DICTIONARY
OF
ALGEBRA TERMINOLOGY
ENGLISH – HEBREW

BY
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Fifth Edition

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To the memory of my father
Dr. Dov Jarden

Foreword

In 1925, several years after the revival of the Hebrew language in Israel, the Hebrew University was established in Jerusalem. It was not by chance that the name chosen for this institution was neither "Jerusalem University" nor "Eretz Israel University." The name selection stemmed from the recognition that the Hebrew language represented a cornerstone in the restoration of the Jewish people in its own land and that the university should assume a leading role in the development and dissemination of the language in every domain. In light of this assumption it was decided that Hebrew should be the official language of instruction, research and administration. Lectures, seminars and tutorials would be conducted in Hebrew and papers written in Hebrew. Even Master and PhD theses should be submitted in the Hebrew language. The founders of the university did not ignore the fact that science in Israel was still in its infancy nor that scientific work in Hebrew was as good as non-existent. On the contrary, they were fully aware that the task of (re-)inventing concepts, terms, and forms of expression would fall on the shoulders of the pioneer lecturers, each in his own field. They also realized that not all members of the staff would rise to the challenge and that some may even consider it unnecessary. Nonetheless it has been agreed upon that the official language of the Hebrew University should be Hebrew.

Professor Edmund Landau from Goettingen University was called upon to head the Institute of Mathematics at the Hebrew University. Landau had studied Hebrew in Germany with a private teacher and displayed his mastery of the language in a talk held on April 1, 1925, at the inauguration of the Einstein Institute of Mathematics. It was a lecture delivered in Hebrew on the subject of "Open and Solved Problems in the Elementary Theory of Numbers." The lecture was addressed to the general public, however it contained a number of mathematical terms, such as "prime numbers," "factors," "member," "series," "even number" et al. In 1928 Landau immigrated to Israel and conducted his lectures in Hebrew at the Institute. Unfortunately, he was forced to return to Germany and his position as the head of the Institute was passed on to professors Michael Fekete and Abraham A. Fraenkel.

Fekete belonged to the Hungarian School of Mathematics. Prior to joining the staff of the Hebrew University he wrote most of his papers in German, some in Hungarian and one or two in French. Fraenkel came from Marburg, Germany. His mother-tongue and scientific language was German. Nevertheless, the two taught in Hebrew immediately upon arriving in Israel. Since they had to conceive ways of applying mathematics to a non-existent Hebrew context, they translated mathematical terms and forms of expression from other languages - mainly German - into Hebrew and in this way they acquired mastery of Hebrew mathematics. Fekete wrote two of his papers in Hebrew (Riveon Lemathematika 8, pp 46-59 and Riveon Lemathematika 9, pp 1-12). Fraenkel went even farther by establishing the Hebrew mathematical language in a series of books on "Introduction to Mathematics."

Those who followed in their footsteps - Arie Dvoretzky, Yaakov Levitzki, Shmuel Agmon, Shimshon Amitsur and Michael Rabin - continued to pave the way towards a Hebrew math language which Fekete and Fraenkel had begun. They all lectured and even wrote articles in Hebrew for the Riveon Lematematika. That journal founded in 1946 by my late father, Dr. Dov Jarden, played an important role in the development of mathematics in Israel, particularly Hebrew Math. The journal published regular research papers - some of importance - refereed according to formal criteria.

In 1961 the Israel Journal of Mathematics was launched. Published in English and French it attracted

articles that had formerly been submitted to the Riveon Lemathematika, eventually leading to the closing down of the latter.

At the same time the mathematical community in Israel was also receptive to influences from outside. Young researchers, especially Americans, joined their lines, including Israel Aumann, Hillel Furstenberg, Benyamin Weiss, and Hershel Farkas. They adapted easily to the Hebrew language. However in time the numbers of visiting faculty grew, which led to the fact that research seminars previously conducted in Hebrew were now delivered in English.

The welcome influx of Russian immigration reinforced this trend. It brought large numbers of excellent mathematicians to all math departments in the country. Many of them were too old to acquire ease of expression in Hebrew mathematics, however, they were eager to establish good connections with the veteran math community. Thus English was elected as the common denominator.

Initially regulations required that Masters and Doctoral theses be submitted in Hebrew with exceptions allowed in English. In time the exception became the rule and nowadays most papers are written in English. One consideration is that works have to be submitted for evaluation from abroad. Another -technical- reason for this state of affairs was that for a long time the TEX word processor was not Hebrew Math enabled. It was only recently that this obstacle has been surmounted, so that now we can write Hebrew Tex with considerable ease owing to the dedication of a few math freaks. In theory this should facilitate the return to graduate theses written in Hebrew.

We have to emphasize that the majority of courses are still delivered in Hebrew and the Russian immigrants spare no efforts in the attempt to master the basic terminology of Hebrew math. From time to time I am approached by one of them to help with the translation of this or that concept into Hebrew.

The present dictionary brings a collection of the Hebrew vocabulary and terms used in math and their corresponding translation into English. Given my professional expertise in the field of Algebra and the Number Theory, I have given priority to the translation of concepts in that field. Although I have been working on this dictionary for several years, this book is only the pilot edition. At first I reviewed Serge Lang's Algebra second edition and selected all relevant items for translation, then I included additional words and concepts, however not in systematic order.

It turns out that the number of basic terms which appear in a five hundred page book such as "Algebra" does not exceed one thousand. There is nothing surprising in this fact: the vocabulary necessary to math is limited, hence no great effort is required in order to master it. I have complemented the dictionary with basic notions that can be used outside of math as well. In addition, I have translated concepts appearing in the indexes of the following books:
J. S. Golan, Studies in Modern Algebra (Hebrew)
S. Amitsur, Algebra A (Hebrew)
A. Borel, Linear Algebraic Groups, Second Enlarged Edition
M. Fried and M. Jarden, Field Arithmetic
R. Hartshorne, Algebraic Geometry
S. Lang, Introduction to Algebraic Geometry
S. Lang, Algebra, 3rd Edition
S. Lang, Algebraic Number Theory
S. Lang, Elliptic Functions

R. Ayoub, An Introduction to the Analytic Theory of Numbers
M. F. Atiya and I. G. Macdonald, Introduction to Commutative Algebra

Convention does not require that a bilingual dictionary brings examples for main entries. Subentries serve for this purpose. However I have taken the liberty of enlarging upon the sub-entries and included also translation for the words making up the expression. Thus for instance next to the primary concept of "space" I placed "vector space," a basic term in linear algebra. The number of entries and secondary entries in the book is about nineteen hundred.

I have translated the various terms and expressions in the dictionary to the best of my ability and knowledge. In general I have opted for the most conventional translation. However a great number of terms do not have a corresponding notion in Hebrew and the foreign word is used in the original. For some of those I have suggested a translation and marked it with 'proposed' next to the term. Thus I translate the concept "moduli space" in algebraic geometry as "merchav mirkam" (suggestion of my wife Rina). For many other concepts I could find no appropriate Hebrew equivalent, so they remain open linguistic problems and until resolved we shall go on using the foreign term. For instance, I have spelled the word "differentiable" in Hebrew, which is almost unpronounceable for the speaker of the language. I could find no equivalent for the term "reductive" since the Hebrew "metzumtzam" is already used for translating "reduced." Occasionally I have placed the foreign term next to the Hebrew one. For example, "complex" is translated both as "michlol" and "complex"; other terms, such as "isomorphism," I have chosen to leave in their original spelling.

I am well aware of the fact that in matters of linguistics and terminology opinions vary and conflict. I also assume that this edition will have its share of errors. Criticism, comments and suggestions are most welcome. Meanwhile I shall continue to enlarge the dictionary by including additional terms from basic manuals of algebra and the theory of numbers. And I shall willingly send the next edition - as I am doing with the present one - to anyone interested.

Most of the verbs in mathematical texts in Hebrew appear in the present or the future tense. In order to make the dictionary as handy as possible, I have therefore chosen to translate verbs from English into Hebrew in the present tense. Thus, I have translated "formulate" into "menase-ach" and "multiply" into "machpil".

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Moshe Jarden
Mevasseret Zion, August, 2005

Abbreviations in this dictionary

הִפ -- הִפְעִיל
הֻפ -- הֻפְעָל
הת -- הִתְפַּעֵל
ז -- זָכָר
מג -- מִלַּת גּוּף
מח -- מִלַּת חִבּוּר
מי -- מִלַּת יַחַס
מק -- מִלַּת קִישׁוּר
נ -- נְקֵבָה
נפ -- נִפְעָל
פָּע -- פָּעַל
פִּע -- פִּעֵל
פֻּע -- פֻּעַל
שפ -- שֵׁם פְּרָטִי
ת -- תֹּאַר
תהפ -- תֹּאַר הַפֹּעַל