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EARLY GEOMETRY TEXTBOOKS PRINTED IN PERSIAN[1]

OS PRIMEIROS LIVROS DIDÁTICOS DE GEOMETRIA IMPRESSOS EM PERSA

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ABSTRACT

The printing of mathematics textbooks in Persian did not begin until the second half of the nineteenth century. The initial stimulus to employ print technology appears to be the founding of Dār al-Funūn, an institution intended to provide instruction in the "new" scientific learning of Europe. Most of the earliest examples of vernacular printed textbooks were either translations of imported European textbooks or adaptations based on the model of these European textbooks. The examination of these early printed textbooks can serve as a case study of the kinematics of mathematical knowledge. Thanks to the digitization of a representative sample of nineteenth century printed geometry textbooks, we are able to trace some basic features of the evolution of these printed textbooks in Persian. Of special interest is the process of adapting European styles of the presentation of mathematical knowledge to forms that could be understood by Persian-speaking students educated in more traditional mathematical sciences. These efforts resulted initially in a "hybrid" presentation style – both the labels of diagram points as well as equations were printed in Roman script while the verbal elements of the text were presented in traditional Persian script.
Keywords: Geometry textbooks in Persian. Early printed geometry textbooks. Geometry teaching. Dār al-Funūn. Prosopography of mathematicians.

RESUMO

A impressão de livros didáticos de matemática em persa não começou até a segunda metade do século XIX. O estímulo inicial para empregar a tecnologia de impressão parece ter sido a fundação de Dār al-Funūn, uma instituição destinada a fornecer instrução na "nova" aprendizagem científica da Europa. A maioria dos primeiros exemplos de livros didáticos impressos em vernáculo eram traduções de livros didáticos europeus importados ou adaptações baseadas no modelo desses livros didáticos europeus. O exame desses primeiros livros impressos pode servir como um estudo de caso da cinemática do conhecimento matemático. Graças à digitalização de uma amostra representativa de livros impressos de geometria do século XIX, podemos traçar algumas características básicas da evolução desses livros impressos em persa. De especial interesse é o processo de adaptação dos estilos europeus de apresentação do conhecimento matemático a formas que possam ser compreendidas por estudantes de língua persa educados em ciências matemáticas mais tradicionais. Esses esforços resultaram inicialmente em um estilo de apresentação "híbrido" – tanto os rótulos dos pontos do diagrama quanto as equações foram impressos em escrita romana, enquanto os elementos verbais do texto foram apresentados na escrita persa tradicional.
Palavras chave: Livros didáticos de geometria em persa. Os primeiros livros didáticos de geometria impressos. Ensino de geometria. Dār al-Funun. Prosopografia de matemáticos.

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INTRODUCTION

It was primarily in the nineteenth century that European mathematics began to have a significant impact on mathematics education in the Middle East. The first wave of infiltration involved the translation of popular European mathematics textbooks into Arabic, Ottoman Turkish, and Persian. These translations were made either by native speakers or, in some cases, by foreigners (often Christian missionaries) who had become skilled in the local vernaculars. Each group had a different agenda motivating its translation efforts. Native speakers were usually commissioned by political rulers to translate textbooks in order to assist in the process of educational and curricular reform for the purpose of strengthening the state against the increasing threats and incursions by European colonial powers. Christian missionaries also desired to reform traditional education, but for the purpose of proselytizing the populace and undermining what they perceived to be corrupt and repressive governments. Their translation efforts were often supported by European governments who saw the introduction of modern education as an aid to colonial administration.[3]

Following European examples of printed textbook production, these translations were disseminated using recently introduced print technologies – usually lithography. This technology, in addition to its low production costs, preserved some of the visual features of hand-written manuscripts, helping to break down barriers against assimilation of the new mathematics. Several years ago, I prepared a preliminary survey of traditional geometry treatises printed in Arabic during the nineteenth century (De Young 2012a). In this study, I have pursued a complementary line of research, focusing now on the early printing of modern mathematics textbooks in Persian. My task has been facilitated by the large-scale digitization project of the Majlis Shūrā Library in Tehran, which has placed online digital versions of a representative collection of early printed geometry textbooks.

1. DĀR AL-FUNŪN

These Persian geometry textbooks from the nineteenth century were apparently initially intended for use at the Dār al-Funūn, a new educational institution founded in 1851 by Mīrzā

[3] My interpretation of the introduction of modern science and mathematics into non-Western cultures has been significantly influenced by the work of Marwa Elshakry (2007; 2008; 2010). The struggle to avoid a Western ethnocentrism in such discussions has seen an upsurge of study in recent years – see, for example, the essay review "Hybrid Science" by Winterbottom (2011) of *Brokered World: Go-Betweens and Global Intelligence, 1770-1820* (Science History Publications, 2009).

Ṭāqī Khan (also known as Amīr-e Kabīr, the vizier of Nāṣir al-Dīn Shāh. The new academic institution was intended to be a kind of polytechnic institute in order to provide a cadre of military officers trained in the new sciences.[4] It was initially staffed entirely by Europeans recruited from Vienna, the capital of the Austrian Empire.[5]

Since this institution represented a new educational initiative, there was no tradition of textbooks on which the new instructors could draw. And since the students were, at least initially, ill prepared for study at advanced levels, the instructors found it necessary to teach fundamentals of science and mathematics before they could commence instruction in their specialized subjects. So almost from the beginning there was a demand for translations of European textbooks, as well as new textbooks modeled on those of the European tradition in the areas of technical instruction.[6] Some of the adaptations were prepared by European specialists appointed to the instructional staff and some were the work of the translators who assisted the Europeans (who, of course, were not often competent in Persian language). Among these were the textbooks on geometry and other mathematical topics that are our focus in this paper.

The early textbooks surveyed here reveal an unusual printing history. After the first geometry textbooks were printed shortly after the middle of the nineteenth century, there was a hiatus of more than four decades before new geometry textbook appear on the scene. This feature of the print history may reflect the institutional history of the Dār al-Funūn as a whole. Although initially supportive of the reformist educational efforts of the Dār al-Funūn, Nāṣir al-Dīn Shāh became increasingly suspicious of the school's leadership and by the early 1860s he had begun to withdraw his support for the new education. Although he did not close the school, his interests turned more toward the photography, music, and painting sectors. The military sector in particular was almost ignored and the number of students studying military subjects dramatically declined, even though the student population as a whole continued to grow. During this period, the number of foreign "experts" teaching at the school declined considerably and its academic standards declined. By the end of the nineteenth century, the school had become less dependent on the personal patronage and whim of the Shah but now took on a new role as modernizing force in society (Ekhtiar 2001).

[4] Ekhtiar (2001) provides a succinct historical survey of the evolution of the institution, focusing on the influence of political events on the development of the school. Gurney & Nabavi (1993) covers much the same material, although focused more on the internal functioning of the institution and its administration.

[5] The choice of Austria was dictated by the deteriorating political and military relations between the Persian Empire and the two great powers of Europe, Britain and Russia. For a concisesummary of the political events that ultimately inspired the foundation of the Dār al-Funūn and the introduction of modern science into Iranian education, see Slaby (2005).

[6] Browne (1914, 157-158) lists treatises published by teachers at Dār al-Funūn, including text- books on mathematical subjects such as algebra, geometry, arithmetic, as well as treatises on various natural sciences and military science. Unfortunately, he only lists authors and titles, but pro- vides no bibliographic information. More recently, Nabavi (1990, 100-103) has also published a list of textbooks and translations used in the Dār al-Funūn.

2. PRINTING IN NINETEENTH CENTURY IRAN

Since our focus is on printed textbooks, it may be useful to review some features of the history of print technologies in Iran during the nineteenth century. These print technologies had a direct impact on the presentation of mathematical information in the textbooks.

A typographic printing press, was introduced into Safavid Iran by European missionaries as early as 1629 (Floor, 1980), but since their purpose was essentially to proselytize, the technology had no impact on the spread of mathematical knowledge in Persian society. By the time a modern commercial printing press had been set up in Iran (in Tabriz, about 1816) using cheap and portable hand presses modeled on the printing technology invented by Charles Stanhope (Green, 2010, 305), numerous books had already been printed in Persian in India (Floor, 1990), including an edition of the first six books of Euclid's *Elements* in the recension of Naṣīr al-Dīn al-Ṭūsī in the Persian translation of Quṭb al-Dīn al-Shīrāzī (De Young 2007; 2012b).

Both typographic and lithographic presses were imported into Iran during the 1820s. But the use of print technology did not become widespread until the proliferation of lithographic presses about the middle of the nineteenth century. Not only was lithography a cheaper process than typography (especially if the publication involved any illustrations), the technology also allowed printers to retain some of the aesthetic characteristics of manuscript copies, which is often cited as a reason why lithography rapidly surpassed typography for printing books in Arabic and Persian, especially in Iran and India (Scheglova 2009, p. 12).[7] Robinson (1993) has discussed at some length the complex interplay of factors that encouraged the Muslim communities of India – and Iran – to adopt lithographic printing as the preferred way to disseminate ideas.

3. SOME REPRESENTATIVE GEOMETRY TEXTBOOKS IN PERSIAN

In this section we shall discuss a few representative geometry textbooks printed in Persian. Due to space considerations, we will present some basic characteristics of a few typical textbooks to illustrate important features, both in terms of content and in terms of physical appearance or architecture of these early geometry textbooks printed in Persian. A more

[7] Use of lithography was widespread across the Islamic world – witness the use of lithography to reprint the Pseudo-Ṭūsī recension of Euclid's *Elements* in Fez in 1293/1876 (De Young 2012c,283-284).

complete analysis is in preparation. Our goal is to present a case study of the transmission and assimilation of European mathematical knowledge into Persia and the impact of this new mathematical knowledge on mathematics education.

This survey is limited to the sample of textbooks currently available for study online. Hopefully, additional textbooks will become available in future and will help to provide a more nuanced picture of the changing educational landscape. In this initial survey, I shall primarily point out features of each treatise that I consider important to the history of mathematics education in Iran. In future, studies of other centers of learning and publication in the Islamic world will help to reveal the unique features of the situation in Iran.

3.1. Hendese 1273[8]/ 1856

The earliest printed geometry textbook that I could locate was a Persian translation of an early edition of the French textbook, *Éléments de géométrie* of A.-M. Legendre (prior to its revision by A. Blanchet).[9] The translator is identified as `Abd al-Rasūl al-Isfahānī by the catalogers of the Majlis Shūrā Library although there is no title page in the digitized copy. The treatise was printed by lithography, a technology only recently introduced into the Persian Empire.

One of the most striking features of this Persian textbook is that all labels of the geometrical diagrams – including text references to these points – retain the Roman script of the original. Similarly, all equations are written in Roman script and so are read from left to right,[10] while the text itself is in Persian script, which is read from right to left. This use of bi-directional text must have introduced some difficulties, one may presume, for the first readers of the textbook.

The copyist's attempt to preserve such traditional aids as "catch words" at the end of each folio (which were intended to guide the reader onto the next folio) sometimes must have

[8] Although there is no title page, the date is indicated in a colophon (imitating the form of traditional manuscripts) following books one, three, and six.

[9] The important differences between the text as penned by Legendre and its revision by Blanchet have been discussed by Schubring (2007). The initial sections of the treatise seem to be afairly close translation of Legendre's textbook – or at least some parts of it. But unlike the typicalFrench editions, the diagrams are inserted directly into the text for each proposition. But book Vhas material mainly from Legendre's book VIII. Moreover, in book VI the translator has divergedfrom the text of Legendre to focus on triangles and triangulation in a very practical sense, suggesting that in this way also the treatise could be considered a hybrid text

[10] All numerals, including fractions and exponents, however, are written using traditional Persian forms. Thus, the formula for the area of a circle, for example, would include the Greek letter*pi*, the Roman letter *r*, and the Persian numeral two as an exponent.

produced confusion rather than assistance. For example, when the next folio begins with an equation, the copyist has mechanically taken the last part of the equation (the part closest to the right-hand margin) as the "catch word" rather than the first part of the equation (which, because it is presented in Roman script, lies on the left-hand side of the line). Or sometimes the catch word is the first word of the first line of text, ignoring the equation(s) that preceded the text on the page.

One might interpret these features as a first step toward assimilation – much as the mediaeval Latin translators from the Arabic had simply transliterated words for which they had no convenient Latin equivalent. But a more traditional convention may also be at work here. Medieval Arabic copyists often seem to have regarded the geometrical diagrams as discrete units. Thus, on occasions when space considerations necessitated rotating a geometrical diagram ninety degrees to the left or right, the Arabic letters labeling the points in the diagram were rotated along with the diagram itself. Perhaps the preservation of the Roman script in these diagrams and equations represents this tendency to see non-text elements as discrete entities that should be preserved intact.

Other features also suggest that the printers were struggling to assimilate the structures of printed European textbooks.

- Each page from books I – IV has a large, bold running header identifying the book. These running headers disappear after the first page of book V and reappear in book VI. The title used is *kitāb*, a literal translation of the French *livre*, representing a curious break with traditional Arabic mathematical discourse, which would have preferred the term *maqālah*.[11]
- Each page has a page number. Like all numerals, these are written in traditional Persian forms. Books I – II are paginated continuously, beginning from page 3. The page number is places in the outer margin beside the first line of the text in the same size font as the text itself. Each of books III – VI are paginated independently, each new book commencing with page one. In book V, the page numbers, centered in the upper margin above the text, replace the running header. In book VI, they return to their position in the outer margin beside the first line of text.

  At the same time, there are several traditional elements that have been preserved from the manuscript tradition.

[11] The same non-traditional terminology was used also by Cornelius Van Dyke when translating John Playfair's *Elements of Geometry* into Arabic (De Young 2014, 513-4). Since both translations appeared in print at almost exactly the same time, it seems unlikely that there can be any influencefrom one to the other. For that reason, the choice of the same non-traditional terminology is espe cially striking.

- The treatise retains the traditional use of "catch words" at the end of each folio to guide the eye to the next folio.
- The treatise retains the use of traditional colophon forms at the end of most books. (The colophons have been omitted from books II and IV, apparently due to lack of space.)
- Key words in the text are sometimes highlighted by a line drawn over them. This technique is regularly used in manuscripts in the same way that italic typeface is used for emphasis in a modern printed book. (In many late mediaeval manuscripts, text to be highlighted was written in red ink, but this technique was difficult to adapt to print technology.)
- The text is written continuously with no break of any sort to indicate the transition to a new proposition. In fact, there are not even proposition numbers, which is unlike traditional Euclidean manuscripts in Arabic and Persian. This is also different from the style of Legendre's textbook in which each proposition is given a heading centered in an otherwise empty line.

Thus, we see in this early printed geometry textbook a hybrid – a mix of new and old forms – to present the new approach to geometrical science.

3.2. \`Ilm al-misāhat 1274 / 1857

The title is supplied by the catalogers of the Majlis Shūrā Library since there is no title page in the copy that has been digitized.[12] The title is very traditional and suggests a treatise devoted to a somewhat more practically oriented application of geometric principles including calculation of areas and volumes, extending sometimes to include surveying.

The introduction informs us that the treatise is the work of Augustus Kržiž (1814-1886), an artillery officer and member of the first Austrian military mission to Persia (1851), recruited to help establish modern education in the Persian Empire (Storey 1958, 22).[13] We are told in the brief introduction that the text was first composed in French. It was then translated by Mīrzā Zakī Māzandarānī, an instructor at the Dār al-Funūn who translated several textbooks authored

[12] Storey (1958, 22) gives the title as *Kitāb-i hisāb ba-\`ilm-i handasah*, but places the title in parentheses, suggesting that he did not find a formal title.

[13] Kržiž was one of several "experts" recruited from Vienna, the capital of the Austrian Empire. Little is known about his personal life, although his name suggests that his family was fromthe Czech or Slovak region. He is best known to historians for his detailed map of Tehran (1857). He is also credited with the installation of the first telegraph line in Iran, linking the Shāh's palace to the Dār al-Funūn (Gurney & Nabavi 1993).

in French by Kržiž.

This textbook shares many features with the previously described example in addition to the fact that both were printed by lithography and neither seems to have been printed with a title page. The treatise appears not to be a translation of an already existing European textbook. Rather, it appears that Kržiž composed his own treatise on the model of existing European textbooks. In a few places, where the translator could not find an Arabic equivalent to the French technical term, he merely transliterated the term into Persian script and usually included also the original French as well.

This textbook also is a “hybrid” treatise in that the labels of geometric points in each diagram are labeled in Roman script and equations are still arranged to read from left to right. The left-to-right orientation of equations is especially noticeable when the last line of a proposition is occupied by an equation. In such cases, the equation is placed flush against the left margin of the text, leaving the right side of the line devoid of text – which must have caused some discomfort for native speakers of Persian.[14]

Unlike the previous treatise, though, this textbook has collected all the diagrams and placed them on large fold-out sheets at the end of the book, as was also done in many European textbooks of geometry. Each diagram on the sheet is given a label consisting of a proposition number written out in Persian script, which reads from left to right. But the diagrams on each sheet are arranged in ascending order from the left-hand edge of the sheet, so that the diagrams are apparently intended to be read from left to right – an arrangement consistent with that in the original French edition.

3.3. Hendese mutavassite 1316 / 1898

This short textbook on solid geometry was prepared by Ghulām Hussein. I have been unable to locate any biographical information about the author apart from the statement on the title page that he was head of the division of arts and professor of mathematical sciences – presumably at the Dār al-Funūn, although this is not stated explicitly.

The treatise is clearly based on a European geometrical text, although I have not yet identified its probable antecedent. Its European roots are seen in many places. For example, the treatise is divided into two books (called *kitāb*). At the end of each there is a selection of

[14] Abdeljaouad (2004) has discussed the problem of “bilatéralté” in the case of Tunisian mathematics education.

exercises (called *tamrīnāt*), exactly as one would expect to find in a modern mathematics textbook. Moreover, there are references to European mathematicians inserted into the text – Cavalieri (whose name the copyist has spelled “Cavalierie”, suggesting that the origins of this treatise may have been French) and Riemann. Neither name is transliterated into Persian script but is copied in Roman script.

This short volume was not intended to be a stand-alone text. It was designed as a part of a set of geometry textbooks. This volume focuses on solid geometry. Unfortunately, the remaining parts of the set have not been digitized so that it is not possible at present to assess how completely the set covered basic geometrical topics.

At first glance, the textbook seems a throw-back to the earlier printed Persian textbooks. It retains the labels of geometrical points in Roman script, for example, so that the text must be read in two directions. But the title page tells us that this is the fourth printing of the treatise, so the commingling of Roman script together with Persian script may perhaps represent only inertia on the part of the publisher rather than reflecting an anachronistic characteristic on the part of the textbook author.

3.4. Usūl awā’il hendese 1317 / 1899

This short textbook on practical geometry was prepared by Mīrzā `Abd al-Ghaffār Khān b. `Alī Muhammad Isfahānī (1255 / 1839-40 – 1326 / 1908), who proudly carried the title Najm al-Dawlah (Star of the Nation). He appears to have spent most of his career teaching at the Dār al-Funūn (Storey 1958, 22-23).

It has a title page, arranged like that of a typical European treatise, with title and author and printer information clearly displayed. There is a page number located at the top outer margin, but no running header. The scribe has included “catch words” at the end of each page to guide the eye to the next page, a feature found in many traditional manuscripts, but in manuscripts the “catch words” are typically only at the end of each folio. The last two pages contain a list of all the topics covered in the treatise, but contains to page numbers, so it is not exactly an index or table of contents in the modern sense of the term.

The treatise is clearly based on European sources, although I have not yet been able to identify a specific progenitor. But even though it is based on a European model, there are two significant changes that set it apart from the earlier printed textbooks. First, the labels for geometrical points are now given in the Arabic alphabet and have been assigned according to the traditional *abjad* or alpha-numeric ordering.[15] In addition, because the geometrical points are now labeled in Arabic script, equations (including radical signs) can be written from right to left and so correspond to the natural order of reading.

3.5. Usūl-i hendese[16] 1318 / 1900

This textbook, a translation of Legendre's *Éléments de géométrie* in the revision of A. Blanchet, was also prepared by Mīrzā `Abd al-Ghaffār Khān b. `Alī Muḥammad Isfahānī and issued in a lithograph edition.[17] On the title page of the treatise, he is again described with the title Najam al-Dawlah. In addition, he is described as "teacher of all mathematical subjects in the Mubāraka School of the Dār al-Funūn."[18] His translation was re-issued posthumously in a third printing in 1333 / 1914. On its title page, `Abd al-Ghaffār is no longer mentioned as teaching in the Dār al-Funūn – probably because he has already died.

When the treatise was re-issued, it was entirely recopied – the original plates were not re-used. This is immediately clear from a cursory visual inspection. The earlier edition had a rather fussy border separating text from margin areas, but this border has disappeared from the later printing. The diagrams have also been redrawn. Although the essential geometrical features remain the same, the diagrams of the new edition often display a somewhat different metric from that found in the earlier edition.

It is instructive to compare this translation with the earlier translation represented by the treatise *Hendese*. Most notably, the use of bidirectional text has been abandoned in the later translation. Certainly, this more completely Persian rendition must have been considerably easier for readers to comprehend.

[15] Classical Greek did not have an independent set of numeral symbols but used instead letters of the alphabet. The Arabic alphanumeric system imitates the ordering found in Greek. See Wright (1971, I, 28B) for the standard Arabic *abjad* system and its variants.
[16] Storey (1958, 23) asserts that `Abd al-Ghaffār published a treatise with the same title as early as 1292 / 1875. I have not been able to see a copy of this treatise. It is presumably different from the textbook under consideration here because Storey gives it a separate entry in his bibliography.
[17] The translation included only the main text of Legendre, omitting notes, supplementary sections, etc. The translator apparently wished to focus only on the geometry. This emphasis helps to strengthen the specific educational aims of the translator and publisher.
[18] Storey reports (1958,22) that Nāṣir al-Dīn Shāh also awarded to `Abd al-Ghaffār the title *Munajjim-bāshī*, or chief astronomer / astrologer. That title does not appear on the title pages of `Abd al-Ghaffār's geometry textbooks.

3.6. Usūl-i hendese dawre ibtidā'iye 1327 / 1909

This short introductory textbook, printed by lithography, consists of twenty-two “lessons”. Its author, Mīrzā Ridā Khān, was a professor in the Dār al-Funūn.[19] He was awarded the title of “Muhandis al-Mulk” (chief geometrician or chief engineer of the nation), as noted on the title page. According to the report of Browne (1914, 158) Ridā Khān authored both elementary and secondary level geometry textbooks. Only this elementary textbook is currently available to me. Storey, however, attributes to him only a treatise on algebra (1958, II, 23).

The treatise is organized as a series of questions and answers.[20] The first “lesson” for example asks the following questions:

- What kind of science is geometry?
- What is a line?
- What is a plane area?
- What is a volume?
- What is a point?

Each question is given a brief answer. These answers are, for the most part, not focused on abstract mathematical knowledge but on practical applications of the mathematics. There are no demonstrations in a formal Euclidean sense. For example, we are introduced to the characteristics of a parallelogram and the author explains the basic procedures used to calculate the area of any parallelogram, but does not demonstrate that these calculation procedures are mathematically valid, as Euclid would have done.

Calculations are always done using specific numerical examples – the author does not develop abstract formulae. It is interesting that the nature of *pi* is not explained nor is the symbol used in any of the equations or calculations. The author simply inserts an approximate numerical value for *pi* (3.14) when working out specific examples.

Like most of these lithographed textbooks, this treatise contains features typical of a modern typeset book, such as page numbers and running headers at the top of the pages. But it also retains some manuscript characteristics, such as the colophon specifying the author, title, and date of copying of the text. Interestingly, the copyist has abandoned use of typical “catch words” at the end of each folio.

[19] Storey (1958, 23) attributes to him only a treatise on algebra.
[20] Abdeljaouad (2015) gives additional examples of this genre in Arabic.

3.7. Haftasad mas’ilah 1311[21] / 1932-3

This treatise represents the first example of a geometry textbook produced by typography rather than lithography. The title page lists the author as Mīrzā Sayyid `Abd Allah Khān.

This treatise marks a distinct break with the kind of textbook that had been produced earlier. In fact, in some ways it is difficult to classify this treatise as a mathematical textbook. It consists of seven hundred calculation problems in the fields of arithmetic and geometry. These problems are numbered sequentially throughout the treatise. Only the last fifty problems deal directly with the traditional domain of geometry. The second section provides the answers. But the explicit steps of the calculations needed to solve these problems are not given.

3.8. Hendese tarsīmī 1313 / 1934-5

This treatise, also printed using typography, represents a more typical geometry textbook. It is a textbook on descriptive or projective geometry, based on the approach of Monge, who is mentioned explicitly in the introduction. Its author was Mīrzā Ridā Khān,[22] who, in addition to his traditional title (Muhandis al-Mulk) is described here as professor and author on higher mathematics. Although the approach to geometrical knowledge is modern, we can note some anachronistic or traditional visual elements are also evident in this typesettreatise. Most noticeable is the use of Roman script to label diagram points. Thisfeature seems initially surprising since the practice had been abandoned in the later lithographed textbooks. Since the subject matter does not involve calculations, there are no equations which might require being read from left to right. In this treatise, since we are dealing only with labels of points, the Roman script labels become only symbols and perhaps make the problem of bi-directional textsomewhat less difficult for readers. Additionally, each diagram is labeled with the Arabic letter *sīn* plus a numeral, a technique used in older lithographed textbooks (as in the *Hendese mutavassiṭe*, for example).

[21] Iran had officially adopted the Jalali or solar hijra calendar in 1911. That this date should be interpreted as Jalali is clear because the author has mentioned the month (Farvardin) as well as the year.

[22] Browne (1914, 158) does not mention this work in conjunction with other works of Mīrzā Ridā Khān. Perhaps this can be taken as an indication that it was first published after Browne constructed his listing of works printed by authors associated with the Dār al-Funūn.

CONCLUDING REMARKS

This brief look at the history of early printed geometry textbooks in Persian has revealed several interesting features. Perhaps most importantly, it has given a glimpse into the struggle to assimilate new mathematical knowledge across linguistic and cultural boundaries.[23] These textbooks set out to communicate elements of the new mathematics which had already become established in Europe. By looking at the historical development of these textbooks, we can recognize something of the struggle that occurred as educators and a traditional educational system tried tocome to terms with the new forms of geometry and attempted to use the new geometry as part of a larger educational reform in the dying Persian Empire.

A part of this changing scene involved technology. Even though the earliest printing press in Iran featured typography (Floor 1980), it was only after the introduction of the cheaper lithographic process in the first half of the nineteenth century that printed geometry textbooks began to appear in Persian.[24] From these early textbooks, we see that the marriage of print technology and geometry textbooks was not a steadyand linear process. Rather it seems to have occurred in two waves – at least based on the sample of printed textbooks available online. And it was lithography that was used to print the majority of geometry textbooks throughout the nineteenth century. In the sample of textbooks that we have examined here, we find the use of typography only after the end of WWI.

In terms of content, we notice a remarkably strong influence from Legendre's *Éléments de géométrie*, with at least two translations.[25] The indirect influence of Legendre is more difficult to assess, but was probably considerable. We know that Legendre's geometry was also translated into Arabic and Ottoman Turkish, although neither of these translations has been investigated systematically until now. This suggests that the French mathematical tradition and especially Legendre played an especially important role in establishing the new mathematics in the Eastern Mediterranean and the Middle East.

Finally, we should note that the earliest printed geometry textbooks preserved both the geometrical diagrams (along with their labels) and the equations in their original Roman script. This use of bi-directional text must have introduced a problem of cognitive dissonance for the

[23] For additional examples, see Elshakry (2008) and Schubring (2000).

[24] The importance of lithography in Iran has repeatedly been noted. See, for example, Marzolph (2001, 13-18), who describes the technical difficulties of printing Persian text using lithography, although the primary focus is on book illustration, and Shcheglova (2009), who gives an overview of the history of lithography in Iran.

[25] Schubring (2007) has given us an example of how such a cross-cultural view of the diffusion of a single textbook can offer new insights into the history of mathematics education.

students who used these early textbooks. These intermediate “hybrid” texts were largely replaced with treatises produced completely in Persian in the second wave of textbook publication near the end of the nineteenth century.

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