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Using Software to Analyse Patterns of Recurrence in the Poetry of the Psalms

Bob MacDonald

Anthony Macauley Associates

Contact: stenagmois@gmail.com

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Abstract

This article shows that automated analysis of Hebrew poetry can reveal structural aspects of the thought of an ancient poet which are clear in the aural nature of the text but are not obvious through regular reading techniques of the modern world especially in translation.

About the author

Bob MacDonald is Director of Research and Development for Anthony Macauley Associates, a software firm specializing in Computer-based Monitoring and Evaluation systems for Government. He is now retired from active programming. His current research includes automated analysis (using the development platform GX-LEAF) of the grammatical forms of ancient Hebrew words, the music which is derived from the text, and concordant translation of the Hebrew Bible. His publications include: *Intuition to Implementation: towards a language of structure for systems*, Prentice Hall 1987, and *Seeing the Psalter: patterns of recurrence in the poetry of the Psalms*, Energion Publications, 2013.

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1. Introduction: Polyglot Dreams

The digital world creates opportunities for textual presentation that students of sacred texts from former times had not dreamt of. Origen (184-254 CE), in his effort to understand Scripture, created his *Hexapla*, a six-column multi-language Bible. Jerome (342-420 CE) used Origen's work to develop the Latin *Vulgate* version of the Psalms from the Greek and he also produced a new Latin translation from the Hebrew, his *Psalterium Hebraicum*. Erasmus (1469-1536), a thousand years later, preferred Jerome's Greek-based Latin version. For an elaboration of this briefly-touched history, see Susan Gillingham's *Psalms through the Centuries*, vol 1 (2012).

My own research has focused on the Hebrew poetry of the Psalms. I have an easier time than they had. I am not limited to parchment and quill or their equivalent. The digital techniques I have used are also not limited to Hebrew. I have tested them in Greek and Hebrew with passages from Isaiah, in Arabic using passages from the Koran, and with Latin, English and French translations. For this article, I will confine my comments to the Hebrew Psalter and English renditions.

My examples are selected from those treated in my book *Seeing the Psalter* (MacDonald, 2013a). In this volume, I have translated and presented all 150 biblical psalms in a two-column diglot format and with corresponding recurrence tables that help the reader to see these poems in new ways. I hand-crafted the database from which I worked, experimenting with format and selection criteria over several years, using the GX-LEAF¹ software. I then completed the work at the University of Victoria as a community fellow of the Centre for Study of Religion and Society. Using the database, I have examined and presented patterns of word usage in individual psalms and across many combinations of psalms. The database allowed me to rediscover many patterns previously reported in the literature, and also to discover many more patterns and to test questions of authorial intent and coherence in the Psalter. Some of these patterns were deliberate by the poet, and the reader will imagine the insight as communication with an ancient mind. Some were deliberate by those who collected the poems, and we can imagine the activity of

these editors. Some are not easily visible without access to a database, but they are there and perhaps were seen by readers in earlier centuries or millennia through their own extensive memorization of the whole body of the Psalter.

First, we will look at the problem of reading and seeing the text (Section 2). Three techniques are noted, two of which are easily implemented in a digital format and one of which is more subjective. Then I will present some individual examples (Section 3) and structures spanning multiple poems (Section 4). In each case I will show how the analytical functions can be done manually and what implications there may be for existing databases and online sites that present religious (or other) texts to be studied. In the final section, I will show some of the functional screens that I developed and used. These techniques allowed me to find and present aspects of the text more easily than earlier generations who, without the advantage of our technology, nevertheless produced detailed glossaries and concordances with annotations.

2. Poetic Text: Challenges and Techniques

One might ask immediately: How can one *see* poetry? Surely we're meant to *hear* it. Surely the sense is in the *performance*. But there are so many possible performances and so many selections and sequences, so how will we learn to hear and understand these poems in our visual culture?

It is unfortunately true in our very fast moving society that poetry can be intimidating. To read poetry, we need to slow down. That is why I deliberately chose to translate and present the text largely without punctuation, so that the reader must take time to form the phrases into thoughts. Even so, we are still reading a column of text. To alleviate the demands on our eyes, ears, and thought, three techniques have been written about over the last 300 years to make it easier both to hear and to see this poetry.

The first is called *parallelism*, a principle named by Robert Lowth (1710-1787) in his *Lectures on the Sacred Poetry of the Hebrews* as *parallelismus membrorum* (Lowth 1815). One can think of it as a form of rhyming ideas. Lowth divides parallelism into three classes: synonymous, antithetical, and synthetic. Much has been written on this technique. For example, David Tsumura (2009) presents what he calls a 'vertical grammar' of parallelism, a grammar that helps lock in the intent of a passage.

An example of parallelism appears in the first verse of the Psalter. Here the three lines describing the happy person are in the parallel form, a-b, b-a, b-a where each 'a' is an action, walk, stand, or sit (italicised below), and each 'b' is a situation or place where esteem or advantage is sought:

Happy the person who
does not walk in the advice of the wicked
 and in the way of sinners *does not stand*
 and in the seat of the scornful *does not sit*

The second technique is called *prosody*. Prosody, in a limited sense, answers the question of how can we arrange the text so that we can see its pieces, the phrases or *members* that Lowth described. It is difficult to perceive form in the poem if it is just a block of text. Prosody, in part, is the art of displaying poetry. A starting point for the Psalms is to see the lines of a psalm in twos and threes, and sometimes fours. For online display where the publication cost is screen real-estate rather than paper, it is optimal for the reader to see the prosodic form rather than a block of text. Prosody is expensive when measured in 'real estate' on paper or screen, but it is an essential part of using the eye of the reader to engage with the text. In the above example, we can see prosody at work in the three lines, and the three main words in each line.

Prosody is more fully defined as 'singing to speech' – the 'elementary form of song' created by the 'infinite gradations of tone in ordinary speech' that 'serve to bring home to the listener the interrelation and coordination of the words used by the speaker' (Jewish Encyclopaedia, 1906). The singing of the psalms is more difficult to know with respect to these ancient texts since we have no recording devices that could let us hear original performances, but there are some surprises here that have been addressed by Suzanne Haik-Vantoura (1976; see also Mitchell, 2013) prior to the computer age. Haik-Vantoura observed that the sets of signs below and above the letters of the Hebrew text, known as the *te'amim* or 'marks of taste', are not punctuation, as has been the theory over the last 1000 years, but musical notation. Vantoura, a pupil of French organist Marcel Dupré, by observation, experimentation, and inference without

the help of the digital revolution, established a definitive and unvarying deciphering key that maps the signs below the letters to scales and the signs above the letters to ornaments.

The third principle is *recurrence*, the repetition of words sharing a common root. These words have shared consonants that make them sound alike. They are part of the assonance of the poem, a part of the technique that ties the poem together. Recurrence is a relatively objective observation when compared to parallelism. It is important to distinguish between these two principles. Parallelism is the expression of the same (or an antithetical) thought in different words. Recurrence is the repetition of the same word in the poem. This distinction removes some subjectivity from initial structural considerations. We will usually agree when two words have the same root letters. We may not agree (especially with respect to a language for which we have no native speakers) that two concepts with words having differing letters express or represent a similar or contrasting thought. Parallels are hard to analyse with an algorithm. Recurrence, on the other hand, may be determined easily with the help of a suitable database.

The problem with recurrence is how to present it to a reader. One requires a suitable set of parameters to both select and restrict the complexity so that forms within the poem, prophecy, or prose can be seen. Recurrence also appears in the example of Psalm 1 above. Such repetition is illustrated in the recurring negative, לא (lo, 'not'), and the first three words, *asheri ha'ish asher*, in this case by means of a homonym, asher, is both 'happy' and also the relative pronoun, 'who'.

אֲשֶׁרִי הָאִישׁ אֲשֶׁר
 לֹא הָלַךְ בְּעֵצַת רְשָׁעִים
 וּבְדֶרֶךְ חַטָּאִים לֹא עָמַד
 וּבְמוֹשָׁב לִצִּים לֹא יָשָׁב

All of these three principles are ancient techniques. If we think of a poem or a set of poems as if we were preparing a software package to be delivered, parallelism and recurrence form the 'package' for the thought of the poets and the editors. Parallelism forms the thought of a verse. Recurrence encloses the thought and links it to other poems where a similar frame is used. Prosody then informs the performance whether for reading or for singing. Prosody in layout is rarer in ancient times but some of the scrolls from Qumran are in a Herodian hand in a poetic form. They may have included the whole Psalter (Seybold, 2010).

3. First Example: Psalm 18

All these definitions are much easier to comprehend with some examples.

Here is an example from Psalm 18, the first long psalm in the Psalter, and therefore rarely performed in churches or synagogues in its complete form. Look at verses 21 and 22:

יְהוָה יִגְמְלֵנִי יְדוּהָהּ כִּצְדִיקִי 21 *will reward me* for my righteousness
 כִּבְרַר יְדֵי יֹשִׁיב לִי for the purity of my hands *he will turn to me*
 יְהוָה כִּי שָׁמַרְתִּי דִרְכָּי יְהוָה 22 *for I have kept* the ways of יהוה
 וְלֹא רָשַׁעְתִּי מֵאֲלֹהֵי and I have not been wicked with my God

Verse 21 is in the form a-b-b-a. It is *action* (italicised above) followed by reason, then the parallel thought, reason followed by *action*. Verse 22 is in the form a-b-a-b. In this case the parallel *action* with its object is expressed in the negative. The form a-b-a-b is a sequential parallel. The form a-b-b-a is a simple circular structure. In a case with just two members, it is called a chiasm. It is named after the Greek letter chi since joining the two parts to each other with a pencil forms the shape X. Note how careful the translator must be to preserve the shape. You can see that the Hebrew has the same shape as the English in this case.

Now we move on from parallelism and look at the word count. In these two verses in Hebrew, the thought is expressed in a very few words: 2, 3, or 4. Translations into languages like English have more words than the Hebrew. Hebrew is a language that uses letters before and after the root word and sometimes in the middle of it, that express tense, mood, aspect, prepositions and pronouns. This reduces the number of ‘words’ required to express the thought in a line of poetry. You can see how easy they are to count, in this case, 3-4-4-3 for verses 21-22 above. Just count the spaces between the words and add 1.

Psalm 18:21-22 is itself part of a section from verses 20 to 25.

וַיּוֹצֵאֵנִי לְמִרְקָבָהּ 20 He has brought me out into a spacious room

יִחְלֹצֵנִי כִּי חִפְּזָא בִּי	he will rescue me for he delighted in me
יִגְמְלֵנִי יְהוָה 21 כְּצִדְקִי	will reward me for my righteousness
כָּבֵד יָדַי יָשִׁיב לִי	for the purity of my hands he will turn to me
יְהוָה 22 כִּי שְׁמַרְתִּי דְרָכָי יְהוָה	for I have kept the ways of
וְלֹא רָשַׁעְתִּי מֵאֱלֹהֵי	and I have not been wicked with my God
כִּי 23 כָּל מִשְׁפָּטָיו לִנְגֹדִי	for all his judgments are before me
וְחֻקָּתָיו לֹא אָסִיר מִנִּי	and his statutes I will not put aside from me
וְאֵלֵּי תָמִים עִמּוֹ 24	and I am complete with him
וְאֶשְׁתַּמְרֵם מִצִּדּוֹנִי	and I have kept myself from my iniquity
וְיָשָׁב יְהוָה לִי כְּצִדְקִי 25	and turned to me for my righteousness
כָּבֵד יָדַי לִנְגֹד עֵינָיו	for the purity of my hands before his eyes

What we see here is already easier to read and see than a block of text. The division by twos and threes really helps.

But look also at the pattern of the recurring words. Table 1 below shows the nine distinct words that recur in this section of the poem (the columns number the words in their sequence in the Hebrew from 1 to 9). These words occur 19 times in the section (count the blocks in the table). Just under half the words in the section recur (19 of 41 Hebrew words above).

Table 1: Psalm 18 verses 20 to 25

Word and gloss * first usage	1	2	3	4	5	6	7	8	9	Vs	Root
כִּי for	■									20	כי
כְּצִדְקִי for my righteousness		■								21	צדק
* כָּבֵד for the purity of			■							21	ברר
יָדַי my hands				■						21	יד
יָשִׁיב he will turn					■					21	שוב
* לִי to me						■				21	לי
כִּי for	■									22	כי
שְׁמַרְתִּי I have kept						■				22	שמר

ולא and not																		22	לא
כי for																		23	כי
* לנגדי are before me																		23	נגד
לא not																		23	לא
ואשתמר and I have kept myself																		24	שמר
וישב and turned																		25	שוב
* לי to me																		25	לי
כצדקי for my righteousness																		25	צדק
* כבר for the purity of																		25	ברר
ידי my hands																		25	יד
* לנגד before																		25	נגד

Notice the

overall arrow-

head pattern created by the recurring words. When there is an arrow-head shape, if you drew circles joining the words in the text you would find the circles are concentric. A concentric or ring structure is a structure where words or phrases are reused in a poem in reverse order. Words recurring in the same sequence will form intersecting circles if the words are joined in the text. These concentric circles are formed by joining the words that recur in reverse sequence: **my righteousness – turn – kept – not**. Now look for what is surrounded by the circles. In this case: *All his judgments and his statutes* are circled four times. Note also how the outer three circles surround the confident hope that *I am complete in him*.

Note also the last recurring word – **before**. This final word is the focus of the passage: in this case, the poet is in a face to face relationship. So the poet writes: His judgments and his statutes are *before me*; and the purity of my hands is *before his eyes*.

The technique to produce the table of recurring words for a section of text requires a database of words, each uniquely identified in its sequence and by its place in the poem, the root for each word, and a pair of queries: one that is hidden to determine the count in sequence of recurring words in the section under consideration, and one that reveals the final table using a cross-tab analytical function (available in Oracle version 8i and above) with the first query controlling the columns. A query is a request to the database to list a set of fields with their values in a particular order and with a particular filter. Such a request reveals patterns of word

usage in a section of the text. Selection criteria for the queries must include the poem, the range of verses to be included or excluded, words to be included or excluded, and the count of recurrence to include or exclude.

The process of building a recurrence table can be done manually though it is time-consuming and error-prone. As you read a poem, for each Hebrew word in sequence you must decide the root (or if no root, the significant letters). As soon as you see a repeating pattern, make a column for that set of letters. Number the column and write the root or letters as column header. At the end of the poem, you will have a table with as many columns as there are repeating roots. Then read the poem again to fill in each row with the word and verse and mark the relative place in the poem with an X as you fill in each column in sequence. You can of course do this for all words in the section, but the table gets quite big. I limited my displays to 40 columns and suppressed the empty ones. The auto-suppression of columns requires a condition derived from the hidden query, on the display of each column.

I have also included a * to indicate that these repeated words are used in this poem for the first time in the Psalter. I did this experiment on the whole Psalter, by section, by poem, and for groups of poems, to test the thesis that the psalms are not a randomly-ordered collection of poems. We are dealing not only with individual poets, but with a deliberate collection of poems and collections of poems into a coherent sequence that tells a story. After 17 psalms, we have here the first repetitions in a poem of *purity*, *to me*, and *before*. Word recurrence is like the framing of a picture in a gallery. The psalms may be considered as if they were in a gallery and were being viewed in sequence. The first usage ‘frames’ are effective in uncovering some structural aspects of the whole that may have been deliberately allowed by the collectors and redactors of the tradition.

4. Further Examples Showing Different Strategies in the Use of Recurrence

Different psalms reveal different strategies for recurrence. Psalm 137, for example, the last reminder of the exile in the Psalter, has three different voices *remembering*: first person plural in the first section, first person singular in the second section, and second person singular imperative in the third section. *Smash*, in a verse usually omitted when reciting Psalm 137,

occurs exactly twice in the Psalter, in Psalm 137 and in the *smashed pots* of Psalm 2 (see also Magonet, 2013). These wider patterns show a storied coherence to the Psalter.

The pattern of a word that repeats once in each of the sections of a poem is also evident in Psalm 51, David's repentance over the incident with Bathsheba, where the word *righteous* appears once in the centre of each of the three sections of the poem. Each recurrence is highlighted by a set of words used in sequence and then in reverse sequence, easily observable by the characteristic arrow-head shape in the recurrence table. The table below shows verses 3 to 11 surrounding verse 6b, *So you are right to speak, you are clear to judge*. Note that I removed repeated recurrences of these words and also of other words to highlight the shape.

Table 2: A ring structure in Psalm 51:3-11

Word and gloss * first usage	1	2	3	4	5	Vs	Root
* מחה blot out						3	מחה
מעיני from my iniquity						4	עין
ומחטאתי and from my sin						4	חטא
* טהרני cleanse me						4	טהר
אדע I know						5	ידע
תודיעני you make me know						8	ידע
* ואטהר and I will be clean						9	טהר
מחטאתי from my sin						11	חטא
עונתי my iniquity						11	עין
* מחה blot out						11	מחה

Some poems exhibit a recurring sound from a single syllable. Psalm 145, the last of the acrostics, has 25 words ending with and 18 beginning with kaf (K). The sound is like a drum beat. The shape in the table is a vertical line of marks in a column. Psalm 44, the first corporate lament, has 40 recurrences of the sound *nu*, the first person plural suffix for *we* and the suffix for *our*. This is observable when recurrence is tested for grammatical forms. While there are aural markers in these poems, this was also a literary culture as the sequence of the alef-bet in the acrostic poems shows us.

These structures are best seen if one follows the instruction of Rabbi Magonet (2004) who advises us to read with a pencil in hand. I have added to his advice by distinguishing *parallelism* from **recurrence**, a distinction that further clarifies structure. So note the **words** that repeat and join them to each other in the text. Ask then: are these words in sequence, or in reverse usage, or a spine in the poem, or a focus? Then pay attention to what is enclosed by the circles, especially if what is enclosed is comprised of words that do not otherwise repeat in the poem.

5. The Translation Problem

Of course, the revealing of such structure, if it is indeed intended by the poet, is dependent on examining the text in the original tongue. Translation obscures both parallelism and recurrence. Identifying repeated words in English will not result in the structure being perceived without some help. Two overall differences become apparent when considering the results of translation, in this case from Hebrew to English. This list is taken from *Seeing the Psalter* (MacDonald, 2013a, p.19):

1. Some words that recur in Hebrew will not show in English. In all these cases, for the verses that are included, the recurrence tables can show the pattern clearly.
 - a. **Relative pronouns**, *who*, *that*, are different in English but the same in Hebrew.
 - b. **Homonyms** in Hebrew will translate to different glosses in English. These may be significant in the Hebrew aural structure (assonance and word-play).
 - c. **Synonyms** in English may translate the same Hebrew word with different English glosses.
 - d. Different Hebrew **verb forms** for the same root may translate to different English glosses.
2. Some words will recur in English that do not recur in Hebrew. With the recurrence tables, which show the direct mapping of each gloss, it will usually be clear why some words are or are not part of the internal structure of the poem.
 - a. English **helping verbs** like *do*, *have*, *make*, are separate words in English but are part of the verb in Hebrew.
 - b. *To be* or *to become* may or may not be present in Hebrew but may be required in English.
 - c. **Homonyms** in English may arise from different Hebrew words.
 - d. **Recurrence between psalms** may require an echo that compromises similar sounding glosses in the current psalm.
 - e. **Prepositions** and **conjunctions** will vary in translation depending on context and verbs.

- f. **Prepositions** and **pronouns** show as separate words in English but are not separate in the Hebrew word.
- g. **Two words** may be required in English to distinguish differing Hebrew words. For example, **verb** + **preposition**: *bring up*, *bring down* represent separate Hebrew verbs; or **adjective** + **noun**: *burning anger*, *burning coals*; or verb + noun: **sing**, **sing a psalm**. You can usually see this if you look left and count the words in the Hebrew.
- h. Sometimes similar sounding words (like *righteous* and *righteousness*) may stand separate in the database.

Tables like the recurrence tables above make the perception of recurrence possible for the English reader.

Producing such tables still requires a determination of what will be presented. Digital texts which have a database available could provide a set of selection criteria and a display of the results. I have not observed any sites online with this feature. I have looked at dozens of sites in Hebrew, in Arabic, and in Greek. All of them have some sort of underlying database and dictionary. Many of them allow identification of the root word, but none of them creates a table of similar sounding words or grammatical forms that could help the reader see the rhetorical content more clearly.

The reason is simple: existing websites are concentrating on a single query based on a word or combinations of words. This technique of searching is in common use at for instance, mechon-mamre.org (Hebrew), blueletterbible.org (Hebrew and Greek), and corpus.quran.com (Arabic). Each of these sites has unique useful features. None of them includes a cross-tab. A single query can return a word count, a definition, and a list of other locations where the word is used. The recurrence table requires more than one parameter and also a hidden pre-query which is then used to create a presentation in a cross-tab or pivot table form, which of course could include links to simpler lists and counts.

Existing websites also often have conflicting components in the database. Traditional Hebrew on some sites, including blueletterbible.org, identifies many words as separate that are derived from a common root or are homonyms. If one is focused on meaning rather than form,

one will miss the potential play on words which a poet might have intended. *Meaning* is outside the competence of a query, but much can be learned by examining different forms of letter, word, and phrase usage. These structures and techniques are not confined to Hebrew, but are evident in many forms of prose and poetry in sacred and non-sacred texts. Seeing the structure may give insight into the creative mind that originated the text.

6. Structures Spanning Several Poems

Building on the thesis that the Psalter is a deliberate whole, I used the database to uncover additional structures spanning more than one psalm. Psalms 2 and 149 demonstrate one of several such structures in the Psalter.

Robert Cole (2002) showed that Psalm 149 has two multi-word links to Psalm 2, both of which look deliberate. All the words used in verse 2b of Psalm 149 are in Psalm 2. Also note how verses 7 to 9 are constructed around 6 words from Psalm 2, one on each line, all used in the same sequence as they were in Psalm 2.

Psalm 149:7-9

לַעֲשׂוֹת נִקְמָה בַּגּוֹיִם	7	making vengeance <i>in the nations</i>
תּוֹכַחוֹת בְּלִאֲמִים		corrections <i>in the tribes</i>
לְאַסֹּר מְלָכֵיהֶם בְּזָקִים	8	to bind <i>their sovereigns</i> in chains
וְנִכְבְּדֵיהֶם בְּכַבְלֵי בַרְזֶל		and these glorious ones with <i>iron</i> fetters
לַעֲשׂוֹת בָּהֶם מִשְׁפָּט כְּתוּב	9	to make in them <i>judgment</i> inscribed
הַדָּר הוּא לְכָל חַסְדֵּי		this honour <i>to all</i> under his mercy
הַלְלוּ יְהוָה		Hallelu Yah

The words in italics above are the words in Psalm 149 that are also in Psalm 2 in the same sequence. It looks as if these two psalms act like an opening and a closing bracket to the overall subject of the Psalter: the kings *over* the anointed. When this is noted along with the five words in Psalm 2 used in the same sequence as the same five words in Psalm 1, the evidence seems to suggest that there may be some observable and possibly deliberate patterns here. Psalms 1-2 and

149 can be considered as an envelope into which the whole Psalter fits. There are other clues that reinforce this thesis.

On the surface, the Psalter contains 150 poems in five books. Each book is marked with a short closing doxology, for example Psalm 41:14: *Bless יהוה the God of Israel, from the everlasting and unto the everlasting, Amen and Amen*. As a second example of a wider structure, when one examines the results of a query on the designation of God in these five books, one uncovers a sandwich structure determined by the use of the tetragrammaton, יהוה, (*yod-heh-vav-heh*) and the designation *Elohim* for God. Roughly speaking most of Books 2 and 3 (Psalms 42 to 83) use predominantly *Elohim*, and Books 1, 4, and 5 use predominantly the tetragrammaton. This kind of information was known long before databases, but now is more easily seen by an experiment using digital means.

While searching for larger structures in the Psalter, I used a query that displayed the percentage of words shared by each pair of psalms in turn. The resulting 150 graphs with 149 points each would require great effort without the computer, and it is too much data to manage even with computing power. One can make some discoveries, though, some of which are obvious, like the repetition of Psalms 14 and 53, and the pair, Psalms 57 and 60, that together form Psalm 108, and the final verses of Psalm 40 that are formed into Psalm 70. Also one notes groups of psalms that are tightly related pairwise: for example, the five consecutive pairs from Psalms 30 to 35 each share more than 40% of their words. As another example, Psalm 135, which is 167 words in length, and Psalm 136, which is 166 words in length, share almost 55% of their words. It makes me wonder in this case if one poem was modeled on the other, or whether the choirmaster gave two poets a challenge to use a particular set of words, including *Og the king of Bashan and Sihon king of the Amorites*, to come up with a poem to follow the Psalms of Ascent (120-134) and celebrate the arrival in the courts of the temple.

Another example of overall structure can be seen without the use of a computer. Although translation obscures these children's games, Books 1 and 5 each contain four alphabetic acrostics, poems whose phrases begin with letters of the alphabet in sequence. All the acrostic poems in Book 1 are missing at least one letter, as if the child said, 'I refuse to play'. These are Psalms 9 and 10 together, then Psalms 25, 34, and 37. In contrast, all the acrostic poems in Book 5 are perfect, each with no letter missing. These are Psalms 111 and 112, 119, and 145. Further to

these observations, it appears that each acrostic follows and celebrates a psalm of significance: Psalms 8, 24, 33, and 36 in Book 1 and Psalms 110, 118, and 144 in Book 5. Seven significant psalms altogether are highlighted.

Now if we consider verbal connections between the pairs of psalms that are highlighted, we find a high level chiasm joining Psalm 8 (a), Psalm 36(b), Psalm 110(b) and Psalm 144(a). Two words (among others) reinforce this pattern – *fingers*, occurring in the Psalter only in Psalms 8 and 144, the first of this set of poems in Book 1 and the last of the set in Book 5, and *oracle*, occurring only in Psalms 36 and 110, the last of Book 1 and first of Book 5.

Figure 1: the acrostics and the poems that precede them

7. Controlling the Process

This section shows examples of the components of a system designed to support translation and rhetorical analysis of a sacred text. These components allow the user to enter and control the data, to experiment with and explore the text, and finally, to present the results of the analysis. The critical aspects of controlling the translation are all present in Figure 1. In the upper left are text boxes for the selection of chapter and verse. A second function allows searches by gloss.

Also included are queries by stem. These (example in the middle of the form) are effected through links on the left hand query results.

The screenshot displays the 'PSALMS 117' web interface. On the left, a sidebar contains search filters: Book (PSALMS), Chapter (117), Search for (commend), and Filter for not in verse (checked). Below this is a table of 'Stem - gloss (word) Ch Vs Pos' with entries for 'praise', 'nations', 'command', 'all', 'for', and 'has prevailed'. The main content area shows the selected verse (117.1) with its Hebrew text, English translation ('Praise your God Zion'), and a list of 3 verses sharing this stem. At the bottom, there are filters for recent updates (300 days since 2011.07.24.16.00.00) and a list of 1146 records. The interface is designed for detailed textual analysis and translation control.

Figure 2 Controlling the Translation Process

On the upper right, the currently selected verse may be seen beside a second verse for close comparison of detailed aspects of the text. The lower centre and right of the form shows the history of changes again with text boxes allowing the user to control the resulting list. Implied in these results is a fully audited history of changes in each GX-LEAF database table. Such history enables even one with limited means to remember the decisions that have informed the current state of the work.

The form illustrated in Figure 1 also allows updating of the translation, the root, the location (chapter/verse), and the glosses. For practical reasons, I used a transcription of the Hebrew for controlling input. It was simply easier to implement than turning a Hebrew keyboard

off and on. It remains true that the Latin alphabet is the ruling component behind the scenes. A back-end procedure, written of course in the Latin character set, invokes a conversion routine to Hebrew characters when needed for presentation. In a similar way, given the excessive cost of a fully Unicode database, my programming staff internationalized the presentations with a well-placed set of extended html to Unicode conversion routines.

The ‘test’ button invokes a query (results shown on the lower left) to show words failing a test for overlapping synonyms in the translation. While producing a full concordance is impossible, I strove to comb out synonyms within semantic domains such that the set of English glosses that I used for one Hebrew root did not overlap with those for another. This also allowed me to produce automatically both a Hebrew to English glossary and its opposite with very little overlap. One consequence of semantic domain analysis from the detailed database is that I was able to reduce the vocabulary to ten different piles of words giving a rough-cut impression of what the Psalter is about: just over 40% is about *covenant*; just under 30% concerns *creation and destruction*; just under 20% is about *geography, grammar, and the names of individuals and tribes*, and just over 10% is about *trouble, appeal, and response* (see MacDonald, 2013b).

Figure 3: The percentage of shared words with other psalms for Psalm 117

The chart in Figure 3 gives an example of a query and of the parameters implicit in its definition. In this case for the Psalter, it shows the percentage of words shared for Psalm 117 and each of the other psalms in the Psalter. Psalm 117 is two short verses containing the word praise, a mere 17 words in length. Look at Psalm 136 in the graph. It shows that Psalm 136 shares 40% of the words of Psalm 117. Note also Psalm 150 at 45%.

Recurrence tables and the text itself with notes such as are shown in Tables 1 to 3 above are produced in the form that is used in the book, *Seeing the Psalter*. Essentially, the book was, at an early stage, entirely in the GX-LEAF database. I then used queries to illustrate which words are shared and whether there are significant things to draw from the experiment. I restricted words and verses using selection parameters to reduce the volume of output. Perhaps I wanted to examine words repeated three to five times. In one example, examining words from verses 1 to 51 omitting verses 5 to 47 shows the integration of an inscription into the poem itself. Or perhaps I wanted to see first time recurrence only, or exclude some words from the resulting tables. I also developed strategies for comparing multiple psalms to examine common vocabulary. These comparisons reveal collections in the text under study. I have not by any means exhausted the possibilities.

8. Summary

I have outlined three techniques that help in the reading of these ancient poems. Two of them are significantly aided by digital methods. *Prosody* displayed on the screen can significantly aid in reading and perceiving the *parallelism* in the poetry. *Recurrence* is a relatively objective phenomenon and can be tested using queries from a database. I have also noted that a selective use of queries from a suitably formed database can help identify texts with common vocabulary and grammar and aid in perceiving the mind and actions of the poets and redactors that created and preserved the texts in their own time. I have showed also how these characteristics of the text can be uncovered and presented in the digital world. The techniques I have used include:

- paired queries and a cross-tab for sections of a text or combinations of texts to determine common vocabulary and sequence of usage,
- queries showing the percentage of words shared among multiple sections of text,
- at the same time not neglecting the obvious markers of an overall collection such as repeated sections and sections with particular structures that reveal distant connections, such as, in the case of the Psalter, the eight acrostics and the chiasm joining the poems that precede them: the first to the last containing formative questions on humanity from

exaltation to futility and the last of Book 1 to the first of Book 5 being the two and only two oracles in the Psalter.

The process requires the skills of database design combined with human imagination and a process of experimentation with the data. I would encourage the technicians supporting sites with sacred texts to use their database more fully in the options they present to the public. These would include more elaborate selection criteria, such as by root word or significant letter combination, to allow for comparison operations between texts, and to present patterns of usage of sequences of shared words in a display to the user of the site.

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¹ GX-LEAF, *Live Enterprise Accountability Framework*, is an interactive development environment for Oracle built by Anthony Macauley Associates. GX-LEAF allows the user to define secure, interactive web forms and queries for data collection, experimentation, and presentation without the technical knowledge necessary to set up the full system. See <http://gx.ca/software/leaf.html> for further information and examples of usage in Government, International Development, and Academia.