Institution:
University of Cambridge

Unit of Assessment:
UoA32b

Title of case study:
A social history of mathematics in ancient Iraq

1. Summary of the impact (indicative maximum 100 words)

Eleanor Robson's research on mathematics in ancient Iraq has delivered impact in two key areas: improved teaching practices in the UK, USA and Pakistan; and increased public understanding of ancient mathematics and Middle Eastern history. Impact on teaching was primarily achieved through video conferences, a multimedia pack for schools downloaded over 14,500 times internationally, and a US teacher training programme. Impact on public understanding of ancient mathematics and Middle Eastern history was achieved through museum exhibitions, art works, radio programmes and contribution to non-specialist publications.

2. Underpinning research (indicative maximum 500 words)

The research was conducted by Dr Eleanor Robson whilst a Lecturer, Senior Lecturer and Reader (the position she holds until 31 August 2013) in the Department of History and Philosophy of Science in the University of Cambridge between 2004 and 2006. The research was based on three strategies: Assyriological, archaeological and socio-historical.

First, production of the first systematic catalogue, edition and translation of nearly 1000 mathematical cuneiform tablets, written in a variety of languages: Sumerian, Eblaite, and the Babylonian and Assyrian dialects of Akkadian (Robson 2007a; 2007d; 2008a). The tablets are from a range of locations, from southwest Iran to eastern Turkey, but mostly from southern Iraq, and now housed in museums all over Europe, the Middle East and North America. Work was based wherever possible on personal inspection and photography (always so for the primary publication of about 100 tablets, e.g., Robson 2007f) but otherwise reliant on published photographs and scale drawings.

Second, detailed investigation of the textual and archaeological context for these tablets. Where all previous studies treated cuneiform mathematics as a closed system, this research instead sought evidence for the ancient individuals, communities and societies which produced them. This entailed close examination of the buildings archaeological assemblages in which mathematical tablets were found (e.g., Robson 2009); prosopographical research into the practitioners and patrons named and described in the mathematical tablets (e.g., Robson 2008c); and investigation of references to and descriptions of mathematical practices in a range of cuneiform genres from Sumerian literature to Babylonian astronomy (e.g., Robson 2007e). It also explored the many complex relationships between formal, professionally taught mathematical skills and ideologies in ancient Iraq and a variety of informal, domestic and artisanal numeracies attested in the writings and objects of the same period (e.g., Robson 2007c).

Third, the use of historical and sociological approaches to account for the particular character of mathematics at different times and places in ancient Iraq (e.g., Robson 2007b) and to situate it with reference to other mathematical cultures of the world (e.g., Robson 2008b). The research identified three phases in the development of the cuneiform mathematics of ancient Iraq and its neighbours: numerate apprenticeship during much of the third millennium BC, during which time most mathematical training was on-the-job and thus left little trace in the textual and archaeological record; a 500-year period in the late third and early second millennium BC, during which time a royal ideology of metrological justice promoted formal scribal learning of the mathematical properties of lines and areas as the abstraction of fair land measurement and division; and, for much of the first millennium BC, the idea of divine quantification, in which the gods were seen to have created an inherently and subtly mathematised world in which many observable natural phenomena were period and predictable. None of these aims or practices had much in common with classical or Hellenistic Greek mathematics and were unlikely to have influenced them directly (Robson 2008a).

3. References to the research (indicative maximum of six references)

1. **2009**: Robson, E. 'Mathematics education in an Old Babylonian scribal school', in E.

Robson and J. Stedall (eds.), The Oxford Handbook of the History of Mathematics, Oxford University Press, pp. 199–228.
2. **2008a**: Robson, E. *Mathematics in Ancient Iraq: a Social History*, Princeton: Princeton University Press. (REF) Winner of the History of Science Society's Pfizer Prize for the Best Scholarly Book, 2011
3. **2007a**: Robson, E. *Digital Corpus of Cuneiform Mathematical Texts* (http//oracc.org/dccmt)
4. **2007b**: Robson, E. 'Literacy, numeracy, and the state in early Mesopotamia', in K. Lomas, R.D. Whitehouse, and J.B. Wilkins (eds.), Literacy and the State in the Ancient Mediterranean, London: Accordia Research Institute, pp. 37–50.
5. **2007c**: Robson, E. 'Mathematics, metrology, and professional numeracy', in G. Leick (ed.), The Babylonian World, London: Routledge, pp. 414–427.
6. **2007d**: Robson, E. 'Mesopotamian mathematics', in V.J. Katz (ed.), The Mathematics of Egypt, Mesopotamia, China, India and Islam: a Sourcebook, Princeton: Princeton University Press, pp. 57–186. (RAE)

All outputs can be supplied by the University of Cambridge on request.

4. Details of the impact (indicative maximum 750 words)

Robson's research on mathematics education in ancient Iraq (e.g., Robson 2009) has been used extensively to help train modern mathematics teachers and to develop mathematics enrichment activities for high-achieving school children. From 2005 to 2008 Robson ran annual video-conferences on Babylonian mathematics for primary schools in the UK and Pakistan for the Motivate: Maths Enrichment for Schools scheme. In 2008 there were four video conferences for students aged between 8 and 13 involving eight UK schools and two in Karachi.

A multimedia resource pack **[5.1]** for KS2/3 School Mathematics was produced in 2010 and made freely available online with funding from the university's HEIF 4 Knowledge Transfer Projects allocation. The pack includes nine short videos in which Robson discusses Babylonian mathematics, mathematical education for trainee scribes and life in ancient Iraq. There are accompanying classroom activities and worksheets with teacher guidance notes and support materials. The pack has attracted over 14,500 page views/downloads since 2010 and positive feedback from mathematics teachers worldwide. One Australian teacher commented on its influence on teaching practice: 'After looking at your work, I was encouraged to bring it into my mathematics classroom – much to the interest of my colleagues in the history and art faculties… My students were fascinated by the stories and the mathematics, and we ended the lesson in an art room, rolling out clay to make our own tables and working out how to make the indentations with the ends of chopsticks' **[5.2]**.

In the USA, the Professor of Mathematics Education at Florida State University [has used Robson's work to develop teacher training programmes using cuneiform tablets from the collection of Florida State University **[5.3. 5.4]**. In 2008, a classroom instructional unit was created for use with 46 students (aged 9 to 11) two classroom mathematics teachers at Eustis Elementary School and two district mathematics supervisors as a pilot project in Eustis, Florida. The classroom teachers stated that the historical perspective and context contributed to increased pupil engagement irrespective of their level of ability. One teacher commented: 'I was amazed at my lower performing students' ability to communicate their processing skills … Almost every student was eager to share their ideas regarding the use of the cuneiform tablets. I witnessed my ESE [exceptional and special education] students to be more actively involved in this lesson than most others. I also observed my higher ability students to be more engaged also.' (Evaluation, 11 October 2008: see **[5.4]**).

As a result of her research, Robson has received numerous invitations to contribute to radio and television programmes about the history of mathematics and/or the history of the Middle East. She gave a mathematical tour of the British Museum exhibition Babylon for the BBC Radio 4 programme More or Less (2009) and used mathematical tablets from the British Museum to explain the Babylonian mathematics of time to a modern astronomer for another Radio 4

programme (2009). She also contributed to the British Museum's outstandingly popular exhibition, museum events, radio series and book, A History of the World in 100 Objects (2010), being interviewed for episode/chapter 17 on the Rhind Mathematical Papyrus, and giving a gallery talk on 18 February 2010, 'Mathematical goddesses in Sumerian culture', as part of the History of the World in 100 Objects: Poetry, Mathematics, and Myth event. The average reach of the radio series was four million; the gallery talk audience was 40, which was full-capacity for the venue. In New York, the Institute for the Study of the Ancient World staged an exhibition of mathematical cuneiform tablets based largely on Robson's work (2010), citing Robson (2007d; 2008) as two of the four core books on the subject and also listing four of her earlier works in the suggested reading. The exhibition was extended due to popular demand, running over eight weeks, attracting a high number of visitors including 22 school groups, and receiving substantial positive feedback both in the guest book and in the form of student letters **[5.5]**. Patricia Fara's recent overview of history of science for a general readership, *Science: A four thousand year history*, opens with a chapter on Babylonian mathematics, credited almost exclusively to Robson's research (**[5.6]**: pp. 8–16). The book, which sold 10,125 copies internationally **[5.7]** and has been translated into nine languages, won the 2011 British Society for the History of Science Dingle Prize.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] Motivate 2008. 'Babylonian mathematics', *Motivate: Maths Enrichment for Schools*, Millennium Mathematics Project, University of Cambridge https://motivate.maths.org/content/BabylonianMaths
[5.2] Statement: Person 1 (Teacher, Randwick Girls' High School)
[5.3] Statement: Person 2 (Professor of Mathematics Educations, Florida State University)
[5.4] Clark, K.M. 2010. 'Connecting local history, ancient history, and mathematics: The Eustis Elementary School pilot project', *British Society for the History of Mathematics (BSHM) Bulletin* 25: 132–143.
[5.5] Statement: Person 3 (Department Manager, Exhibitions and Public Programs Department, Institute for the Study of the Ancient World, New York University)
[5.6] Patricia Fara (2010) *Science: A four thousand year history* (OUP: Oxford)
[5.7] Statement: Person 4 (Academic and Trade Dept, OUP)