeck, Tübingen, 2025, pp. 129–149;
- Elisabetta Mori, 'The influence of organization & methods on early business computing', in A. Borrelli and H. Durnová (eds.), *Computing cultures: Knowledges and practices (1940–1990)*, Meson Press, 2025, pp. 120–145;
- Donal O'Shea, a new (fifth) edition of the book *Ideals, Varieties and Algorithms: An Introduction to Computational Algebraic Geometry and Commutative Algebra*.
- David Rowe
  - (with Jeremy Gray), 'In Memoriam: Thomas W. Hawkins (1938–2024)', *Notices of the American Mathematical Society*, 72(10) (November 2025), 1156–1159;
  - 'On Felix Klein's approach to Riemann surfaces', *Mathematics Today* 61(3) (June 2025), 76–79.

5.5. **Other outcomes.** In addition to conventional publications, the MHM programme included a range of wider public engagement and knowledge-exchange outputs, including public lectures such as those listed in §2.6 and engagement with theatrical performance (§2.3.4). Participants contributed to major digital and reference projects (including the *Stanford Encyclopedia of Philosophy*[12] and the Newton Project[13]) and organised works-in-progress sessions, extending the programme's impact beyond formal research publications. Moreover, the MHM programme has inspired a forthcoming event to be held at the Australian National University in Canberra in July 2026: 'Global mathematics histories and futures'.[14]

Beyond its measurable outputs, the MHM programme generated a range of less tangible, though no less significant, outcomes. As remarked by several participants, the extended residential format allowed them time for sustained reflection, informal discussion, and the

[12] https://plato.stanford.edu/

[13] https://www.newtonproject.ox.ac.uk/

[14] https://maths.anu.edu.au/news-events/events/global-mathematics-histories-and-futures

gradual development of ideas in ways rarely possible within shorter meetings. Collaborations were deepened through daily interaction; early-career researchers benefited from proximity to senior scholars; and conversations begun in seminars continued over coffee, and in other informal settings. An enduring legacy of the programme will be the intellectual relationships, shared perspectives, and renewed sense of community that it fostered within the international field of the history of mathematics — foundations on which future collaborations and projects are already being built.

Appendix A. Chronological list of major events and activities at MHM

(1) Mini-Workshop on the Work of Oswald Veblen (8–17 January 2025). Organisers: Della Dumbaugh, Sloan Despeaux, and Jemma Lorenat. See §2.2.1.
(2) Opening Workshop (MHMW01) — Modern History of Mathematics: Emerging Themes (20–24 January 2025). Organiser: Adrian Rice. Full details available at `https://www.newton.ac.uk/event/mhmw01/`. See §2.1.1 and Appendix B.
(3) Mini-Workshop on Dynamical Systems (27 January–14 February 2025). Organiser: June Barrow-Green. See §2.2.5.
(4) History for Diversity in Mathematics Network Workshop (MHMW04): History of Modern Mathematics in HE Mathematics Teaching (4–5 February 2025). Organiser: Isobel Falconer. Full details available at `https://www.newton.ac.uk/event/mhmw04/`. See §2.1.4 and Appendix E.
(5) Mini-Workshop on the Classification of Finite Simple Groups (10 February–13 March). Organisers: Volker Remmert and Rebecca Waldecker. See §2.2.2.
(6) Satellite Event: 'Research in Progress': A one-day meeting of the British Society for the History of Mathematics, held at The Queen's College, Oxford (Saturday 22 February 2025). Organisers: Christopher Hollings and Brigitte Stenhouse. Full details available at `https://www.bshm.ac.uk/events/research-progress-5`.
(7) Mini-Workshop on the Brill–Noether Translation Project (24 February–7 March 2025). Organisers: Karine Chemla, Nicolas Michel, and Paul-Emmanuel Timotei. See §2.2.3.
(8) Mini-Workshop on 20th-Century 3-Manifolds (3–21 March 2025). Organisers: David Rowe and John McCleary. See §2.2.6.
(9) 'Diving into Math with Emmy Noether'. Theatre performance by Portraittheater Vienna (Tuesday 11 March 2025). Full details available at `https://www.portraittheater.net/?portfolio=diving-into-math-with-emmy-noether`. See §2.3.4.
(10) Mini-Workshop on Computer Science/Data (24 March–4 April 2025). Organisers: Ursula Martin, Liesbeth de Mol, David Dunning, Deborah Kent, Jemma Lorenat, and Troy Astarte. See §2.2.7.
(11) Trip to Bletchley Park and The National Museum of Computing (Saturday 29 March). Organiser: Brigitte Stenhouse, for the British Society for the History of Mathematics. Full details available at: `https://www.bshm.ac.uk/events/bletchley-park-and-national-museum-computing`.

(12) History of Mathematics for Mathematical Leadership (MHMW03): One-day meeting hosted by the London Mathematical Society (Monday 14 April 2025). Organisers: June Barrow-Green and Deborah Kent. Full details available at: `https://www.newton.ac.uk/event/mhmw03/`. See §2.1.3 and Appendix D.
(13) Mini-Workshop on Provincializing Modern Mathematics (15–16 April 2025). Organiser: Michael Barany. See §2.2.8.
(14) Coffee Hours for Early-Career Researchers. Every Thursday 4–5pm. Organisers: Brigitte Stenhouse and Nicolas Michel.
(15) Closing Workshop (MHMW02) — Modern History of Mathematics: Looking Ahead (28 April–2 May 2025). Organiser: Christopher Hollings. Full details available at: `https://www.newton.ac.uk/event/mhmw02/`. See §2.1.2 and Appendix C.

Appendix B. List of speakers and presentations at MHMW01

Niccolò Guicciardini, Università degli Studi di Milano
Whiteside's edition of the mathematical papers of Isaac Newton: Achievements and open issues

Scott Mandelbrote, University of Cambridge
Paper trails: Mathematical collaborations in Newton's archive

Vincenzo De Risi, CNRS (Centre national de la recherche scientifique)
The genesis of relationism. Leibniz's early theory of space and Newton's Scholium

David Rabouin, CNRS (Centre national de la recherche scientifique); Université Paris Cité
Leibniz as inventor of conceptual mathematics?

Rob Iliffe, University of Oxford
Writing the system of the world: a digital edition of the Principia Mathematica

Sonja Brentjes, Bergische Universität Wuppertal
A holistic approach to the history of the mathematical sciences in Islamicate societies

Sayori Ghoshal, Max Planck Institute for the History of Science
Calculative reasoning: Colonial tool to democratic compulsion

Karine Chemla, University of Edinburgh; CNRS (Centre national de la recherche scientifique)
The history and historiography of mathematical symbolism: A project

Caroline Ehrhardt, Paris 8 University Vincennes-Saint-Denis
Death, money, mathematics: Life insurance in France (1780–1840)

Sloan Despeaux, Western Carolina University
Women behind the "Great Men" of mathematics: The case of Caroline Eustis Seely

David Aubin, Sorbonne Université; CNRS (Centre national de la recherche scientifique)
Numeracy, mathematical education and the popularization of science

Tinne Hoff Kjeldsen, University of Copenhagen
Perspectives into history of mathematical biology and modeling in 20th century

Deborah Kent, University of St Andrews
A stone to be seen: Kwanlin Dün and the 1869 US total solar eclipse expedition

Karen Parshall, University of Virginia
Toward a history of mathematics in the United States

Frédéric Brechenmacher, École Polytechnique
Mathematical fictions and mathematicians' choices

Erika Luciano, Università degli Studi di Torino
The mythopoesis of mathematics in Fascist Italy

Reinhard Siegmund-Schultze, University of Agder
Modern historiography of applied mathematics: Content, methodology, deficits

Liesbeth De Mol, CNRS (Centre national de la recherche scientifique); Université de Lille
A paradoxical resolution of a paradox from the history of the history of computing

Matthew Jones, Princeton University
Images of mathematics/realities of mathematics in AI

Appendix C. List of speakers and presentations at MHMW02

Norbert Schappacher, Université de Strasbourg
The long way to intersection theory: Mathematical politics about space curves from Max Noether to the 1990s

Ivahn Smadja, Université de Nantes
From Diophantine analysis to philology: Contextualizing C. G. J. Jacobi's late engagement with Diophantus' text

Megan Briers, Technische Universität Berlin; Max Planck Institute for the History of Science
Greenwich as a home and observatory: The Airy family and the RGO collections

Nicolas Michel, Isaac Newton Institute; University of Cambridge
Ways of figure-making: Ideals and practices of objectivity in the theory of algebraic curves

Saša Popović, Mathematical Institute of the Serbian Academy of Sciences and Arts; University of Rijeka Centre for Logic and Decision Theory
Veronese redivivus and the (re)writing of the history of fin-de-siècle non-Archimedean mathematics (what remains to be done: future prospects for historiographical research)

Jesper Lützen, University of Copenhagen
Impossibility and existence

Michael Barany, University of Edinburgh
Situating modern mathematics

Jenny Boucard, Université de Nantes
Looking back and ahead: Blending perspectives on history of mathematics

Jemma Lorenat, Pitzer College
Instructing the imagination: The role of place in mathematical training

Aiden Sagerman, University of Cambridge
We have never been (mathematically) modern: Diagrammatic practice, algebraic topology, and the making of mathematical modernism

Amira Moeding, University of Cambridge
Practices of prediction: Big data as foundation of modern AI

June Barrow-Green, The Open University
Tripos and tribunals: The wartime diary of a Cambridge Senior Wrangler

Ekaterina Babintseva, Purdue University
Freedom and control: Pedagogical computing in the US and the Soviet Union

Richard Staley, University of Cambridge; University of Copenhagen
On the history of celestial mechanics, climate models and the 'Pacemaker of the Ice Ages' paper of 1976: Some lessons on the relations between models, mathematics and data from the empirical climate sciences

Ursula Martin, University of Oxford; University of Edinburgh
Will machines change mathematics?

Michael Friedman, Rheinische Friedrich-Wilhelms-Universität Bonn
On disappearing material practices: From folding and modeling in the 20th century to AI 'produced' diagrams in the 21st century

David Dunning, Smithsonian Institution
Between mathematics, logic, and computing: Writing as the material culture of theory

Emmylou Haffner, CNRS (Centre national de la recherche scientifique); École normale supérieure, Paris
Oswald Veblen's 1901 notebook on the foundations of geometry as an axiomatics laboratory

Brigitte Stenhouse, The Open University
Communicating mathematics through the household in Regency Britain

Sarah Hart, Birkbeck, University of London
Squaring the circle: The challenge of public engagement with the modern history of mathematics

Appendix D. List of speakers and presentations at MHMW03

Jeremy Gray, University of Warwick; The Open University
Why history of mathematics matters

Christopher Hollings, University of Oxford
Current research in mathematical history of mathematics: J. M. F. Wright and Newton's method of first and last ratios

Niccolò Guicciardini, Università degli Studi di Milano
Current research in mathematical history of mathematics: Editing Newton's mathematics in the digital age

Deborah Kent, University of St Andrews
Life in the discipline: What a mathematical historian of mathematics can do for your department

June Barrow-Green, The Open University
The use and importance of mathematical archives

Ursula Martin, University of Oxford; University of Edinburgh
Mathematics, museums, and the REF

Noel-Ann Bradshaw, University of Greenwich
History of mathematics, the curriculum and QAA subject benchmarks

Appendix E. List of speakers and presentations at MHMW04

Della Dumbaugh, University of Richmond
Open to possibility: Pioneers who promoted women in math and science

John Tucker, Swansea University
The rise of data science: Widows, slaves and children

Maurice Chiodo, University of Cambridge
Ethics in mathematics at Cambridge—9 years on

Jiří Hudeček, Charles University, Prague
You fight your way, I fight my way: Wu Wen-Tsun's research amid weak mathematical institutions in China