DOCUMENT 2:

"Bar Hillel and Bar Natan Inquire, Witztum and Rips Respond"

This document has three parts:
1) A list of questions submitted by Dr. Dror Bar Natan and Professor Maya Bar Hillel to Doron Witztum and Professor Eliyahu Rips.

2) The reponses of Doron Witztum and Professor Rips.

3) An epilogue.

Note: Remarks enclosed with [square brackets] were added at a later time by the authors.

Jerusalem, Nov. 27, '96

At the request of [Professor] Robert Aumann, we are submitting in writing a number of questions which came up as we read your paper [Statistical Science, Vol. 9, No. 3. '94] and the reports concerning the discovery of a letter-skipping code in the Torah, and during the course of our attempts to replicate the experiments described therein. We would be grateful if we could receive your responses in writing as well.

1. We would like to receive details on the chronology of the research: For example, who first discovered the great proximity between the name-date pairs, and when? When was the first list prepared? The second list? Who requested the preparation of a second list? When were the results first submitted to a scientific journal, and which one? How did it occur to you to reexamine the dates reported by Margalioth? Did you investigate all of the dates, or only those which seemed to you, for whatever reason, suspicious? Or only those instances in which you knew somehow about the existence of an alternative?

2. We would appreciate it if we could receive from you a data base containing the text of the book of Exodus and the other books of the Pentateuch, so that we may conduct our own investigations, and be assured that you and we are using the exact same text. We would be grateful if you could provide us with a copy of your own data base. We would also like to know what the level of significance of the first list comes to according to your calculations, so that we may compare it with our own, in order to verify that there is no flaw in the program.

3. Margalioth's encyclopedia, which you used, was published in '61. Is there a more recent source concerning outstanding Rabbinic personalities? Is there perhaps a computerized data base to be found somewhere? Or at least a source from which it would be possible to draw, for example, a list of birth and death dates for outstanding Rabbinic personalities, not limited to those appearing on your list? How can people like ourselves receive a list which is more up-to-date and accurate than that of Margalioth?

4. Why did you use in your list of dates only 3 out of the 4 forms (בא תשרי, א בתשרי, א תשרי, and בא תשרי, but not בא בתשרי)? And in general, why did you not use all the other possible forms (for example:

ח״ח אדר‎, ‎כסלו in addition to ‎כסליו, ‎איר in addition to ‎אייר, ‎חשון in addition to ‎מרחשון‎ in addition to ‎ראש השנה, א אדר‎ in addition to ‎יא לתשרי, א תשרי‎, etc.)?

5. We attempted to compile for ourselves a list of famous Rabbinic figures from the (Margolith's) Encyclopedia, using the criteria you specified. There were several discrepancies which we would like to ask you about:

- For Rabbi Aharon of Karlin there was only a single column plus 11 lines of bibliographical text, and not the required 17 lines. Why was he included?

- The Vilna Gaon died on the third day of Chol Hamoed Sukkot (the intermediate days of the festival of Sukkot). Is this not the 18th of Tishri (whereas in your list it says: 19th of Tishri)?

- For Rabbi David Ganz there are 2 columns and 31 lines of text, according to which he should have been included in the second list. Why was he included in the first list?

- For Rabbi Yehudah Ayash there is only a single column plus 15 lines of text. Why was he included?

- For Rabbi Yehosef Ha-Nagid there is only a single column plus 16 lines of text. Why was he included? Besides the fact that his dates do not meet the criteria.

- The date of birth of Israel Baal Shem Tov is not mentioned in Margalioth. Can you direct us to your source?

- Why was Rabbi Meir Eisenstat not included in the second list? There are exactly 1.5 columns of text for him, that is, a column plus 17 lines.

These are our questions for the moment. Thank you.

Maya Bar-Hillel
Dror Bar-Natan

BS"D
15 Tevet 5757
(Dec. 25, '96)

Dear Professor Aumann,

      Greetings. I am writing in response to a letter dated Nov.27, '96, signed by Professor Maya Bar-Hillel and Dr. Dror Bar-Natan. (The paragraph numbers below correspond to the question numbers in the aforementioned letter):

1. We were asked about the chronology of our research. Here is a summary of how things developed:

A. In the spring of '85 we discovered two phenomena relating to ELS's (Equidistant Letter Sequences):

  (i) A tendency towards convergence between ELS's which are minimal over large segments of the book of Genesis, and which have a conceptual relationship between them, as they appear on two-dimensional tables dictated by the ELS's themselves (as explained in the paper).

  (ii) A tendency towards convergence between ELS's as above and expressions appearing in the text on two-dimensional tables, as above (as explained in the second paper).

B. In a meeting which took place in May '85, Eliyahu Rips suggested that we move from using intuitive impressions to quantitative measurement. To this end we defined the function which is designated in our paper as $c(w, w')$ A computer program for calculating this quantitative value was prepared over the course of that summer by Yoav Rosenberg, and it was tested by measuring convergences from the already existing pool of examples.

C. In the autumn of '85 Eliyahu suggested that we check ourselves by examining an a priori list of word pairs. He proposed using pairs of the type -- "personality-date (of birth or death)" -- because the conceptual relationship between them is particularly well defined. He proposed using outstanding Rabbinic personalities because if the phenomenon under investigation was genuine, it seemed reasonable to assume that outstanding Rabbinic personalities would receive fuller treatment in the "hidden text" than others might. Until that point, neither phenomena (i) nor (ii) had been investigated in relationship to this topic, therefore we had no prior knowledge whether any tendency towards "personality-date" proximities existed. On the other hand, one example of this type of relationship had emerged from Doron's previous work, which was an elaboration of a concept of Rabbi Weissmandl, o.b.m., concerning ELS's with skip lengths of special significance. (In this example the name "Herzl" was paired with his birth date, the 10th of Iyar).

D. Eliyahu presented his proposal to investigate name-date proximities for a list of outstanding Rabbinic personalities before at least two scientists: Professor Zevin from the Department of Physics, and Professor Shenkovsky from the Department of Mathematics. He also explained to them the function we had defined. Professor Shenkovsky's reaction was (with a certain degree of humor): "I don't know whether I should wish you luck . . . "

E. It was Doron's task to see to the preparation of the list and to carry out the measurements. Since he had no prior experience in the requisite areas of bibliography and linguistics, he turned for assistance to the linguist Yaakov Orbach, o.b.m. (who passed away last year), who directed him to the Encyclopedia of Great Men in Israel, by Dr. Mordechai Margalioth. From this source Doron selected the "greatest" personalities using the following criteria: His list was comprised of those whose entry consisted of at least three columns of text, and for whom a date of birth and/or death was cited. These were the 34 personalities whose names and appelations were to comprise the list (now known as *the first list*).

It is well known that encyclopedias contain errors, therefore Doron gave the list to two people, who were to compare the dates appearing in the encyclopedia with those appearing in several other sources. They were to make note of any additional information pertaining to the dates. A few weeks later Doron received the reports of the two crosscheckers and learned that they had found following:

(i) There is a well known dispute concerning the dates of death of two personalities: Rabbi Yitzhak Alfasi and the Baal Shem Tov.

(ii) There was an error concerning one of the dates in the encyclopedia -- that of Rabbi David Ganz.

(iii) One date omitted from the encyclopedia is known -- the birth date of the Baal Shem Tov.

One of the crosscheckers mentioned to Doron that in his perusal of the sources he learned of additional names or appellations for some of the personalities.

F. With all of this information in hand, Doron returned to Yaakov Orbach, and asked his advice concerning the dates, and concerning the names and appellations. Regarding the proper indication of the Hebrew dates and the correct spelling of the names and appellations, Mr. Orbach proffered his own linguistic expertise. The principles which guided him appear in the paper. Concerning the question of which names or appellations to use for each of the Sages, he recommended turning to Professor Shlomo Zalman Havlin (of Bar Ilan University), who is well known for his bibliographic expertise. Doron approached Professor Havlin and gave him the list of the 34 personalities, and requested that he prepare a list of names and appellations which, in his opinion, characterize these Sages.

G. Professor Havlin prepared the list of names in the winter of '85-86. Then an experiment was run on this first list. When this experiment proved successful, we decided to write a paper. This paper was published as a preprint on Oct. 6, '86 (the "White Preprint").

H. This paper was sent to Professor D. Kazhdan, who passed it on to Professor P. Diaconis. In a letter of response to Prof. Kazhdan, dated Dec.30, '86, which was later forwarded to us, Professor Diaconis suggested that we prepare a second list of famous personalities, and that we investigate it using the exact same procedure.

I. Doron prepared a new list of Sages using the same encyclopedia. This time it included those personalities whose entries consisted of between 1.5 and 3 columns. He found 32 such personalities. Since experience had shown that on the first list there were dates which were in doubt, or simply wrong, Doron was concerned that with the Sages on the new list, who were less famous, there were liable to be more errors. He therefore decided to double check all of the dates, using the resources of the National Library. And indeed, several errors and doubtful dates were detected, of which he made note in the second preprint. He passed on this second list to Professor Havlin, in order that he should prepare a second list of names and appellations.

J. Once we had all the data in hand, we carried out the experiment on the second list. We then performed an additional test in which we paired [i. e. mismatched]all the names on the second list with the dates of the next personality on the list. This test, too, was performed at the request of Professor Diaconis. These measurements were completed by May '87, and were sent on May 19 to Professor Diaconis. In the wake of these experiments a new version of the paper was composed. It was then published as the second preprint (the "Blue Preprint") in the winter of '87-'88.

K. We wanted to submit the paper for publication in the PNAS [Proceedings of the Nationall Academy of Sciences], and since submission of a paper for publication in this forum must be done by a member of the National Academy of the Sciences, we turned to Professor Robert J. Aumann.

We quickly discovered that this periodical puts a limit on the length of the papers it publishes. In order to comply with the regulations of the journal we were forced to omit some of the information included in the paper (including the tables of names and appellations). We prepared an abridged version of the paper. This preprint is appended to our letter.

L. Negotiations were carried out over whether or not to publish this preprint as a paper. It was during the course of these negotiations that Professor Diaconis first proposed, in a letter dated Aug. 3,'88, that we perform a test based on a large number of random permutations. Eventually the details of the test, the number of permutations and the required level of significance were specified by Prof. Diaconis in a letter dated Sept.5, '90. He had already proposed using Knuth's Algorithm P as the mechanism for producing the permutations. All of the details of his proposal are described in the published paper. He requested that this test be carried out on the second list.

M. At Prof. Aumann's suggestion, the paper was rewritten before this test was performed, with the exception of the results of the test which was yet to be carried out.
 [Because English is not our native language, this version of the paper was rewritten by an English-speaking scientist. When we reviewed the manuscript, we overlooked the fact that the description of Professor Havlin's method of compiling the list may be misinterpreted. As he confirmed in writing at the time that he submitted his list, "[the list] was based on my own personal judgment and on the examinations I carried out with the assistance of the database in the Data Retrieval Institute at Bar Ilan University — the Responsa Project"] .
In this form the paper was sent out to additional scholars for critique. Once they had approved the test and specified the required level of significance (each one giving his own figure), the experiment was performed in the winter of '91-'92. The results were incorporated into the paper. This paper was also intended for publication in PNAS. However, it was finally published as is, in Statistical Science.

2. A. All of our experiments were performed on the book of Genesis, so I do not understand the request for a data base with the rest of the Pentateuch, "so that we may conduct our own investigations, assured that you and we are using the exact same text." Nontheless, we can supply you with our data base of the book of Genesis. The file containing the entire Torah, which we received gratis several years ago from "Mishmeret STaM" in Bnei Brak, was given to us on the condition that we may not pass it on to others. If you consider it important to obtain this data base, you can approach them directly.

B. We were asked what the level of significance was for the first sample according to our calculations. The figures resulting from the first list were:

$P_1 = 0.000000001334$ and $P_2 = 0.00000000145$

In the randomization test, which was carried out exactly as it was for the second list, the ranking of P_2 was 22 out of 1,000,000. This was the best result.

3. We are not experts in the field of bibliography, and we are certain that a professional in the field would be much better able to advise you than we can.

4.A. We were asked why in our list of dates we used the forms תשרי א ,בתשרי א, and תשרי בא, but not בתשרי בא.

Indeed, we did not use the form בא בתשרי in our list of dates. We were made aware of this by your comments, as well as by those of one other person. To our sorrow, we are unable to ask the linguist Yaakov Orbach, of blessed memory, why he did not include this form in his recommendation. However, in order to remove any suspicion, we hereby declare that the list of dates was prepared by Yaakov Orbach, exactly as stated in the first preprint, <u>before</u> the experiment had been carried out on the first list. We used the exact same forms of the dates with regard to the second list.

If anyone still suspects that some hidden motive lay behind the omission of the form בא בתשרי, in order to improve our results, we invite him to consider -- as we did when we first heard this criticism from Dr. Dror Bar-Natan -- what would have happened had we included the form בא בתשרי. Recall that the <u>only</u> measures of success which were used regarding both the first and second lists, as was stated in the first preprint (the "White Preprint") , the second preprint (the "Blue Preprint"), as well as in the preprint which was originally sent to PNAS, were the over all probability measures: P_1 and P_2. The randomization test of Professor Diaconis was suggested at a later stage.

(i) The results which were calculated for the first sample were:

$P_1 = 0.000000001334$ and $P_2 = 0.00000000145$.

If we had used the form בא בתשרי as well, the results would have been:

$P'_1 = 0.000000000349$ and $P'_2 = 0.00000000207$.

In other words, the best result would have improved by a factor of 3.8.

(ii) The results which were calculated for the second sample were:

$P_1 = 0.0000000331$ and $P_2 = 0.00000000201$.

If we had used the form בא בתשרי the results would have been:

$P'_1 = 0.00000000507$ and $P'_2 = 0.00000000171$.

In other words, the best result would have improved by a factor of 1.18.
Given this, it should be obvious that the forms of the dates were chosen a priori.

B. We were asked why we did not use other forms of indicating the date (for example: מרחשון in addition to חשון, אייר in addition to איר, כסליו in addition to כסלו, ר״ח אדר in addition to א אדר, ראש השנה in addition to א תשרי, and יא לתשרי). We will try to respond on behalf of the consultant who determined which forms of the date would be used, since he cannot respond.

(i) מרחשון -- We do not know why he chose not to use this form in addition to חשון. In any event, we have now checked this form as well, and we found that had we used מרחשון, the results would not have changed at all.

(ii) כסליו ,אייר -- According to the linguistic guidelines which were established (see above 1 F), אייר and כסלו are the correct spellings, so this is what we used.

(iii) יא לתשרי -- This is a nonstandard form of referring to a date. For example, both Margalioth's encyclopedia, as well as the Encyclopedia Hebraica use the forms we used, and not this form. It is clear that the forms we used are the most widely used forms. We conducted a survey regarding the use of the various forms, using the computerized responsa database of Bar Ilan University. Here are the results for a pool of modern Halachic authorities:
We will categorize the forms as follows:

Form 1-- א תשרי & בא תשרי
Form 2-- א בתשרי   & בא בתשרי
Form 3-- א לתשרי   & בא לתשרי

Formation	1	2	3
תשרי	178	51	2
חשון	364	130	1
כסלו	409	90	0
טבת	375	108	0
שבט	434	190	4
אדר	582	159	6
ניסן	303	126	0
אייר	359	82	0
סיון	319	86	0
תמוז	419	181	2
אב	68	263	0
אלול	286	86	0

(iv) Concerning ר״ח אדר and ראש השנה -- we simply cannot comprehend what was wrong with our use of the standard and accepted forms, in which most of the dates in the encyclopedia are written, rather than forms which are exceptional. It seems more than likely that had we used every possible form, critics would have asked why we did not use the standard forms.

5.A. We were asked why we listed the day of death of the Vilna Gaon as the 19th of Tishri, when it is known that he passed away on the third day of Chol Hamoed Sukkot. The answer is simple: Outside of Israel every major Festival (Yom Tov) is two days, so that in Vilna the third day of Chol Hamoed was the 19th of Tishri.

B. We were asked where we found a birth date for the Ba'al Shem Tov. This date can be found, for example, in the lexicon HaHassidut, by Yitzhak Alfasi, published by Sifriat Maariv.

C. We were asked why we included R. Aharon of Karlin, R. Yehudah Ayash, and R. Yehosef Ha-Nagid in the second list, despite the fact that their entries in Margalioth's encyclopedia are, in the opinion of the inquirers, less than a column and a half. Similarly, we were asked why R. Meir Eisenstat was not included in the second list, despite the fact that his entry is, in their opinion, exactly a column and a half. We were also asked why R. David Ganz was included in the first list rather than the second, despite the fact that in their opinion his entry is just short of three columns.

The answer is simple: The inquirers measured the size of the entry by counting lines. On the other hand, when Doron selected the 34 personalities, he did so (as best as he can recall) by a visual estimate. This is how he selected the 32 personalities of the second list, as well. As it turns out, it was an error in judgement to rely on a visual estimate, and the measure used by the inquirers is a better one.

If anyone suspects that this was done in order to improve the results through manipulation, let them examine the results of the following experiment, which we carried out as soon as we were made aware of this complaint:

(i) We recalculated the results of the first sample omitting R. David Ganz. Let us compare:

The results we originally received were:

$P_1 = 0.000000001334$ and $P_2 = 0.00000000145$.

If we recalculate, omitting R. David Ganz we receive:

$P'_1 = 0.00000001336$ and $P'_2 = 0.00000000276$.

In other words, the best result became worse by a factor of 2.07.

 (ii) We recalculated the second sample, omitting R. Aharon Karlin, R. Yehudah Ayash and R. Yehosef Ha-Nagid, and adding in R. David Ganz and R. Meir Eisenstat (the names and appellations which were used to refer to him were delivered to us by Professor Havlin on the Dec. 22, '96. They are: "פנים , מהר״ם א״ש, מאיר איזנשטאט, מאיר איזנשטט, איזנשטאט, איזנשטט ,איזנשטט ,רבי מאיר מאירות,"פנים מאירות״ בעל"). For the sake of comparison, here again are the results of the second sample:

$P_1 = 0.0000000331$ and $P_2 = 0.00000000201$

If one recalculates, incorporating the changes mentioned above, we receive:

$P'_1 = 0.00000000422$ and $P'_2 = 0.00000000129$.

In other words, the best result improved by a factor of 1.56.

To summarize, one can clearly see that the results we would have received would have been of the same order of magnitude.

Sincerely yours,

Doron Witztum
Eliyahu Rips

Epilogue

Prof. Maya Bar Hillel raised some criticisms of our work at a conference which took place in Jan. '97 at Zarka Ma'in. Prof. Aumann also participated in this conference. Before leaving for the conference, he asked Doron Witztum to re-run the experiment, taking into account the last point in our reply above (i.e. which Sages should be included in the list based the number of columns in the encyclopedia).

Prof. Aumann said that since the second list was the one actually used in the formal test on which he and Diaconis agreed, and that was eventually published in Statistical Science, it would be of some interest to ask how the use of the correct list would affect the true significance level (that given by the permutation test). That is, quite apart from the question of cheating, which is not indicated by this mistake, the question arises: in view of this mistake, do the results in fact remain valid?

In the short time before Prof. Aumann left for the conference, Doron managed to run this experiment with ten million permutations. The results do remain valid. In fact, the best statistic, P_4, which scored 4 out of a million in the original experiment, **now became 1 out of ten million.** (At a later time, when Doron had time to further test the list with one hundred million permutations, the value of P_4 was 19 out of one hundred million.)