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CREATING THE LANGUAGE OF MATHEMATICS INSTRUCTION: hebrew schools in Palestine before 1948[1]

CRIANDO O IDIOMA DE ENSINAR MATEMÁTICA: escolas hebreias em Palestina antes de 1948

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ABSTRACT

This paper describes the process through which the Hebrew language, formerly only a liturgical language, became the language of mathematical instruction in Hebrew schools. Around the end of the 19th century and the beginning of the 20th century, Hebrew was not used in daily life by the Jewish community in Palestine. With the foundation of Hebrew schools, the lack of Hebrew mathematical vocabulary became apparent and a systematic creation of Hebrew scientific terminology began. This new terminology enabled the creation of the first Hebrew secondary mathematics textbook.
Keywords: History, Mathematics Instruction, Palestine, Eretz-Israel, Language, Hebrew.

RESUMO

Este artigo descreve o processo através do qual a língua hebraica, anteriormente apenas uma língua litúrgica, tornou-se a língua de instrução matemática nas escolas hebraicas. Por volta do final do século XIX e início do século XX, o hebraico não era usado na vida diária pela comunidade judaica na Palestina. Com a fundação das escolas hebraicas, a falta de vocabulário matemático hebraico tornou-se aparente e começou uma criação sistemática de terminologia científica hebraica. Esta nova terminologia permitiu a criação do primeiro livro didático de matemática secundária em hebraico.
Palavras-chave: História, Ensino de Matemática, Palestina, Eretz-Israel, Idioma, Hebraico

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INTRODUCTION AND HISTORICAL BACKGROUND

The Ottoman Empire ruled Palestine from 1517 to 1917. In the middle of the 19th century, the Palestine population consisted of roughly 400,000 permanent residents; the majority were Muslim Arabs and the minorities were Christians, Jews (about 10,000), and others (Sharshevski et al., 1968a, pp. 20-21).

Jews had immigrated to Palestine since remote antiquity because of religious reasons. These immigrants followed their longing for Jerusalem and their hopes for the return of the Messiah. Their main purpose was sanctity studies (*Torah*, Hebrew Bible, *Talmud*, and rabbinic literature) and prayer (Schur, 1998, p. 250; Sharshevski et al., pp. 48-51). Jewish immigration to Palestine in 1881 opened a new chapter in the history of Jewish Palestine: "inspired for the first time by an essentially modern national movement, this *Aliyah* [Jewish immigration] laid the foundations for the national rebirth of Jewish society" (Shavit, 1992a, p. 220).

Between 1881 and 1914, the *Yishuv* (pre-state Jewish community in Palestine) changed and modernized. The immigrants established several *moshavot*—villages of independent farmers—or joined the urban settlements of Haifa and Jaffa, which were economically independent. Other immigrants were inspired to create communal agricultural settlements, forerunners of the *kibbutz*. The immigrants began to develop a cultural and social life. Jaffa, Jerusalem, and several big settlements had community clubs and libraries, where the immigrants spent their spare time, conducted speeches and meetings, and arranged parties and shows on holidays. They founded the first labor union, labor parties, and a defense organization, *Hashomer*, the purpose of which was to protect the *Yishuv*. Foreign philanthropic associations (usually non-Zionist) and Hebrew pioneer teachers[3] founded kindergartens and elementary schools; in some of these institutions, teaching was conducted in the Hebrew language. In 1905 the first Hebrew secondary school was founded: The Herzlia Hebrew Gymnasium. In 1912 the cornerstone of the *Technicum* (*Technion* of today)—the first higher educational institution for technology in Palestine—was laid (Sharshevski et al., 1968a, pp. 167-172, 185-189, 214; Shavit, 1992b, p. 202).

World War I broke out in 1914 and the Turks joined forces with the Germans against the Entente powers. The war severely impacted the *Yishuv*; after the war, the number of Jews in Palestine was estimated to be 56,000, down from 84,000 in 1914 (Sharshevski et al., 1968a, p. 237).

[3] To read more about the pioneer Hebrew teachers see Haramati, 2000.

In November 1917, the British government issued the Balfour Declaration, which declared that the British government supported the project of establishing a "national home for the Jewish people." Palestine was occupied by the British and in 1922 the League of Nations officially assigned the Mandate for Palestine to Great Britain. Arab opposition to the Balfour Declaration, to the Jewish settlement, and to the goals of the Zionism movement was strong and caused violent conflicts. During the thirty years of the British Mandate, the Arab-Jew conflict continued and the British stance on the conflict took many twists and turns (Sharshevski et al., 1968b, pp. 19-20).

Waves of Jewish immigration continued throughout the Mandate period. During the 1930s, Palestine became a Jewish cultural center. There were many intellectuals among the immigrants, and Jewish cultural centers were transferred to Palestine along with the immigrants from Eastern Europe (Sharshevski et al., 1968b, pp. 113-116).

On May 14, 1948, one day before the British Mandate was terminated, the State of Israel was proclaimed.

During the end of the 19th century and the first half of the 20th century, establishing Hebrew as the language used by Jews for everyday communication, teaching all subjects in Hebrew, and creating the necessary terminology, played an important role in the revival of the Jewish nation. Pioneer Hebrew teachers aspired to introduce Hebrew speech in Palestine. "Hebrew teachers took upon themselves to spread the living Hebrew…. They viewed Hebrew as the most important component in the national revival revolution, and regarded developing instruction of all subjects in the Hebrew language as the main goal of education"[4] (Shahar, 2000). Haramati (2000) named the new education "National-Hebrew" because "teaching Hebrew as a national language was stressed as a national goal" (p. 8). Eliezer Ben-Yehuda (1858-1922), who is known as "the father and reviver of modern Hebrew," regarded the adaptation of Hebrew for use as the spoken language among Jews in Palestine as "the key ingredient for the national revival of the Jewish people" (Corry & Schappacher, 2010, p. 453).

The process of developing a national mathematical language emerged in other countries as well. In Lithuania, the first mathematics textbooks in Lithuanian can be traced back to the end of the 19th century and the beginning of the 20th century. The authors of the first mathematical textbooks had to coin many Lithuanian mathematical terms and the Lithuanian mathematical vocabulary underwent various difficulties. Some of these difficulties were similar to the challenges that the first Hebrew mathematics teachers and textbook authors

[4] All translations from Hebrew are by the author.

endured. For example, they dealt with having several words that expressed the same mathematical notion until one of them was finally chosen (Pekarskas, pp. 19, 24).

A study of the process of creating mathematical terminology in Hebrew provides an opportunity to explore the development of a scientific language as part of founding a nation with a new educational system and language.

1. LANGUAGES IN PALESTINE

Around the end of the 19th century and the beginning of the 20th century, Hebrew was not used in daily life by the Jewish community in Palestine; Hebrew was merely the liturgical language, used for prayers and in sanctity studies. Ashkenazi Jews mainly used Yiddish, Sephardic Jews mainly used Ladino, and immigrants from Islamic countries spoke in the language of their country of origin. Hebrew merely served as the inter-communal communication language. Most schools employed Arabic, French, Turkish, or German, which were the common spoken and written languages (Carmi, 1986, p. 25; Efrati, N., 2004).

During that time there were no secondary schools in Palestine and most elementary schools were run by foreign philanthropic associations (usually non-Zionist), such as the German association *Ezra* (Hilfsverein der Deutschen Juden) and the French association *Alliance* (Alliance Israélite Universelle). Every association encouraged assimilation by promoting its own culture, literature, and language in its schools. In addition, several Hebrew kindergartens and elementary schools that used only the Hebrew language were established by pioneer teachers who envisioned that teaching would build the Jewish nation and revive its language (Even- Shoshan, 1966, pp. 164-165).

With the beginning of the new Jewish community and the foundation of Hebrew schools, the Hebrew language proved to be too limited for the schools' broadening needs, as it lacked scientific vocabulary. There was an immediate necessity to invent new words and "every teacher overcame this deficiency according to his own way. It was not long before the differences in vocabulary among various schools and teachers became apparent" (The Hebrew Language Committee, 1928, p. 3). The need for a central institution, which would determine new vocabulary accepted by all, became clear. Thus, in 1890, the Hebrew Language Committee was founded, but it closed in 1891 and reopened only in 1903. During these years, the development of the language continued and many new words were coined by writers, educators, teachers, and doctors who needed these words for their professional work (The Hebrew

Language Committee*,* 1928, pp. 3-4).

The language problem influenced the course of teaching and, specifically, mathematics teaching. In 1893, Ahad-Ha'am (pen name of Asher Ginsberg)—one of the primary pre-state Zionists and founder of Cultural Zionism, who envisioned a Jewish spiritual center in Palestine—visited the Hebrew schools in Palestine. Following his visits, he wrote two papers called "Truth from *Eretz-Israel*" in which he described the schools in Palestine. Hebrew school teachers were described as stutterers and laconic because they could not explain topics in Hebrew, and students graduated school with limited knowledge. He claimed that teaching sciences (including mathematics) in Hebrew is harmful "since we do not have textbooks…and teachers translate by themselves from textbooks in European languages and teach from their own written materials." Ahad-Ha'am argued that "it will not hurt if, as long as the Hebrew language has a limited scientific lexicon, sciences are taught in one of the European languages, even in Palestine" (Ahad-Ha'am, 1950, pp. 32-33).

Despite Ahad-Ha'am's approach:

- In 1904 the Teachers Federation of Israel was founded; its first goal was to establish a national education system in Hebrew (Even-Shoshan, 1966, p.164).
- In 1905 the first Hebrew secondary school was founded, "The Herzlia Hebrew Gymnasium"; one of the school's two principles was "only Hebrew" (The Herzlia Hebrew Gymnasium, 1909, p. 1).
- In 1908 the Hebrew Language Committee published "Arithmetic Terms", which included the most necessary arithmetic and geometric terms for school use (1928, p. 6).

2. THE WAR OF THE LANGUAGES

In 1908 the *Ezra* association decided to establish the first higher educational institution for technology in Palestine, called the *Technicum* (*Technion* of today) and a *Reali* school. In 1913 the *Ezra* association announced that the language of instruction in both schools would be German and not Hebrew. The reasons were practical: German was an accepted scientific language, whereas the Hebrew language was only beginning to be used as a spoken language. Hebrew lacked a scientific vocabulary and offered no textbooks.

This decision caused strong opposition among the *Yishuv*, who demanded that the language of instruction be Hebrew. The Teachers Federation of Israel proclaimed an anathema on the *Technicum* and the *Reali* school and on any teachers and officials in these institutions yet

to be established who would not stop their work immediately. This conflict was known as "The War of the Languages." As a protest against the *Ezra* association, the Committee for Maintaining the Hebrew Education in Haifa was founded and suggested opening "a Hebrew secondary school next to the *Technicum*'s German *Reali* school. Thereby prevent the opening of the German school" ("Protests against the *Technicum*'s Board," 1913, p. 2). Indeed, in December 1913, The Hebrew Reali School opened in Haifa with Hebrew as its only language of instruction and the *Reali* German school did not open. In 1914 the *Ezra* association gave up and announced on February 22 that the language of instruction in the *Technicum* would be Hebrew, not German. Due to budget constraints and the outbreak of World War I, the opening of the *Technicum* was delayed; it became operational in 1924. By that time, Hebrew was recognized as one of Palestine's official languages by the British Mandate (along with English and Arabic).

As a result of the victory in The War of the Languages, the desire to use Hebrew as the language of instruction in Palestine and in the Jewish communities in the Diaspora became more common, the *Ezra* schools closed, and many Hebrew schools opened.

In the following years the Hebrew Language Committee worked to "qualify the Hebrew language for use as a speaking language in all areas of life: homes, schools, public life, commerce…and sciences" (The Hebrew Language Committee, 1928, p. 7). Every few years the Hebrew Language Committee published a dictionary of mathematical terms containing the approved mathematical terms.

In order to diminish the cases of independent neologies, the Hebrew Language Committee published public announcements calling on people to facilitate its work:

In order to facilitate the role of the Hebrew Language Committee we ask from the senior Hebrew readers in Eretz-Israel and in the Diaspora to write any renewed words that they encounter while reading and to send us a list with the words and the book or the newspaper, the year, the issue, the author's name, and the name of the paper (story or song) in which they encounter the new word. Additionally, we wish to remind authors and publishers in Palestine and abroad their duty to provide the Hebrew Language Committee with one copy of every book and professional journal which contain suggestions of terms or any neologies for their scrutinizing and use. ("By the Hebrew Language Committee," 1932, p. 3)

In 1953 the Academy of the Hebrew Language was founded to replace the Hebrew Language Committee; its work, including examining mathematic and scientific terminology, continues to this day.

3. THE CREATION OF SCIENTIFIC TERMINOLOGY

During the end of the 18th century and the first half of the 19th century, before the Zionist revival of the Hebrew language, the European Jewish Enlightenment (known in Hebrew as *Haskala*) advocated the revival of the Hebrew language and Hebrew literature. Foreign literature was translated into Hebrew, including mathematics books. Additionally, Hebrew journals published scientific articles throughout Central and Eastern Europe. Soon, the lack of Hebrew scientific lexicon became apparent. Consequently, the Enlightened Jews (or *maskilim*) became involved in creating a Hebrew mathematical lexicon: they incorporated words from the Talmud and from the Middle Ages, adopted foreign terms (when the terms were commonly used in other European languages), and invented new words (Corry & Schappacher, 2010, pp. 449-457; Shavit & Reinharz, 2010, pp. 94-122).

Hayyim Selig Slonimski (1810-1904) was a prominent Enlightened Jew who was among the first to write scientific books and papers for the wide Jewish public in Eastern Europe, focusing on mathematics, physics, and astronomy. His goal was to spread mathematics and natural sciences among East European Jews. Slonimski authored several books and articles on various topics; among his publications are mathematics books about numbers, arithmetic, algebra, geometry, and trigonometry. Moreover, Slonimski was involved in creating the essential mathematical terminology in Hebrew (Corry & Schappacher, 2010, pp. 449-457; Shavit & Reinharz, 2010, pp. 94-122).

Around the end of the 19th century and the beginning of the 20th century, in addition to the Hebrew Language Committee's work to promote the Hebrew language, the Teachers Federation and various teachers toiled as well in order to turn Hebrew into the only language of instruction in all educational institutions of the *Yishuv*, including institutions under foreign philanthropic associations, such as *Ezra* (Efrati, 2004, pp. 55-56).

One of the greatest contributors to the creation of the scientific Hebrew language was Dr. Avraham Baruch Rosenstein (Baruch). Baruch (1881-1950) emigrated from Poland to Palestine in 1909 to teach mathematics in The Herzlia Hebrew Gymnasium; after about a year he travelled to Vienna in order to complete a Ph.D. in mathematics and in 1911 he returned to teach mathematics in The Herzlia Hebrew Gymnasium. He constructed The Herzlia Hebrew Gymnasium mathematics curriculum, authored 25 mathematics and physics textbooks that were used in Palestine Hebrew schools for over 50 years, and played a major role in inventing mathematical terms and notation in the Hebrew language (Razi-Stein, 1991, pp. 22-23).

Not only did Baruch invent words when needed, but he also dedicated himself to

researching the Hebrew language's sources, starting with the Bible and including sources from the Middle Ages through the 20th century. He renewed, exchanged, and invented many mathematical terms and notations that are being used today. The source for most of this section is Baruch's "Mathematics Instruction in The Herzlia Hebrew Gymnasium in Jaffa and in Tel-Aviv" (circa 1929-1933[5]). In this document Baruch discusses his contribution to the process of creating mathematical terminology and notation in Hebrew as well as the construction of Hebrew mathematics curriculum in The Herzlia Hebrew Gymnasium. This primary document was found by the researcher in The Herzlia Hebrew Gymnasium Archive; only the first 28 pages of the document were recovered.

Baruch started teaching mathematics in The Herzlia Hebrew Gymnasium in 1909, a time when scientific terms in Hebrew were lacking and no Hebrew mathematical textbooks for secondary school existed; therefore, he began creating Hebrew scientific terminology. Baruch wrote about the challenges of translating scientific terms into Hebrew. Many terms appear in the ancient Hebrew literature of the Middle Ages and the literature of the 18th and 19th centuries, and he stated that these must be considered: "there is no permission to a teacher who comes to teach sciences in Hebrew not to consider this treasure of terms" (p. 3).

Baruch elaborated on the process of creating terminology while using primary sources. First, he accepted terms that appeared in the Bible, saying that "if a term was mentioned in the Bible no other term will be used instead, with the exception of special cases" (p. 5). Terms that appeared in later sources were treated as follows:

1. Terms in general use, even if not all writers agreed on them, were considered appropriate (for example, "addition," "subtraction," "multiplication," "division").
2. Terms in use in Hebrew literature, as long as that use did not contradict the mathematical concepts, were accepted (for instance, "triangle," "circle," "isosceles").
3. When different words were used for the same concept, the terms that most closely matched the mathematical meaning or those that would not cause errors or confusion were accepted.
4. When different words were used for the same concept in the Hebrew literature but had Greek counterparts commonly used in other European languages (e.g., "pyramid," "prism," "cone"), the Greek terms were employed.
5. Most of the mathematical terms that appeared in European languages in recent centuries—some translated to Hebrew by Friesenhausen (1797, 1835) and some by Slonimski (1865)

[5] From Baruch's discussion, especially on page 22, it is clear that at the time he wrote the document there were no Hebrew external graduation examinations, which means that the paper was written before 1933. Also, Baruch wrote about a conversation that occurred about thirty years after the beginning of reform in the teaching of mathematics, which started around 1900.

and Lichtenfeld (1865)—were reexamined and most of them adapted appropriately (for example, “positive,” “negative,” “limit,” and “vertex“).

6. Any remaining mathematical terms that had not been translated into Hebrew before were translated according to the spirit of the Hebrew language, with due consideration for the mathematical meaning (p. 5).

The following are examples for some of the terms that Baruch collected from various sources: from the Bible, the names of the numbers, “integer,” “value,” “length,” “width,” “height,” “depth,” “edge,” “square,” “cycle,” and “plane” were employed with their original meaning; from Klemantinowski (1894), Baruch took “mixed number” and “unit”; from Ibn Ezra (1867, 1895), he took terms for “multiplication,” “division,” “fraction,” “prime number,” “even number,” and “complex number”; from Friesenhausen (1797, 1835), he took “positive,” “negative,” and “algebraic numbers”; from Slonimski (1865), he took “limit” and “vertex”; from Greek, he took the terms “parabola,” “graph,” and “asymptote”; from Latin, he took “proportion,” “commission,” “one thousandth,” “percent,” “function,” “constant,” “variable,” “independent variable,” “maximum,” and “minimum” (some terms he used as is and some he Hebraized); and from Arabic, he took “algebra.”

4. THE TEACHERS AND THE HEBREW LANGUAGE COMMITTEE

Disagreements and struggles arose between teachers and the Hebrew Language Committee. The teachers insisted that scientific terminology should not be decided solely by the Hebrew Language Committee; instead, these decisions should be made in collaboration with teachers and with experts in these fields. The teachers claimed that the members of the Hebrew Language Committee lacked the professional qualification that they had acquired through their own teaching experience in the classroom and that the Committee needs to consider the terms that teachers had already coined and used in schools (Efrati, 2004, pp. 68-76).

Baruch rejected several of the mathematical terms set by the Hebrew Language Committee. As mentioned above, Baruch systematically and independently developed the Hebrew mathematical lexicon. Some of the terms Baruch coined were approved by the Hebrew Language Committee in 1914; other terms were used in schools and later in Baruch’s textbooks and in that way became a part of the Hebrew language. Most of the latter terms were later approved by the Hebrew Language Committee. In the introduction to one of his textbooks,

Baruch (1921) wrote:

> Most of the scientific terms in this book were renewed or translated by the author and a few of them were determined by the author according to ancient Hebrew books. During the 12 years in which I have been teaching mathematics in the first gymnasium in Eretz-Israel these terms became assimilated among learners. (p. III)

Baruch disapproved of some of the Hebrew Language Committee decisions; in his paper, "Mathematics Instruction in Schools—Objectives and Means of Mathematics Instruction," Baruch (1912-1913) wrote:

> There are terms that were suggested by several teachers and that were approved by the Hebrew Language Committee, and in my opinion, make no sense…. There is a general consensus that only uniformity is essential for the mathematical terms rather than the suitability of the term to its concept. This attitude is harmful, not only to mathematics instruction, but also to the language itself. (pp. 266-267)

Baruch believed that "the suitability of the term to its concept" (p. 267) was important as well; he fought the Hebrew Language Committee to change the offending terms and often succeeded.

Table 1 contains examples of several terms that Baruch was able to change and that are still used today. For example, the word approved by the Hebrew Language Committee in 1908 for *numerator* can be translated into English as *how many*, while the term Baruch advocated can be translated as *counter*. The word approved by the Hebrew Language Committee in 1908 for *power* can be translated into English as *step* or *stair*, while the term Baruch advocated was derived from the word *power* or *strength*. The word approved by the Hebrew Language Committee in 1908 for *exponent* can be translated into English as *crest*, while the term Baruch advocated was derived from the word *value.*

Table 1. Terms Accepted by the Hebrew Language Committee and Later Changed Following Baruch's Suggestions.

English term	Hebrew term determined by the Hebrew Language Committee in 19086	Hebrew term according to Baruch, 19127; approved by the Hebrew Language Committee, 19338
Numerator	כמה (pronounced cama)	מונה (pronounced mone)
Denominator	מנה (pronounced mana)	מכנה (pronounced mechane)
Power	מדרגה (pronounced madrega)	חזקה (pronounced hezka)
Exponent	רכס (pronounced reches)	מעריך (pronounced ma'arich)
edge (of a solid figure)	חד, פה (pronounced hod, pe)	מקצוע (pronounced miktso'a)
Face	פנה (pronounced pane)	פאה (pronounced pe'a)

As noted in the preface of one of his textbooks, Baruch did not always succeed in his attempt to change terms fixed by the Hebrew Language Committee:

> I inserted into this book several terms that were accepted by the Hebrew Language Committee which are contrary to the terms I used before, for example: the word "polygon" changed from *רבצלעון* [pronounced *ravtzil'on*] to *מצולע* [pronounced *metzula*] and the word "projection" changed from *השלכה* [pronounced *Hashlacha*] to *הטלה* [pronounced *Hatala*]. (1946, preface from 1930)

The discussions and disagreements continued for several years. The Hebrew Language Committee conducted over 20 meetings during the years 1936-1937 to discuss approved, though controversial, terms. No further information regarding the committee decision process is available (The Hebrew Language Committee, 1940, p. 3).

[6] The Hebrew Language Committee, 1928.
[7] Baruch, 1912-1913.
[8] The Hebrew Language Committee, 1934.

5. ARITHMETIC AND ALGEBRAIC NOTATION

The second issue Baruch worked on was mathematical notation. Previous Hebrew writers had accepted the original notion for the four arithmetical operations (with the exception of the "+" sign), equality, percent, and others. In order to avoid writing a cross (a symbol used in Christianity), they omitted the lower part of the notation, which makes the addition notation look a bit like the notation for perpendicular lines: "⊥." Baruch accepted all these notations except the one for addition; he used the original addition notation,"+," as did the other nations, so that it would not be confused with the perpendicular notation. (Later both notations were approved and both are still being used.) Baruch employed the fraction line to be horizontal rather than oblique to avoid possible mistakes, especially when writing mixed numbers. (For example, in the oblique notation, it is hard to distinguish between 33 3⁄4 and 3 33⁄4.) He set the notation for multiplication as "×" in simple arithmetic and as a dot "•" in algebra (p. 17).

For letters in algebraic equations, Slonimski and other Hebrew writers used initial letters of the Hebrew alphabet, א, ב, ג, instead of the Latin letters, a, b, c, for parameters and the Hebrew letters צ and ק instead of x and y for variables. They also wrote equations from right to left, as the Hebrew language is written from right to left. Slonimski explained his choice in the introduction to his book from 1865:

> I was compelled to change the order of reading algebraic formulae, to be from right to left, contrary to the way they are read in the languages of the nations [European languages], because reading them from left to right in a Hebrew book is an obstacle for the reader and is misleading. (Corry & Schappacher, 2010, p. 453)

Below is an example of a multiplication exercise; Figure 1 is the exercise as it appeared in a Hebrew textbook from 1898, written in Vilnius, Lithuania (Slonimski & Retner, p. 32), and Figure 2 is the exercise according to Baruch's notation (p. 17):

^{2}ב9 ⊥ אב6 – ^{2}א4

ב3 ⊥ א2

---

^{2}אב18 ⊥ ^{2}ב^{2}א12 – ^{3}א8

^{3}ב27 ⊥ ^{2}אב18 – ^{2}ב^{2}א12 ⊥

---

^{3}ב27 ⊥ 0 – 0 – ^{3}א8

Figure 1. A multiplication exercise, 1898 textbook.

$4a^2 – 6ab + 9b^2$

$2a + 3b$

$8a^3 – 12a^2b + 18ab^2$

$12a^2b – 18ab^2 + 27b^3$

$8a^3 + 27b^3$

Figure 2. A multiplication exercise, Baruch's notation.

Note that the reading of the exercise in Figure 1 goes from right to left and that the addition is denoted by "⊥" and not "+."

As opposed to Slonimski, Baruch decided to use Latin letters for equations and to write the equations from left to right, as was the case in all other nations. He explained the difficulty of using Hebrew letters as parameters or variables:

> (a) Every Hebrew letter has a specific numerical value and not an arbitrary value (א symbolizes 1, ב symbolizes 2, and so on).
>
> (b) Using Hebrew letters makes us read part of the expression from right to left (אב) and part from left to right (18), which makes reading and calculating more difficult.
>
> (c) Once a student gets used to Hebrew letters in algebra it will be very difficult for him to use the acceptable Latin letters, and it is not reasonable to assume that a Hebrew reader will never need to use foreign mathematics books; and since every high school student knows the Latin letters, it would not be difficult to introduce them in algebra. (p. 17)

6. GEOMETRIC AND MEASUREMENT NOTATION

The majority of the accepted geometric notations were those employed in most European textbooks. A capital Latin letter was used for a point (vertex) while a lowercase Latin letter was used for a line or segment. Triangle angles were denoted by A, B, C, or M, L, K, and the edges by a, b, c, or m, l, k, respectively. Greek letters, α, β, γ, denoted angles measured in

radians. Sometimes *Rashi* script[9] was used for angles (not in use today). The notation for an angle was "^" above the letter (a different notation is now in use), "˘" for an arc (also different from current usage), "~" for similarity. The notation for base, height, area, bisects, and other concepts were the Latin initials of the Hebrew words; for instance, b for base (pronounced *basis*), g for height (pronounced *govah*), and S for area (pronounced *shetah*) (p. 18).

For measurement units, *Rashi* script initials (not in use today) were used; for example, "מ" (equivalent to m) for meter, "ק"מ" (equivalent to km) for kilometer, and "ג" (equivalent to g) for gram (p. 18).

7. ATTEMPTS FOR STANDARDIZATION IN NOTATION

Although Baruch used these and similar notations in his textbooks for years, and despite the wide use of his textbooks and notation, discussions about proper notation continued. Correspondence among the members of the Committee for Determining Uniform Mathematical Notation and the Department of Education of the Jewish National Council in Palestine (JNCP), which was held in 1944, reveal that the issue of scientific notation was still under discussion. The committee discussed appropriate notation for the digits 2 and 7, the order of writing the digits, the direction in which to write an equation, the equality and decimal fraction symbols, the division and addition notation, and more. Finally, two documents[10] were generated by the Department of Education of the JNCP dictating the proper notation to be used by all teachers:

> The lack of uniformity of mathematical notation is undesired and in order to end this situation the Department of Education has decided to oblige all teachers to use the following mathematical notation. (JNCP, Department of Education, circa 1944a, p. 1)

Here are some examples of the Department of Education's directives:

The addition notation: The Department of Education determined that "it should be allowed to use both notations for addition, '+' and '⊥'"; they argued that "they cannot oblige the students and teachers to use only one of the notations, because the use of the former may cause religious hesitations" (JNCP, Department of Education, circa 1944b, p. 1).

The fraction line: The Department of Education determined, as did Baruch, that "the

[9] *Rashi* script is a semi-cursive typeface for the Hebrew alphabet which is named for the author of the most famous rabbinic commentary on the *Talmud*, Rashi.

[10] The documents are undated; apparently they were issued shortly after the Committee for Determining Uniform Mathematical Notations submitted its suggestions in June 1944.

fraction line should be horizontal" and not oblique (JNCP, Department of Education, 1944a, p. 3).

The decimal point: The committee considered the following notations for the decimal point: ".57," "0˙57," "0.57," "0,57"; the Department of Education determined the choice to be: "0.57." Despite this decision, the notation "0,57" was used in the 1947 Hebrew Liberal Arts Department graduation examination (Holtzberg, February 1944; JNCP, Department of Education, 1944a, p. 4; JNCP, Department of Education, 1948, p. 29).

8. ATTEMPTS FOR STANDARDIZATION IN TERMINOLOGY

The Hebrew Language Committee worked as well during that time on Hebrew mathematical terms, "though, the Hebrew Language Committee aim to reach uniformity…was not fully achieved. Duplicities in several important concepts abided" (The Hebrew Language Committee, 1940, p. 3). The Hebrew Language Committee collected, approved, and invented new mathematical terms, striving for uniformity.

The Hebrew Language Committee periodically published lists of new terms to be used in various aspects of life; among these publications are mathematical dictionaries. The following are a few of the newly approved terms from three mathematical dictionaries:

1. Arithmetic Terms, 1908

   Ray, zero, the four arithmetic operations, addition, total, sum, subtraction, subtract, remainder, cube, fraction, mixed fraction, divisibility rules, decimal, denominator, natural numbers, digit, surface (1928, pp. 77-82).

2. The Work of the Hebrew Language Committee, 1933[11]

   Algebraic Terms: square root, power, exponent, cubic equations (a different term is currently in use), congruent, prime number, numerator, mathematical induction, inequalities, coefficient.

   Geometric Terms: right angle, plane, edge, dimension, length, width, thickness, height, surface, compass, protractor, ruler, circle, circumference, center, radius, diameter, triangle, base, quadrilateral, polygon, theorem, bisector, to prove, conclusion, hypothesis, data, definition, axiom, degree, parallel, parallelogram, rhombus, solid, locus, diagram, pentagon,

[11] The terms were determined by the Committee for the Mathematical Terms, which was a part of the Hebrew Language Committee, according to Baruch's suggestions; Baruch was among the committee members.

hexagon, octagon (not the current term), axis, sphere, cube.

Trigonometric Terms: radian, sine, cosine, tangent, cotangent, secant, cosecant (pp. 345-355).

3. A Dictionary of Mathematical Terms, Hebrew-English-French-German, 1940

   Arithmetic, Algebraic, and Analysis Terms: binary (a different term is currently in use), multiplication table, analysis, group, ring, field, homogeneous, matrix, infinitesimal calculus, differential calculus, differential, derivative, integral.

   Geometric Terms: solid geometry, figure, vector (a different term is currently in use) (pp. 5-59).

Notwithstanding the Hebrew Language Committee's efforts to reach uniformity in terms, it was obvious that the use of terms remained inconsistent. The journal *Hed Ha-Hinuch* reported on an order issued by Mossinson, the head of the Department of Education of the JNCP and the former headmaster of The Herzlia Hebrew Gymnasium, to Hebrew schools "demanding the teachers to use the terms that were determined by the Hebrew Language Committee while teaching." The writer explained that "textbook authors and teachers choose their own words and, eventually, students and graduates do not understand each other and an external examiner finds various terms for the same concept, which causes a great trouble" (Yalon, 1941, p. 288).

Indeed, among different textbooks, examinations, curricula, and notebooks, the researcher found various terms for the same concept. Table 2 contains examples for several concepts that were expressed by various Hebrew terms over the years. For each concept, the table notes the different terms in Hebrew and the years and sources in which each of the terms has been used.

Table 2. Examples of Using Different Hebrew Terms for the Same Concept.

English term	Various Hebrew terms	The Hebrew Language Committee	Textbook	Curriculum	British graduation examination	Hebrew graduation examination
Polygon	רב-צלע			H1911, R1914		
	רבצלעון	1934, 1940	B1926	H1926		
	מצולע*	1934, 1940	B1936, BR1933	H1937, H1944, J1925	1927	1942
Diagonal	קרנזול	1934, 1940	B1926, B1936	H1944	1929, (1943), 1944	
	אלכסון*	1940	BR1933		1924, 1925,	1936, 1941,

					1930, 1943	1945
	דיאגונל				(1924)	
Trapezoid	טרפציה	1934	B1926, B1936	H1911, J1925, H1937, H1944	1929, 1934	1936
	טרפז*	1940			1943	
Radius	חצי-קוטר	1934, 1940	B1926		1925, 1927, 1930	
	מחוג	1940				1941, 1942, 1944, 1945, 1947
	רדיוס*	1934	B1926, BR1933, B1936	H1937, H1944	(1925), (1930), 1943	1936, 1937, (1942), (1944)
Bisector of an angle	חוצה זוית*	1934, 1940	B1926, B1936	H1944	1931	
	ביסקטריסה		BR1933			1947
Sides of right-triangle	זוקף		BR1933		1924A	(1944)
	משולש ניצבים	1934				
	ניצב*	1940	B1926			1944
Projection	השלכה		BR1933			(1942), (1945)
	הטלה*	1934, 1940	B1936	H1937, H1944		1942, 1945
Equation	משוויה			J1925, R1930	1925-1931, 1933, 1934, 1943, 1944	
	משוואה*	1934, 1940		H1937, H1944	1924A, 1932	1936, 1937, 1941, 1942, 1947
	השוואה		B1921, B1929, B1936, B1951	H1911, R1914, H1926		

Note. *Words in use today. B1921 = (Baruch, 1921); B1926 = (Baruch, 1926); B1929 = (Baruch, 1929a, 1929b); B1936 = (Baruch, 1936b); B1951 = (Baruch, 1951); BR1933 = (Bilanski & Robinson, 1933a); H1911 = (The

Herzlia Hebrew Gymnasium, 1911); H1926 = (The Herzlia Hebrew Gymnasium, 1926); H1937 = (The Herzlia Hebrew Gymnasium, 1937); H1944 = (The Herzlia Hebrew Gymnasium, 1944); R1914 = (Biram, circa 1914-1917); J1925 = (The Jerusalem Gymnasium, 1925). In several examinations a concept was named by two different terms one after the other and the latter is in parentheses; in these cases, the year that represents the latter term is in parenthesis.

DISCUSSION AND CONCLUSION

This paper reviews the development of Hebrew scientific terminology. The language problem influenced the course of teaching and mathematics teaching in particular. Around the end of the 19th century and the beginning of the 20th century there were no Hebrew secondary schools, and only a few elementary schools used the Hebrew language as the language of instruction. Hebrew school teachers were described as stutterers and laconic because they could not explain mathematical topics in Hebrew and students graduated school with limited knowledge (Ahad-Ha'am, 1950, p. 33).

With the foundation of Hebrew secondary schools, a systematic creation of Hebrew scientific terminology began. During these years, the learning of mathematics in Hebrew and the creation of the scientific terminology it necessitated were important aspects of the Jewish national identity. In 1921, Y. Lourie, the head of the Zionist Administration Department of Education, reported that "the Hebrew secondary schools took a great role in the revival of our nation. It created a living Hebrew spoken by the young generation…. The language united different parts of our nation into a single national body" (p. 47).

Many gaps remain in our knowledge of the decision process by which Hebrew scientific terms were created. Revisiting this issue in the future should greatly aid our understanding of the process of creating scientific terms and notation. What suggestions were discarded? What disagreements arose? How were final decisions made? These questions need to be answered.

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