

*THE BOOK OF ISAIAH : CHARACTERIZATION OF AUTHORS BY
MORPHOLOGICAL DATA PROCESSING **

1. INTRODUCTORY - On computational Stylistics

The term "computational stylistics" as such, hardly needs any explanation : it refers to the branch of computational linguistics that is primarily concerned with the styles of various texts. Formal, i.e., mathematical and statistical stylistic hypotheses are set up which then are tested by automatic data processing.

The stylistic characterization of a literary work can be of intrinsic interest (1) but over and above all that, the following three further purposes are served by it :

- a.- The stylistic characterization of a given family of texts may help the esthetician and literary critic to a better understanding of the literary devices used, by enabling them to understand the link between certain linguistic devices and the esthetic effects they manage to produce, just as the linguist accounts for our linguistic intuitions and the logician accounts for our logical intuitions, so the esthetician has to account for the esthetic intuitions of the readers of literary works. The findings presented here are a case in point.

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b.- Stylistic theories may help psycho-linguists to formulate theories on linguistic performance (2). It is the linguists who set up hypotheses regarding the linguistic competence of the speakers of natural languages. They concern themselves with such questions as

- (1) Whether the phrase "the meat smells good" is grammatical ?
- (2) What are the various syntactical structures of the phrase "The Provisional State Council" ?
- (3) What is the meaning of the word "to grill" ? and
- (4) What are the various functions (3) of the phrase "tell it to the marines (to grandma, in Hebrew)" ?

On the other hand, these linguists have little interest in such questions as

- (1') Why does a given writer use such phrases as "the meat smells good" where others would say "the meat gives off a good smell" ?
- (2') What does the ordinary English speaker understand by the expression "The Provisional State Council" - that the council or the state is provisional ?
- (3') Does the word "to grill" remind the English speakers of the word "grill" ? and
- (4') How did the phrase "tell it to the marines" come to be an expression of disbelief ?

Of course the linguist is also interested in general questions about a given language or in still more general questions about a family of languages and even about the family of all natural languages, but all

these questions focus on linguistic competence. The psycho-linguists also use linguistic theories regarding linguistic competence, but their purpose is to formulate theories in the field of linguistic performance - the manner in which the speaker of the natural language uses his linguistic competence. They will try to answer question (2') with the aid of the answers that linguistic theories provide to question (2). The answer to question (2') will thus not be given in whole by the answer to question (2) for the psycho-linguist will supplement the linguistic theory with psychological interpretation mechanisms of the speaker concerned. By combining the psychological with the linguistic information he may thus arrive at a full answer to question (2'). Here the stylistic theories come in. Linguistic information on the phrase "the meat smells good" together with information on the systems of preference of phrases of a certain kind over similar other phrases, coupled with suitable psychological information, may give an answer to question (1'). Thus the stylistic theories provide observational information and theoretical insights on linguistic performance.

- c.- The third area where stylistic theories may play a major role is that of historical research. There are many texts whose origin has not been fully established. For instance, the identity of the author of Shakespeare's works is in dispute. The authorship of some of the famous Federalist papers (4) were in doubt. There are differences of opinion about the single authorship of Plato's letters (5), and so on and so forth. This is the field dealt with here.

II. LE STYLE C'EST L'HOMME

Let us approach this old adage that the style is the man in all seriousness, assuming that the word "style" is here used as a linguistic term and the word "man" as a psychological term. The saying would then be paraphrased to mean that the personality traits of every person are reflected in their entirety in the style of his speech or writing. This is a proposition to be dealt with jointly by linguists and psychologists within their psycholinguistic theories. The general discussion of this proposition does not interest us here (6). We shall confine ourselves to one simple example that may illustrate its validity.

At the Scientific Centre of IBM in Grenoble (France) the TV speeches and interviews of General de Gaulle during his first period in office as president of France (1958-1965) were examined (7). The results were hardly surprising in that they corresponded to his image, i.e. to the general view prevailing about his personality. There are some 62,000 words in these texts (8). The most frequent word was "France" which recurred 756 times. The word "nous"(we) appeared 721 times and the word "je" (I) - 477 times. For the sake of comparison let us note the proportions in which each of these words appeared in these speeches and in other texts :

Table I (9)

	Hamilton	Madison	Jay	James Joyce	Balgour	De Gaulle
We	0.3	0.119	0.186	0.16	0.07	1.1
I	0.164	0.077	0.13	1.02	0.37	0.77

The close relationship between a person's style of writing and speaking and his personality warrants the assumption that every person's style has certain constant elements that characterize its author. This is the fundamental assumption underlying all attempts to identify the author or the authors of a text or its stylistic characterization, and as such may need some further clarification.

While there are considerable differences between the identification of a person by his fingerprints or by the style of his writings, there also are certain similarities between the two. A person cannot easily change his fingerprints. He can cover his fingers or scar their tips but cannot simply change their prints. Similarly a person cannot easily change the elements that characterize his style of writing. He can hide them by writing everything twice - first formulating his thoughts with his usual stylistic spontaneity and then making a stylistic revision of the first spontaneous version. By thus reformulating his writings he can hide some of his natural inclinations but not all; he cannot disguise all the characteristics of his style of writing. If the revision and editing are also carried out with stylistic spontaneity then the finished product will again reflect the writer's natural tendencies. The same applies if the editing is done with partial stylistic spontaneity. If it is done without any stylistic spontaneity, it may be done either at random or deliberately. In our case the possibility of random editing need not be considered, as the proportion of random changes that have been made in the texts that interest us is presumably so small as to be safely ignored. We are left with deliberate stylistic editing. By this means the typical features of the author's style can be hidden only if the stylistic editor is fully aware of them. In other words, the style of an author can be changed so as to become unrecognizable only on the basis of a perfect,

fully elaborated theory which describes and explains all the characteristics of that style. We have no such theory, and in fact a theory that comprises all and every characteristic is hardly conceivable (10).

In speaking about the elements characterizing the style of writing of a given person we mean that if various measurements are performed on his works a certain regularity is discovered : the author obeys certain laws of style. The nature of the stylistic laws will become clear from the following example. Louis Milic has examined (11) eight works of Swift and two each of Macaulay, Addison, Gibbon and Johnson, for the most frequent occurring combinations of three parts of speech - preposition - definite article - noun (e.g. "of the man") or finite verb - preposition - definite article (e.g. "went to the") and the like. Eighteen such combinations comprised the ten most frequent combinations of each of the sixteen works examined. Among these Milic distinguished between those combinations which contained a verb and those which did not, and measured the relative frequencies of both categories.

The results for combinations not including a verb are :

Table II (12)

Work	Combinations without a verb, per cent	Work	Combinations without a verb, per cent
Swift 1	23.4	Macaulay 2	28.1
Swift 2	22.9	Addison 1	27.0
Swift 3	23.3	Addison 2	26.5
Swift 4	23.4	Gibbon 1	36.5
Swift 5	23.0	Gibbon 2	41.7
Swift 6	23.1	Johnson 1	21.9
Macaulay 1	25.0	Johnson 2	22.2

The findings in the left hand column of Table II can be formulated in terms of a law that states the relationship between two variables : the number of words in Swift's works and the number of non-verbal combinations among the eighteen most frequent combinations in the works examined.

How, in terms of this law, shall we interpret the differences between one work of Swift and another ? We have several ways for doing so. The simplest explanation is that these differences can be ignored because none of them is greater than 0.5 per cent. But this is an over-simplification, as will be noted from the right-hand column of Table II, where we see that the difference between Gibbon 1 and Gibbon 2 is over 5 per cent.

The proper explanation for differences between the works of one and the same author must be sought in the problem of *relevant variables* (13). When we make measurements in order to find a law in physics, psychology or computational stylistics, we must from the outset determine not only which are the variables that are being measured but also which variables, whether measured or not, should be regarded as relevant and which may be considered to be irrelevant. For instance, in determining the relationship between the duration of the free fall of an object and the length of the path it describes, the two variables are measured several times, for different paths and durations. All these measurements must, however, be made at the same place because the location where the free fall takes place is a variable which is relevant to its velocity. The duration of the free fall of an object along a certain path on the North Pole will be different from the duration of the free fall of the same object along a parallel path on the equator. On the other hand, what colour hair the wife of the person who carries out the

measurements has, is not a relevant variable as far as the ratio examined is concerned. Similarly, on making stylistic measurements on the works of Swift and other writers we must first determine which are the relevant variables regarding the relationships we are about to examine, and which are not relevant to our purposes. The variations between different works of the same author are therefore related to the extent to which all the relevant variables not measured, have remained constant throughout. Clearly, they have not. The literary type of the works was not the same - some were poems, others were plays. Thus Macaulay 1 is a literary work while Macaulay 2 is a historical work. Among the other relevant variables that may have to be taken into consideration are the audience to which the author addressed himself, i.e. whether we are dealing with a book, a letter, a diary; the time of publication - in the author's youth, adulthood or old age - the language used and the contents of the work. Obviously a variable may change its status : a variable initially considered to be relevant may as a result of the various measurements turn out to be irrelevant, or conversely, a variable that initially was thought to be irrelevant may be found to be relevant.

The relevant variables cannot serve as a simple way out, to account for every discrepancy. In planning any measurements we determine in advance that certain variables are either relevant or irrelevant, but when we come to explaining certain results by means of this distinction the matter is not so simple. In order to be sure that a given variable is responsible for certain differences between any two works we must take appropriate measurements, one of the variables measured being that which is held responsible for these differences. For instance, in contending that the difference between the occurrence of a word in the works of the same author is due to the times of their composition, we must show the constant occurrence, of this word

in each period of the author's life in works of the same literary type, directed at an audience of the same size and type, and the like.

In the stylistic characterization of a whole family of works, one of the most relevant variables is the author of each of these works. Given two works, each of which was written by a different author, then even if both are of the same literary type, both are designed for the same type and size of audience, and both are written at the same period and so on, certain differences are still to be expected in view of the proposition that the style of an author's works reflects his personality, and the further assumption that each of the authors has a personality of his own. Conversely, when we do not know the identity of the author of a given work we compare the style of this anonymous work with that of other similar works of the same literary type, in the same language and from the same period (if the period is known, despite the anonymity of the work), the identity of whose authors is known. The closer style of the anonymous author resembles the style of works the identity of whose author is known, the more we shall tend to identify the author of the anonymous work with the known author of the remaining works. When the differences are found to be substantial, we shall tend to reject such an identification.

The identification of the author of an anonymous work is not always done solely on the basis of stylistic considerations. Sometimes we also have other information that enables us to reject or accept a given suggestion regarding his identity. The same applies to a whole family of works. The hypothesis that all the works in this family were written by the same author can be tested both by comparing their stylistic elements and by the use of non-

stylistic, historical or other evidence. Here the question arises how are the stylistic considerations integrated with all the other considerations : We shall assume that on the basis of all the non-stylistic considerations the hypothesis that all these works were written by the same author may be assigned the probability p . Different people are likely to estimate p in different ways. For instance, some people are likely to put greater evidence in the statement of a later author that all the works were written by the same author, than others who may cast doubt on his evidence and regard his statement as not very or not at all reliable without, however, rejecting it. Let us assume now that a certain person, after weighing all the non-stylistic evidence, has made an estimate of p . We are then interested in the quotient $p/(1-p)$ ($p \neq 0$, $p \neq 1$), the ratio between the probability that person, on the basis of the non-stylistic evidence in his possession, assigns to the hypothesis that the works were all written by the same author and the probability that he assigns, on the basis of the same non-stylistic evidence, to the hypothesis that all works were not all written by the same author. This ratio (14) is likely to change as a result of the stylistic examination of the all these works. On the basis of all the stylistic evidence in our possession let us say that we assign the probability q to the hypothesis of single authorship (again assuming that $q \neq 0$, $q \neq 1$), then the quotient $q/(1-q)$ is the ratio between the probability our man, on the basis of stylistic evidence, assigns to the hypothesis that all the works were written by the same person and the probability assigned on the basis of the same stylistic evidence to the contrary hypothesis. A rational person will take into account both the non-stylistic and the stylistic evidence. Accordingly the probability ratio of the different hypotheses will not be $p/(1-p)$ but $(p/1-p) \cdot (q/(1-q))$ and it is clear that when $q \neq 0.5$ then the new probability ratio, based on the evidence now in the possession of our imaginary person will be different from the previous probability

ratio, which was based solely on non-stylistic evidence. A rational person is thus likely to change his mind as a result of the stylistic evidence.

We still have to deal with the extreme cases where q is 0 or 1 or where p is either 0 or 1. Now, the possibility that q may be either 0 or 1 may be ignored since the stylistic measurements, which are statistical by nature, can never lead to such extreme conclusions. The eventuality of p being either 0 or 1 is not associated with extreme conclusions but rather with extreme assumptions. Whoever attaches the probability of 1 to the hypothesis that all the writings are the work of the same author thereby asserts that he is not willing to take into account the possibility of being presented with evidence that is likely to change his mind. The same applies to whoever attaches to this hypothesis a probability of 0 - he is simply unwilling to take into account the possibility of being presented with evidence that may change his mind that all the works were not written by the same author. Both adopt a dogmatic attitude and, being unwilling to change their views on a question of fact on the basis of factual evidence, they cannot be regarded as using rational methods.

III. The Book of Isaiah - The Problem and its Possible Solution

The problem of the Book of Isaiah can be stated in simple terms : was it all written by the same prophet or not ? It derives from the fact that the simple assumption that it was in fact written by one prophet raises numerous difficulties. For instance, although the title of the book states "The vision of Isaiah the son of Amoz, which he saw concerning Judah and

Jerusalem in the days of Uzziah, Jotham, Ahaz and Hezekiah, kings of Judah," i.e. in the times before the destruction of the Temple and the Babylonian exile, some of its verses seem to call for an alternative interpretation. A case in point is e.g. 64, 9-12 : "Behold, consider, we are all thy people. Thy holy cities have become a wilderness, Zion has become a wilderness, Jerusalem a desolation. Our holy and our beautiful house, where our fathers praised thee, has been burned by fire : and all our pleasant places have become ruins. Wilt thou restrain thyself at these things, O Lord ? Wilt thou keep silent and afflict us sorely ? " Another well known example is the mention of King Cyrus in 44, 28 "Who says of Cyrus, 'He is my shepherd, and shall fulfil all my purpose'; saying of Jerusalem 'She shall be built,' and of the Temple 'Your foundation shall be laid' ", although Cyrus lived some 150 years after the Kings of Judea mentioned at the outset of the book. I shall not weary the reader by listing all the difficulties that arise in this text and the various counter arguments that have been devised to explain them (15). For our purposes it is sufficient to know that the scholars are divided in their views as to the number of authors to which they attribute the prophecies. They may be roughly divided into those who uphold the authorship of a single prophet and those who maintain that the book was composed by several prophets. The latter are again subdivided according to the number of authors to which they attribute the book, ranging from two or three to six or more (16).

Most of the evidence either way is not stylistic in nature. In the examples we have cited the evidence is historical. Many other arguments relate to the theological ideology expounded by different portions of the book. Neither the historical nor the theological arguments can be regarded as

“pure” textual evidence but need external support - the historical ones from non-biblical historical sources and the theological ones from certain interpretations of the Scriptures. Only stylistic evidence is “purely” textual.

Some such evidence has already been presented. M.H. Segal, for instance, writes that ... “there is a considerable difference between the stylistic characteristics of the language of the second and first parts. In the second part the language is lyrical, expansive and flowing, full of softness, delicacy, pathos and enthusiasm, while the prophecies in the first part are distinguished by their elevated, lofty, vigorous and concise language” (17). It is clear that such an impressionistic description cannot serve as a stylistic characterization that can form the basis for a decision on the authorship of the book. What for instance, is the difference between a language that is full of pathos and a language that is elevated and lofty.

This study was designed to furnish accurate stylistic evidence on the authorship of the Book of Isaiah. As will be shown, our results tend to sway the balance in favour of the multiple authorship hypothesis (18).

Most of the stylistic tests performed concern the morphology of the verb. This aspect was chosen on the following grounds :

- a. One of the first tests made in the history of statistical stylistics was the examination of mean sentence length (19). To this day many investigators prefer this test, largely because of its simplicity. However, the verses into which the bible is divided are not equivalent to grammatical sentences.

The two verses - "If you are willing and obedient, you shall eat the good of the land; but if you refuse and rebel you shall be devoured by the sword; for the mouth of the Lord has spoken". (1, 19, 20) are one sentence. On the other hand, the two sentences "What more was there to do for my vineyard, that I have not done in it? When I looked for it to yield grapes, why did it yield wild grapes?" (5, 4) are one verse. Accordingly little stylistic value attaches to the length of the verse which hardly reflects the length of the sentence. A redivision of the book into sentences is of course conceivable, but this is hardly a realistic possibility as the linguistic intuitions of whoever performs such redivision would become confused with the author's linguistic intuitions. It was therefore decided that sentence or verse length should not be the main subject of examination, and that results relating to the length of the verse should be interpreted solely on the basis of other, better-founded data.

- b. Syntactical tests are another well accepted method (20). For instance, an examination was made of the distances between adjectives in several works of Jane Austen, George Eliot and Virginia Woolf (21). It was found, for instance, that the proportion of adjectives separated by one word is 6 per cent in certain writings of Austen and Eliot but 9 in a given work of Virginia Woolf.

To my mind these are "superficial" findings in the sense that they appertain only to that small part of the iceberg that is visible and not submerged.

The place of adjectives in the sentence reflects the use of certain linguistic rules - certain derivation rules and above all certain stylistic transformations (22). Stylistic explanations are connected with the preferential use

of certain derivation rules and certain transformations over other derivation rules and transformations. This is only indirectly connected with where the author chooses to put the adjectives, the site of which is primarily determined by the derivation and the transformations used, without his having any direct preferences regarding the site of the adjectives in his sentences.

Little stylistic importance was therefore attached to syntactical findings not connected with the derivation rules and transformations but having to do solely with the sequence in which the various parts of speech appear in the sentence. We consequently refrained from such superficial syntactical examinations.

- c. The prevailing tendency to examine the characteristics of sentences - their length, syntax etc. - has to no small extent been determined by the nature of the languages in which the works examined were written. In English, for instance, when structural aspects of linguistic units are being examined, the stylistic investigator cannot deal with single words but only with phrases or whole sentences, as the single word in English is much less structured than in German or in Hebrew.

I see no reason to adopt the tendencies of investigators who are limited by certain facts inherent in the structure of the English language when these limitations do not apply to Hebrew.

Among Hebrew words the verbs have the richest structure and that is why they were chosen for our stylistic examinations. To obviate the need for complex semantic decisions about the meaning of the text not relating to

its morphological analysis we have omitted from the class of verbs examined all those which appear in the present participle form. We also did not examine the verbs in the prose sections of the book (as e.g. the entire chapters 38-39) because the stylistic elements of the prophetic writings of any single author may from the start be different from those of a piece of prose written by the same author.

We did not base ourselves on the accepted division of the Book of Isaiah by chapters, since this is known not to be authentic; it was apparently made by the theologian Stephen Langton, the Archbishop of Canterbury at the beginning of the 13th century. For our purposes we redivided the book into 29 units in such a way that the context should be neither mixed nor disrupted, and such that each unit is long enough to be statistically, significantly measurable. A list of the units is given in Appendix 1 (23). Our examination related not only to these units separately but also to groups of several units, as described below. In a sense, we take for granted the given *order* of elements in our text, but not its division into larger units. This is so, because basically we are interested in putting to the stylistic tests some well-known hypotheses concerning the structure of the book. Hence in this paper we shall not discuss the methods for obtaining optimal subdivisions of the text which involve *complicated* rearrangements. It might be argued that our redivision may skew some statistical analysis, but then every division which is not authentic does, and it seems reasonable to prefer a context sensitive division over an arbitrary or defected one.

IV. The data processing

1.- Editing

A separate punched card was assigned to each verb (24) on which the word itself, its exact reference, a full morphological characterization and surface syntactical information were recorded. The morphological information included (notation of) the prefix, the root, the person, the gender, the number, the conjugation and the tense (25), and in case of pronominal suffix - the gender, person and number of this pronoun. The total surface syntactical information comprises of the place of the verb in the verse, its place among the verbs in the verse and the parts of speech of the adjacent words. The entire information was recorded on appropriate forms which were then punched, checked and proofread.

For the sake of comparison the verbs of the books of Micha and Hosea were similarly prepared.

2.- Homogeneity tests - first statistical processing

To be able to adduce evidence in support of the hypothesis that Isaiah was written entirely by one prophet, we must be able to demonstrate the stylistic homogeneity of the work. In other words, we must prove that there are no statistically significant stylistic differences between the various parts of the work. In order to produce evidence corroborating the contrary hypothesis, that Isaiah is the work of several authors, we must demonstrate that there are statistically significant differences in some of the stylistic elements of the various parts of the book which cannot be accounted for by variations

in the contents of the prophecies, in the audience to which they were addressed and the like. We therefore set out by examining all the morphological information available, and testing each item included in our morphological analysis for the existence of statistically significant differences between the various parts of the work.

In Appendix 2, typical examples from the dozens of tables obtained in this first processing stage are given. Here we present the information obtained at this stage about the distribution of the verbs by conjugation in the various units of Isaiah (Tables 1-4 in App. 2). Table 1 gives the distribution in absolute figures, the first line showing the distribution in the work as a whole and each of the subsequent lines referring to one of its units. Table 2 shows the same distribution in percentages. Table 3, instead of showing the distribution of the conjugations by units shows the distribution of the units by conjugations. The most interesting table for our purposes is N° 4, where the point correlation is given for each conjugation and each unit. A positive correlation for a given unit and conjugation means that that unit contains more verbs of this conjugation than appear on the average in the rest of the book. A negative correlation means that verbs of this conjugation occur in this unit less than the average elsewhere. The asterisks in this table denote the statistical significance level of the correlation. When there is no asterisk, then the deviation from the mean for that unit and conjugation is of no statistical significance. One asterisk denotes a significant deviation at a certain level and two asterisks - a significant deviation at a higher level (26).

From Table 4 of Appendix 2 we accordingly see that the distribution of the verbs by conjugation is not homogeneous but that the deviations are not very great. The most striking deviations are in "pu'al" but as there are only 48 such instances in the entire work no decisive conclusions can be drawn

from this. Every statistically significant deviation in this Table does indeed call for some explanation, but in their entirety the deviations most of which are statistically insignificant, do not point to any distinct trends in any unit of the book.

Yet not all the tables we obtained showed such homogeneous results; quite the contrary. In Appendix 3 other aspects of the morphological analysis of the verbs in the Book of Isaiah are presented - again in four tables, as in Appendix 2. From this a different picture emerges. Firstly, in all the columns of Table 4 in Appendix 3 about two thirds of the data are statistically significant, and in some of them - more than two thirds. Secondly, the statistically significant deviations clearly tend in a given direction - in the first part of the work (chapters 1-37, units A to M) usually in the opposite direction to that of the second part (chapters 40-55, units N to W), while the deviations in the third part (chapters 56-66, sections X-C₁) seem to have no constant direction.

3.- Homogeneity test of the various sections - second statistical processing

To be able to confirm the hypothesis that the Book of Isaiah was composed by several authors it is not enough to show that there are statistically significant differences between the different parts of the work : to corroborate the assumption that the first part was written by one prophet and the second part by another we must demonstrate that each of these parts is stylistically homogeneous, or in other words, that the differences within each of these parts are not statistically significant.

We therefore repeated the tests performed previously on each unit, and for the work as a whole, this time carrying them out separately for each part. The results for some of the elements are shown in Appendix 4. Though various stylistic elements were tested special importance was attached to two of them : the use of the pronominal suffix and of the past-to-future *waw* conversive (27), because here the author seem to have a free choice. It is his direct preference whether he uses the pronominal suffix or a separate pronoun, the matter being one of style alone. Again, the author seems to be free to choose between the simple future and the future formed by the use of the conversive prefix, for here, too, the decision is purely a matter of style.

The results of these tests show that the first and the second parts of the work are fairly homogeneous (28). Statistically significant deviations were found mainly in the elements of the three central columns which are highly sensitive to contents. It can be definitely stated that the differences in the first part and in the second part, taking each part separately, are significantly smaller than in the work as a whole. These findings therefore tend to support the hypothesis that the first and the second parts were not written by the same author, rather than the contrary hypothesis of single authorship.

In Appendix 5 some similar finding about other stylistic elements are presented, which while in themselves not highly significant are given added importance by their consistency with the previous results.

4.- *Evaluation of Stylistic Heterogeneity*

The stylistic heterogeneity of the Book of Isaiah is best evaluated by comparing the stylistic elements in which significant differences were found between the various parts of the book with the same elements in other Biblical works. For the purposes of this comparison we chose the prophecies of Hosea and Micha, in order as far as possible to eliminate the time factor (29), all three works ostensibly dating from the same period. Some of our findings about Micha and Hosea are presented in Appendix 6. A comparison between them and the corresponding findings for the various parts of Isaiah is highly informative. The results of this comparison for some of the findings are summed up below :

Table III

	Isaiah Part I	Isaiah Part II	Micha	Hosea
Percentage of verbs without pronominal suffix	94.5	87.3	93.2	88.0
Percentage of verbs without past-future Waw conversive	68.0	79.5	72.5	72.6

What are the inferences to be drawn from this brief comparison ? First of all, regarding the preference given to the pronominal suffix, the first part of Isaiah is closer in style to Micha than to the second part of Isaiah. In the same respect the second part of Isaiah is closer to Hosea than to the first part. Secondly, as regards the preference given to the Waw conversive, the first and the second parts of Isaiah are each closer to Micha and Hosea than they are to each other.

Two points should be noted in this context : the second part of the table

shows a surprising similarity between Micha and Hosea in the preference they give to the use of verbs without that conversive prefix. Even so close a resemblance, as between 72.5 and 72.6 per cent, still does not, however, prove conclusively that Hosea and Micha were composed by the same author. For such a hypothesis to be confirmed it is necessary to demonstrate the same similarity for a large number of stylistic elements. From the first part of Table III it is evident that this is impossible since in respect of the pronominal suffixes the divergence between the two works is considerable, supporting the hypothesis that they were written by two authors, much more so than the previous finding tended in favour of the opposite hypothesis.

According to the first part of Table III, Hosea is closer in style to the second than to the first part of Isaiah. According to the second part of the same table, however, it is closer in style to the first than to the second part of Isaiah. Are these findings contradictory (30) ? The answer to this question is : no. The sense of contradiction arises from the fact that we used the loose term "style" instead of the more precise term "stylistic element" in making our comparisons.

While in one stylistic element the style of Hosea is closer to the first than to the second part of Isaiah, in another stylistic element it is closer to the second than to the first part. Independent stylistic elements may indicate different behavioural trends, and I see no reason to assume that the elements presented in Table III are interdependent. Hence there is no contradiction in our findings.

In conclusion we would like to mention some other instructive comparisons, where the books of Jeremiah, Ezekiel and Job were used as control texts.

The Book of Jeremiah includes more than 3,300 verbs and is divided naturally into three parts : the prophetic chapters 1-25 and 46-51 and the prose chapters 26-45. The percentage of verbs with pronominal suffix is 9.8 in chs. 1-25, 16.3 in chs. 26-45, and 7.1 in chs. 46-51. While the difference between the second figure and the other two is indeed explained by the difference in literary type, the numbers 7.1 and 9.8 show to what extent does this stylistic characteristic vary among works which are supposed to be written by one and the same author.

A similar examination of the Book of Ezekiel reveals the same results. All the prophetic parts of the book have about the same percentage of verbs with pronominal suffix : 7.9 (chs. 1-12), 7.2 (chs. 13-21), 7.4 (chs. 22-29) and 8.2 (chs. 30-39). Again, the percentage of these verbs in the prose part (chs. 40-48) is 11.1. The book includes more than 3,300 verbs.

A slightly more complicated analysis of the Book of Job shows the same results.

All the apparent disparities in percentage of verbs of a certain kind should be explained in terms of type, time, content and so on. (We do not consider random variation as an adequate explanation of any result of significance). The point we are stressing here is that this differences, which deserve explanation, are all much smaller than those found between the two parts of the Book of Isaiah.

So far all the calculations and tabulations were made with the aid of an IBM 360/20 computer.

5.- *Testing of stylistic hypotheses - further data processing*

Since the style of Isaiah was found to be non-homogeneous, it seemed worthwhile to test various hypotheses regarding the stylistic composition of the work. The formulation of such hypotheses is the task of the philologist and Bible scholar. In the following we shall try to assist them in testing their hypotheses. Obviously the methods by which this is done are not peculiar to Isaiah but apply equally well to stylistic hypotheses formulated in respect of any other text. How are hypotheses of this kind formulated and tested ?

The motive for a hypothesis regarding the style of a given work or family of works being conceived of in the first place may be furnished by the historical information available about the identity of the authors, the conclusions arrived at from analysing the ideas contained in the work, stylistic intuitions and the like. The hypothesis is tested by its first being reformulated in stylistic terms and possible inferences being drawn from this formulation. Let us try to illustrate this process by means of an imaginary example.

Let us assume that a certain scholar has reasons for putting forward the hypothesis that units B, C and D were written by one author and units O, P and Q by another. To test the stylistic significance of this hypothesis we shall ask him which are the stylistic elements to which he attaches a priori importance. Let us say that what he considers important is the percentage of verbs with the connective, the percentage of verbs in the first person singular, masculine, in the second person singular feminine, in the infinitive, without pronominal suffixes, and the like. From our tables we then extract all these stylistic data in respect of each of the six units B, C, D, O, P, Q. In Appendix 7, Table 1 each of these units is presented within the "stylistic space" determined by our imaginary scholar (31). The first piece of information we shall present

him with is a table of "distances" (Appendix 7, table 2), showing the distances that separate each of the units of the work from all the remaining units, within the stylistic space chosen. From this table he may infer, for instance that units A to M are closer to unit B than are units N to W. In other words, with respect to those stylistic elements he chose to deal with, unit B resembles units A to M more closely than it resembles units N to W. With the aid of the table this similarity can be actually measured in quantitative terms. Another conclusion that may be drawn from this table is that unit C is closer to unit B than are units N to W, but less so than units D to M. So far no direct reference has been made to the stylistic hypothesis itself - the division into two basic groups (1) B, C, D and (2) O, P, Q but the additional information we shall put at the scholar's disposal impinges directly upon his hypothesis. We shall then examine the discriminatory effect of each of the stylistic elements chosen, that is, we determine to what extent the two sets of units are set apart by it. A stylistic element is considered to be highly discriminatory if it satisfies the following two conditions :

- a) its values within each set of units are more or less constant;
- b) its mean value in one set of units shows an appreciable difference from its mean value in the other set of units.

These are the criteria according to which the discriminatory effect of each of the stylistic elements was calculated, using an appropriate formula (32).

To each unit of the work we now assign a figure which is a weighted sum of the values obtained for the stylistic elements in that unit. The weight assigned to each stylistic element is its discriminatory effect (33). In

Appendix 7, Table 3 the numerical values obtained for each of the units (by the so-called "regression function") are presented. Clearly these values reflect the position of each unit from the point of view of the original hypothesis, because the weight accorded to a stylistic element chosen is the discriminatory effect of this element as regards the two sets of units referred to in the hypothesis.

From this table some interesting conclusions may be drawn. The numerical values obviously fall into two groups - one positive and one negative. Apart from unit A all the remaining units up to M, i.e. all the units in the first part of Isaiah, have positive values. On the other hand all the units from unit N down to unit W, that is, all the chapters of Isaiah from 40 to 58 have negative values, while all the remaining units constitute a non-homogeneous group with some having positive and others having negative values.

The most interesting finding relates to unit A. Although its value is negative, its absolute value (2.54) is lower than that of any of the other units so that in this respect it lies midway between the positive and the negative value groups. The scholar who put forward this hypothesis will now examine the stylistic conclusions thus obtained at the hand of the non-stylistic information in his possession. If he has no such information he must accept the stylistic conclusions as they are. If his extraneous information agrees with the stylistic conclusions he will accept them as further strong confirmation of his hypothesis. If his non-stylistic information conflicts with the stylistic findings, then either this information or his original hypothesis is suspect. In Appendices 8 and 9 similar tests are presented according to the same pattern for other, alternative hypotheses.

So far we have helped the scholar to derive stylistic inferences from his

original hypothesis, but it is still conceivable that he may have difficulties in deciding between one hypothesis and another, when the two are not too far removed from each other. From Table 3 in Appendix 7, for instance, it is difficult to decide whether unit A belongs to that portion of the work that also includes units B, C, D or whether it had be ascribed to the other part that contains units O, P and Q. In order to enable the scholar to answer questions of this kind, two further programmes are put at his disposal. Each of these programmes, according to principles of its own, divides the sections into a number of groups - from two to five, as desired. Here is a brief description of these two programmes.

In the first programme we start off with a given division into two groups each composed of various units. We now compute the centre ("of gravity" (34)) of each of the two groups and redistribute all the units according to their distance from this centre of gravity. We accordingly again obtain two groups. The process is repeated by computing the centre of gravity of each of the new groups and dividing their units according to their distance from the two new centre of gravity. This is continued until the process degenerates - that is, until the redistribution obtained coincides exactly with the previous distribution. This is an extremely rapid programme and no more than five to six iterations were needed to arrive at the final distribution.

This distribution process is fully represented in Appendix 10, starting from the given two groups and ending with the final distribution.

The programme itself is somewhat more sophisticated. The starting point need not necessarily consist of two groups, but three four or five may also be used. Each of the units may, moreover, be weighted by the number of verbs it contains, so that data from bigger units will have some priority, in a certain sense,

over the data from the smaller units. The programme also performs statistical computations which make it possible to calculate the probability of a given unit being written by the same author who composed the units in one of the sets given at the outset (35).

To some extent this is a static programme, for the scholar is as a rule not interested in the intermediate stages of the process, but only in the sets he starts off with and the final redistribution of the sections. In this respect the second programme is more dynamic and is designed for those scholars who are not interested solely in the initial and the final stages but also in the various intermediate phases (36).

This is an "iterative annexation" programme. In the first stage two units are marked off on the basis of some evidence we may have or with a view to testing a given hypothesis (37). These are used as foci (points of reference) for the groups consisting of assembled units. In the second stage each of these foci tries to annex to itself other units in its vicinity. In the subsequent stage each of the units so annexed in turn becomes a focus for further annexations. When two units belonging to different groups try to annex the same unit, certain means are computed to decide between the two. Gradually a group of units is formed around each of the initial foci. The various annexation stages may thus be observed, showing the internal relationships in each of the groups that are being formed.

Appendix 11 shows an abbreviated outline of two annexation processes of this type. The second column from the left shows the stage where a unit has been annexed to the group. The unit marked 0 obviously represents one of the initial foci. The next three columns provide information on the nature of the annexations taking place at each stage of the process. The

first of these three columns shows the total number of units in the vicinity of the unit referred to in that line of the table. The second column shows how many of these units were still free at this stage, not having been annexed to any of the groups in the foregoing stages of the process. The third column indicates how many of the units in the vicinity of the unit in question already belonged to the other group. The second column from the right indicates the unit which annexed the unit referred to in that line. The right-hand column gives the value of the regression function mentioned above.

By means of all these programmes dozens of hypotheses were tested and we shall be glad to put the results at the disposal of whoever may be interested. All the programmes described in this section were specially written for the purposes of this study. The language used was Fortran IV, and the programmes were run on IBM 360/40 and IBM 360/50 computers.

V. *CONCLUSIONS*

- a) Detailed statistical examination has shown that the Book of Isaiah is not a stylistically homogeneous work. On the basis of certain stylistic elements it may be divided into three parts :

(1) chapters 1-37, (2) chapters 40-55, and (3) chapters 56-66 (38). Each of the first two parts are stylistically more homogeneous - as regards the elements examined - than the work as a whole.

The third part is not stylistically homogeneous, with some units showing the stylistic characteristics of the first part and other leaning towards the second part.

- b) By processing morphological data by statistical methods and pattern recognition techniques it is possible to characterize the internal stylistic structure of each part of the work under consideration so as to reveal some slight stylistic divergences that may require explanation.

Acknowledgements

It is my pleasant duty to express my profound gratitude to all those who have helped me engage in this work and carry it to its conclusion.

I am much indebted to the Research Committee of Bar-Ilan University for financing this study, and particularly to Professors M.Z. Kaddari and A.S. Fraenkel.

The tiresome work of preparing the information about all the verbs in the Books of Isaiah, Micha and Hosea was undertaken by Mr. Rimmon Kasher of the Department of Biblical Studies at Bar-Ilan University. The numerous statistical calculations were carried out by Mr. Benjamin Sherf of M.L.L. Co. Ltd., Tel Aviv. The programmes for the testing of stylistic hypotheses were written by Miss Haya Sonderfen of M.A. Co. Ltd., Ramat Gan. My sincere thanks go out to all three of them.

I am also indebted to the readers of this paper for some helpful comments.

Finally I wish to mention my dear father, the late Shimeon Kasher, who gave me much encouragement in my work but unfortunately did not live to witness its outcome.

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FOOTNOTES

- (1) See R.W. BAILEY and L. DOLEŽEL, *An annotated bibliography of statistical stylistics*, The University of Michigan, Ann Arbor, 1968, sections 2 and 4 and L. DOLEŽEL and R.W. BAILEY (eds.) *Statistics and style*, American Elsevier, New York, 1969, sections II, III and V; cf. also our note 33.
- (2) Regarding the distinction between linguistic competence and performance, see N. CHOMSKY, *Aspects of the theory of syntax*, MIT Press, Cambridge, Mass. 1965, pp. 10-15, 25.
- (3) For a detailed elaboration of the need for a linguistic examination of the function of sentences, apart from their syntactical and semantical structure, see ch. III of my work *On the logical status of context dependent sentences* (The Hebrew University of Jerusalem, 1969).
- (4) See F. MOSTELLER and D.L. WALLACE, *Inference and disputed authorship : The Federalist*, Addison-Wesley Reading, Mass. 1964, ch. 1 and ch. 9.
- (5) See M. LEVISON, A.Q. MORTON and A.D. WINSPEAR, The seventh letter of Plato, *Mind* N.S. N° 307, July, 1968, pp. 309-325, and L. BRANDWOOD, *Plato's Seventh Letter*, in *Revue Internationale Organization for ancient Languages Analysis by Computer*, 1969, n° 4, pp. 1-25.

- (6) See G.A. MILLER, *Language and Communication*, McGraw Hill, New York 1951, 3rd ed. 1963, pp. 119-139, esp. 131. cf. also L.T. MILIC *A quantitative approach to the style of Jonathan Swift*, Mouton, The Hague, 1967, pp. 76-77, 80, 154.
- (7) J. COTTERET and R. MOREAU, *Le vocabulaire du Général de Gaulle*, Armand Colin, Paris, 1969.
- (8) What is meant are word occurrences ("tokens") - the number of "lexical entries" de Gaulle used was about 4,000 and the number of "types" - about 6,000.
- (9) The data of this Table are taken from the following sources : Table 1-8.1 (pp. 243-248) of the book cited under note 4 - for *Hamilton* (48 of his Federalist papers), *Madison* (50 of his Federalist papers) *Jay* (3 of his Federalist papers) and *James Joyce* (Ulysses); *The basic word list for elementary schools* (Hebrew), ed. by R. BALGOUR, Otzar HAMOREH, Ramat-Gan, Israel, 1968 for *Balgour*. Considering the table one has indeed to take into account the fact that the first three works are of a different literary type than the rest, and the fact that Hebrew has 1st person verb inflections.
- (10) That no such theory is possible requires further justification according to the principles of the methodology and philosophy of science but this does not seem to be the proper context for such an elaboration.
- (11) See MILIC, *ibid.*, pp. 204-225.
- (12) According to MILIC, *ibid.*, p. 225.

- (13) See R. CARNAP, *Philosophical foundations of physics* (An introduction to the philosophy of science), Basic Books, New York 1966, pp. 42-47.
- (14) See MOSTELLER and WALLACE, *Ibid.*, pp. 52-56.
- (15) See O. EISSFELDT, *The Old Testament*, translated from the 3rd German edition (1964), Oxford 1965, pp. 303-346.
- (16) Among those who divide Isaiah into more than three sections some divide the first part (caps. 1-39) into several parts while others divide the second part (caps. 40-66) into several parts.
- (17) Isaiah, *Encyclopaedia Biblica*, Vol. III, Bialik Institute, Jerusalem 1958, p. 927.
- (18) A further possibility to be taken into account is that all the prophecies were delivered by a single prophet, while the version extant is not the original one but a text composed by several of his disciples. In this case any stylistic differences found would reflect the personal differences between these disciples and not between different prophets. Some support for this hypothesis may be derived from the Babylonian Talmud, Babba Batra, 15, 1 : "Hezekia and his group wrote Isaiah". Cf. Midrash Leviticus Rabbah 6,4 and 15,2.
- (19) This is generally attributed to Yule, but the original idea is derived from Sherman, see articles 516-517 in the first work cited in note 1; cf. also the articles in section III of the second work cited in note 1.

- (20) See C.W. HAYES, *A study in prose styles : Edward Gibbon and Ernest Hemingway*, in : L. DOLEŽEL and R.W. BAILEY (eds.) *Statistics and style* (cf. note 1 above), pp. 80-91.
The syntactical methods used by the author of this article are generative - transformational grammar techniques. See also I.S. FRANCIS, *An exposition of a statistical approach to the Federalist dispute*, in : J. LEED (ed.) *The Computer and literary style*, Kent State University Press, Kent 1966, pp. 72-75.
- (21) K. KROEBER, *Computers and research in literary analysis*, in : E.A. BOWLES (ed.) *Computers in Humanistic research*, Prentice Hall, Englewood Cliffs, N.J. 1967, pp. 138-141.
- (22) Stylistic transformations are optional transformations. Cf. the book mentioned in note 2.
- (23) The redivision was made by Mr. Rimmon KASHER of the Department of Biblical Studies, Bar Ilan University.
- (24) As stated, the present participle forms were not included and whenever we shall henceforth refer to verbs, these forms will be excluded.
- (25) The classification of the verbs by tenses was made solely on the basis of morphology and not of semantics.
- (26) For determining the statistical significance levels, the z-test was used : one asterisk indicates a significance level of 2σ two asterisks - a significance level of 3σ . See H. ARKIN and R.R. COLTON, *Tables for statisticians*, 2nd ed., Barnes & Noble, New York 1963, Table 15 (pp. 16-17, 127).

- (27) The identification of verbs with conversive prefixes was made solely on morphological and not on semantic or pragmatic grounds.
- (28) Unit X is a borderline unit : in some of the tables it will appear under Part II, and in some under Part III. On the basis of the present results we tend to regard it as belonging to Part III.
- (29) It is clear that the elimination of the period effect is merely an assumption based on the titles of the books and the like.
- (30) This problem was raised by my colleague, Mr. Yaacov Choueka, and I am grateful to him for drawing my attention to it.
- (31) The term "stylistic space" is a mathematical concept. It is an n-dimensional Euclidian space in which each of the units is represented by a point having the appropriate coordinates.
- (32) The formula for calculating the discrimination effect of a stylistic element is :
- $$w = (M_a - M_b) / (R_a^2 + R_b^2)$$
- where M_i is the mean of the values of that element in group i ($i = a, b$);
and
 R_i is the standard deviation of the values of that element in group i , a group being assumed to include at least two units; see MOSTELLER and WALLACE, *Ibid.*, pp. 200-203.
- (33) This is Fisher's method of discrimination. For its statistical basis and its uses in computational stylistics, see R.S. WACHAL, *Linguistic evicence, statistical inference, and disputed authorship* Ph.D. thesis,

The University of Wisconsin 1966, pp. 181-191.

See also : H.H. SOMERS, *Statistical methods in literary analysis*, in : J. LEED (ed.) *The computer and literary style* (cf. note 24 above) pp. 130-133.

- (34) About the use of this method for taxonomical purposes, see B. SHERF, the use of electronic computers in the development of geodesic indexes, *Proceedings of the 1st (Israeli) Data Processing Conference* (ed., A. KASHER), the Israeli Information Processing Association, Jerusalem, 1965, pp. 177-181, esp. 180.
- (35) The t-test has been used here. About its use for such purposes see MOSTELLER and WALLACE, *Ibid.*, pp. 210-211.
- (36) In a sense, this is a pattern recognition programme, but it should be clear that as it stands now it has no mathematical justification. The problem under consideration is extremely difficult as only the minimum information is available *a priori*. From the literature no general methods for solving problems of this kind are known and we therefore evolved a heuristic method for this purpose. Admittedly, such methods can in some special circumstances lead us astray. See : Yu-Chi-Ho and A.K. AGRAWALA, *On pattern classification algorithms, Introduction and survey*, Harvard University, Division of Engineering and Applied Physics, Technical Report N° 557, March 1968, pp. 29-38. See also : E.H. RUSPINI, *Numerical methods for fuzzy clustering, Information Sciences*, vol. 2 (1970), pp. 319-350, for a method which might involve similar heuristics.

(37) The units obviously lie within a given stylistic space. The programme makes it possible to start the process from more than two points.

(38) This conjecture was already made by B. DUHEM, in his commentary of Isaiah, Göttingen, 1892, but obviously for other reasons.

APPENDIX 1

List of Units

A	1 - 2,5	O	41
B	2,6 - 4	P	42
C	5	Q	43
D	6 - 9,6	R	44
E	9,6 - 12	S	45
F	13 - 14	T	46 - 48
G	15 - 18	U	49 - 51,11
H	19 - 21	V	51,12 - 52,12
I	22 - 23	W	52,13 - 55
J	24 - 27	X	56 - 57
K	28 - 30	Y	58 - 60
L	31 - 33	Z	61 - 63,6
M	34 - 37,35	A ₁	63,7 - 64
N	40	B ₁	65
		C ₁	66

ABSOLUTE VALUES

APPENDIX 2, Table 1

GROUP	TOTAL	0	VERBS TYPE 2							8
			1 Kal	2 Niph'al	3 Pi'el	4 Bu'al	5 Hiph'il	6 Hoph'al	7 Hitpa'el	
T	3624		2341	265	330	48	511	29	46	47
A	103		63	9	7	3	17	1	1	2
B	92		62	11	8		9		1	
C	83		57	7	8		10	1		
D	165		114	10	14	1	21	1	3	1
E	174		115	9	13	2	27		3	5
F	138		80	14	9	4	23	4	1	3
G	113		73	12	4	5	13	2	1	2
H	135		94	15	11	1	12	1		1
I	121		79	8	12	5	16			1
J	202		115	16	25	9	29	3	1	4
K	255		166	20	15	1	41	4	4	4
L	147		102	12	10	4	16	1		2
M	130		85	11	16	1	13	1	2	1
N	93		54	9	18	1	9	1		1
O	99		72	1	5		18		1	
P	84		53		3		24	1	2	
Q	81		47	6	6		20			1
R	113		82	3	5		17	1	4	1
S	78		45	8	10		9	1	4	1
T	179		114	10	21		31		1	2
U	175		110	13	17	3	25	2	3	2
V	77		54	4	8	2	4		2	3
W	154		103	13	8	4	21	2		3
X	110		73	5	9		21		1	
Y	204		124	13	36		23	1	5	2
Z	89		53	9	9		13		2	3
A ₁	70		42	6	8		12		1	1
B ₁	83		55	8	10	1	8		1	
C ₁	77		55	3	5	1	9	1	2	1

APPENDIX 2, Table 2

COLUMN 39			ISIAAH		VERBS TYPE 2							
GROUP	TOTAL		0	1	2	3	4	5	6	7	8	
HORIZONTAL O/OS												
T	1.77	2.07	2.07	.0	64.6	7.3	9.1	1.3	14.1	.8	1.3	1.3
A	1.83	2.21	2.21	.0	61.2	8.7	6.8	2.9	16.5	1.0	1.0	1.9
B	1.74	1.76	1.76	.0	67.4	12.0	8.7	.0	9.8	.0	1.1	.0
C	1.74	1.82	1.82	.0	68.7	8.4	9.6	.0	12.0	1.2	.0	.0
D	1.73	1.94	1.94	.0	69.1	6.1	8.5	.6	12.7	.6	1.8	.6
E	1.76	2.16	2.16	.0	66.1	5.2	7.5	1.1	15.5	.0	1.7	2.9
F	1.86	2.33	2.33	.0	58.0	10.1	6.5	2.9	16.7	2.9	.7	2.2
G	1.77	2.04	2.04	.0	64.6	10.6	3.5	4.4	11.5	1.8	.9	1.8
H	1.72	1.74	1.74	.0	69.6	11.1	8.1	.7	8.9	.7	.0	.7
I	1.77	1.98	1.98	.0	65.3	6.6	9.9	4.1	13.2	.0	.0	.8
J	1.88	2.28	2.28	.0	56.9	7.9	12.4	4.5	14.4	1.5	.5	2.0
K	1.77	2.13	2.13	.0	65.1	7.8	5.9	.4	16.1	1.6	1.6	1.6
L	1.73	1.86	1.86	.0	69.4	8.2	6.8	2.7	10.9	.7	.0	1.4
M	1.76	1.94	1.94	.0	65.4	8.5	12.3	.8	10.0	.8	1.5	.8
N	1.87	2.03	2.03	.0	58.1	9.7	19.4	1.1	9.7	1.1	.0	1.1
O	1.68	1.92	1.92	.0	72.7	1.0	5.1	.0	18.2	.0	1.0	.0
P	1.79	2.43	2.43	.0	63.1	.0	3.6	.0	28.6	1.2	2.4	.0
Q	1.85	2.31	2.31	.0	58.0	7.4	7.4	.0	24.7	.0	.0	1.2
R	1.70	2.04	2.04	.0	72.6	2.7	4.4	.0	15.0	.9	3.5	.9
S	1.87	2.28	2.28	.0	57.7	10.3	12.8	.0	11.5	1.3	5.1	1.3
T	1.79	2.09	2.09	.0	63.7	5.6	11.7	.0	17.3	.0	.6	1.1
U	1.80	2.13	2.13	.0	62.9	7.4	9.7	1.7	14.3	1.1	1.7	1.1
V	1.72	1.97	1.97	.0	70.1	5.2	10.4	2.6	5.2	.0	2.6	3.9
W	1.75	2.01	2.01	.0	66.9	8.4	5.2	2.6	13.6	1.3	.0	1.9
X	1.75	2.04	2.04	.0	66.4	4.5	8.2	.0	19.1	.0	.9	.0
Y	1.82	2.11	2.11	.0	60.8	6.4	17.6	.0	11.3	.5	2.5	1.0
Z	1.85	2.26	2.26	.0	59.6	10.1	10.1	.0	14.6	.0	2.2	3.4
A1	1.83	2.19	2.19	.0	60.0	8.6	11.4	.0	17.1	.0	1.4	1.4
B1	1.76	1.83	1.83	.0	66.3	9.6	12.0	1.2	9.6	.0	1.2	.0
C1	1.71	1.99	1.99	.0	71.4	3.9	6.5	1.3	11.7	1.3	2.6	1.3

APPENDIX 2, Table 3

GROUP	COLUMN 39		VERBS TYPE 2								
	TOTAL	ISAIAH	0	1	2	3	4	5	6	7	8
VERTICAL O/OS											
T	100.0	.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
A	2.8	.0	2.7	3.4	2.1	6.3	3.3	3.4	2.2	4.3	
B	2.5	.0	2.6	4.2	2.4	.0	1.8	.0	2.2	.0	
C	2.3	.0	2.4	2.6	2.4	.0	2.0	3.4	.0	.0	
D	4.6	.0	4.9	3.8	4.2	2.1	4.1	3.4	6.5	2.1	
E	4.8	.0	4.9	3.4	3.9	4.2	5.3	.0	6.5	10.6	
F	3.8	.0	3.4	5.3	2.7	8.3	4.5	13.8	2.2	6.4	
G	3.1	.0	3.1	4.5	1.2	10.4	2.5	6.9	2.2	4.3	
H	3.7	.0	4.0	5.7	3.3	2.1	2.3	3.4	.0	2.1	
I	3.3	.0	3.4	3.0	3.6	10.4	3.1	.0	.0	2.1	
J	5.6	.0	4.9	6.0	7.6	18.8	5.7	10.3	2.2	8.5	
K	7.0	.0	7.1	7.5	4.5	2.1	8.0	13.8	8.7	8.5	
L	4.1	.0	4.4	4.5	3.0	8.3	3.1	3.4	.0	4.3	
M	3.6	.0	3.6	4.2	4.8	2.1	2.5	3.4	4.3	2.1	
N	2.6	.0	2.3	3.4	5.5	2.1	1.8	3.4	.0	2.1	
O	2.7	.0	3.1	.4	1.5	.0	3.5	.0	2.2	.0	
P	2.3	.0	2.3	.0	.9	.0	4.7	3.4	4.3	.0	
Q	2.2	.0	2.0	2.3	1.8	.0	3.9	.0	.0	2.1	
R	3.1	.0	3.5	1.1	1.5	.0	3.3	3.4	8.7	2.1	
S	2.2	.0	1.9	3.0	3.0	.0	1.8	3.4	8.7	2.1	
T	4.9	.0	4.9	3.8	6.4	.0	6.1	.0	2.2	4.3	
U	4.8	.0	4.7	4.9	5.2	6.3	4.9	6.9	6.5	4.3	
V	2.1	.0	2.3	1.5	2.4	4.2	.8	.0	4.3	6.4	
W	4.2	.0	4.4	4.9	2.4	8.3	4.1	6.9	.0	6.4	
X	3.0	.0	3.1	1.9	2.7	.0	4.1	.0	2.2	.0	
Y	5.6	.0	5.3	4.9	10.9	.0	4.5	3.4	10.9	4.3	
Z	2.5	.0	2.3	3.4	2.7	.0	2.5	.0	4.3	6.4	
A ¹	1.9	.0	1.8	2.3	2.4	.0	2.3	.0	2.2	2.1	
B ¹	2.3	.0	2.3	3.0	3.0	2.1	1.6	.0	2.2	.0	
C ¹	2.1	.0	2.3	1.1	1.5	2.1	1.8	3.4	4.3	2.1	

APPENDIX 2, Table 4

COLUMN 39	ISAI AH		VERBS TYPE 2						
	0	1	2	3	4	5	6	7	8
PT CORRELATIONS									
A	.00	.01-	.01	.01-	.02	.01	.00	.00-	.01
B	.00	.01	.03 *	.00-	.02-	.02-	.01-	.00-	.02-
C	.00	.01	.01	.00	.02-	.01-	.01	.02-	.02-
D	.00	.02	.01-	.00-	.01-	.01-	.00-	.01	.01-
E	.00	.01	.02-	.01-	.00-	.01	.02-	.01	.03 *
F	.00	.03 *	.02	.02-	.03 *	.01	.05 **	.01-	.02
G	.00	.00	.02	.03 *	.05 **	.01-	.02	.01-	.01
H	.00	.02	.03 *	.01-	.01-	.03 *	.00-	.02-	.01-
I	.00	.00	.01-	.01	.05 **	.00-	.02-	.02-	.01-
J	.00	.04 *	.01	.03 *	.07 **	.00	.02	.02-	.01
K	.00	.00	.01	.03 *	.02-	.02	.02	.01	.01
L	.00	.02	.01	.02-	.03 *	.02-	.00-	.02-	.00
M	.00	.00	.01	.02	.01-	.02-	.00	.00	.01-
N	.00	.02-	.01	.06 **	.00-	.02-	.01	.02-	.00-
O	.00	.03 *	.04 *	.02-	.02-	.02	.02-	.00-	.02-
P	.00	.00-	.04 *	.03 *	.02-	.06 **	.01	.02	.02-
Q	.00	.02-	.00	.01-	.02-	.05 **	.01-	.02-	.00
R	.00	.03 *	.03 *	.03 *	.02-	.00	.00	.04 *	.01-
S	.00	.02-	.02	.02	.02-	.01-	.01	.05 **	.00
T	.00	.00-	.02-	.02	.03 *	.02	.02-	.01-	.00-
U	.00	.01-	.00	.00	.01	.00	.01	.01	.00-
V	.00	.02	.01-	.01	.02	.04 *	.01-	.02	.03 *
W	.00	.01	.01	.03 *	.02	.00-	.01	.02-	.01
X	.00	.01	.02-	.01-	.02-	.03 *	.02-	.01-	.02-
Y	.00	.02-	.01-	.07 **	.03 *	.02-	.01-	.03 *	.01-
Z	.00	.02-	.02	.01	.02-	.00	.01-	.01	.03 *
A ¹	.00	.01-	.01	.01	.02-	.01	.01-	.00	.00
B ¹	.00	.01	.01	.02	.00-	.02-	.01-	.00	.02-
C ¹	.00	.02	.02-	.01-	.00	.01-	.01	.02	.00

APPENDIX 3, Table 1

ABSOLUTE VALUES

Group	Total	Waw Conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	no pronominal suffix
A	103	12	12	21	1	102
B	92	18	2	32	0	92
C	83	7	6	43	0	81
D	165	31	10	73	1	164
E	174	36	14	79	5	164
F	138	29	20	41	3	130
G	113	18	6	54	10	111
H	135	35	8	54	2	129
I	121	19	9	39	13	109
J	202	26	9	71	1	180
K	255	46	8	102	2	240
L	147	16	5	62	0	140
M	130	20	8	31	0	115
N	93	3	2	41	5	84
O	99	0	22	25	1	76
P	84	2	24	27	0	76
Q	81	0	26	9	3	64
R	113	1	19	55	1	97
S	78	1	18	18	1	67
T	179	2	33	26	30	148
U	175	10	36	47	12	147
V	77	0	4	20	19	74
W	154	5	15	63	17	133
X	110	6	19	26	24	101
Y	204	28	13	49	11	187
Z	89	9	15	23	1	80
A1	70	1	1	18	0	55
B1	83	14	18	20	0	76
C1	77	17	13	19	0	75
TOTAL	3624	412	399	1188	163	3297

APPENDIX 3, Table 2

HORIZONTAL 0/0S

Group	Waw Conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	pronominal suffix
A	11.7	11.7	20.4	1.0	99.0
B	19.6	2.2	34.8	.0	100.0
C	8.4	7.2	51.8	.0	97.6
D	18.8	6.1	44.2	.6	99.4
E	20.7	8.0	45.4	2.9	94.3
F	21.0	14.5	29.7	2.2	94.2
G	15.9	5.3	47.8	8.8	98.2
H	25.9	5.9	40.0	1.5	95.6
I	15.7	7.4	32.2	10.7	90.1
J	12.9	4.5	35.1	.5	89.1
K	18.0	3.1	40.0	.8	94.1
L	10.9	3.4	42.2	.0	95.2
M	15.4	9.2	23.8	.0	88.5
N	3.2	2.2	44.1	5.4	90.3
O	.0	22.2	25.3	1.0	76.8
P	2.4	28.6	32.1	.0	90.5
Q	.0	32.1	11.1	3.7	79.0
R	.9	16.8	48.7	.9	85.8
S	1.3	23.1	23.1	1.3	85.9
T	1.1	18.4	14.5	16.8	82.7
U	5.7	20.6	26.9	6.9	84.0
V	.0	5.2	26.0	24.7	96.1
W	3.2	9.7	40.9	11.0	86.4
X	5.5	17.3	23.6	21.8	91.8
Y	13.7	6.4	24.0	5.4	91.7
Z	10.1	16.9	25.8	1.1	89.9
A1	1.4	1.4	25.7	.0	78.6
B1	16.9	21.7	24.1	.0	91.6
C1	22.1	16.9	24.7	.0	97.4
TOTAL	11.4	11.0	32.8	4.5	91.0

APPENDIX 3, Table 3

VERTICAL 0/0S

Group	Waw Conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	no pronominal suffix
A	2.9	3.0	1.8	.6	3.1
B	4.4	.5	2.7	.0	2.8
C	1.7	1.5	3.6	.0	2.5
D	7.5	2.5	6.1	.6	5.0
E	8.7	3.5	6.6	3.1	5.0
F	7.0	5.0	3.5	1.8	3.9
G	4.4	1.5	4.5	6.1	3.4
H	8.5	2.0	4.5	1.2	3.9
I	4.6	2.3	3.3	8.0	3.3
J	6.3	2.3	6.0	.6	5.5
K	11.2	2.0	8.6	1.2	7.3
L	3.9	1.3	5.2	.0	4.2
M	4.9	3.0	2.6	.0	3.5
N	.7	.5	3.5	3.1	2.5
O	.0	5.5	2.1	.6	2.3
P	.5	6.0	2.3	.0	2.3
Q	.0	6.5	.8	1.8	1.9
R	.2	4.8	4.6	.6	2.9
S	.2	4.5	1.5	.6	2.0
T	.5	8.3	2.2	18.4	4.5
U	2.4	9.0	4.0	7.4	4.5
V	.0	1.0	1.7	11.7	2.2
W	1.2	3.8	5.3	10.4	4.0
X	1.5	4.8	2.2	14.7	3.1
Y	6.8	3.3	4.1	6.7	5.7
Z	2.2	3.8	1.9	.6	2.4
A1	.2	.3	1.5	.0	1.7
B1	3.4	4.5	1.7	.0	2.3
C1	4.1	3.3	1.6	.0	2.3
TOTAL	100.0	100.0	100.0	100.0	100.0

Extrait de la Revue (R.E.L.O.)

VIII, 1 à 4, 1972. C.I.P.L. - Université de Liège - Tous droits réservés.

APPENDIX 3, Table 4

POINT CORRELATIONS

Group	Waw conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	no pronominal suffix
A	.00	.00	.05-**	.03-*	.05 **
B	.04 *	.05-**	.01	.04-*	.05 **
C	.01-	.02-	.06 **	.03-*	.04 *
D	.05 **	.03-*	.05 **	.04-*	.06 **
E	.07 **	.02-	.06 **	.02-	.03 *
F	.06 **	.02	.01-	.02-	.02
G	.03 *	.03-*	.06 **	.04 *	.05 **
H	.09 **	.03-*	.03 *	.03-*	.03 *
I	.03 *	.02-	.00-	.06 **	.01-
J	.01	.05-**	.01	.05-**	.02-
K	.06 **	.07-**	.04 *	.05-**	.03 *
L	.00-	.05-**	.04 *	.04-*	.03 *
M	.02	.01-	.04-*	.04-*	.02-
N	.04-*	.05-**	.04 *	.01	.00-
O	.06-**	.06 **	.03-*	.03-*	.08-**
P	.04-*	.09 **	.00-	.03-*	.00-
Q	.05-**	.10 **	.07-**	.01-	.06-**
R	.06-**	.03 *	.06 **	.03-*	.03-*
S	.05-**	.06 **	.03-*	.02-	.03-*
T	.07-**	.05 **	.09-**	.13 **	.07-**
U	.04-*	.07 **	.03-*	.03 *	.05-**
V	.05-**	.03-*	.02-	.14 **	.03 *
W	.05-**	.01-	.04 *	.07 **	.03-*
X	.03-*	.04 *	.03-*	.15 **	.01
Y	.02	.04-*	.05-**	.01	.01
Z	.01-	.03 *	.02-	.03-*	.01-
A1	.04-*	.04-*	.02-	.03-*	.06-**
B1	.03 *	.05 **	.03-*	.03-*	.00
C1	.05 **	.03 *	.03-*	.03-*	.03 *

APPENDIX 4, Table 1

POINT CORRELATIONS

Group	Waw Conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	no pronominal suffix
A	.03-	.05 *	.09-**	.02-	.05 *
B	.02	.04-	.01-	.03-	.05 *
C	.05-*	.01	.06 *	.03-	.03
D	.02	.01-	.04	.03-	.07 **
E	.03	.02	.05 *	.02	.00-
F	.03	.09 **	.05-*	.00	.00-
G	.01-	.01-	.05 *	.12 **	.04
H	.07 **	.01-	.01	.01-	.01
I	.01-	.01	.03-	.16**	.05-*
J	.04-	.03-	.02-	.04-	.08-**
K	.01	.05-*	.02	.04-	.01-
L	.05-*	.04-	.03	.04-	.01
M	.01-	.03	.08-**	.04-	.07-**

APPENDIX 4, Table 2

POINT CORRELATIONS

Group	Waw conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	no pronominal suffix
N	.02	.12-**	.10 **	.04-	.04
O	.05-	.04	.02-	.08-**	.08-**
P	.00	.08 **	.02	.09-**	.04
Q	.04-	.10 **	.10-**	.05-	.05-
R	.03-	.01-	.14 **	.09-**	.00
S	.02-	.04	.03-	.07-*	.00
T	.03-	.01	.13-**	.11-*	.04-
U	.09 **	.03	.02-	.03-	.02-
V	.04-	.08-**	.02-	.14 **	.08 **
W	.02	.08-**	.10 **	.03-	.01
X	.06 *	.00-	.04-	.14 **	.05

APPENDIX 4, Table 3

POINT CORRELATIONS

Group	Waw Conversive past to future	1st person masc. singular	3rd person masc. singular	2nd person fem. singular	no pronominal suffix
Y	.01	.13-**	.01-	.17 **	.03
Z	.04-	.08	.01	.04-	.01-
A1	.14-**	.12-**	.01	.06-	.16-**
B1	.05	.14 **	.01-	.07-	.02
C1	.11	.07	.01	.06-	.10 *

APPENDIX 5, Table 1

Section:	Units A-M	Units N-C1
Measure:		
Verb after -		
verb (%)	11.4	14.3
noun (%)	41.0	39.5
other (%)	31.1	35.9
nothing (%)	16.5	10.3
Verb before -		
verb (%)	11.5	14.2
noun (%)	53.3	45.5
other (%)	25.7	30.1
nothing (%)	9.4	10.3
Verb in what place in sentence -		
1-4 (%)	38.1	33.4
5-8 (%)	29.2	29.5
9-12(%)	20.6	21.3
13-16(%)	8.0	9.6
17-20(%)	3.0	4.8
21-24(%)	.8	1.2
25-28(%)	.3	.2
1-3 (%)	30.5	33.4
Verb is the n-th verb in sentence - (%)		
n = 1	34.7	28.7
2	28.4	25.3
3	18.0	20.4
4	10.3	13.3
5	4.9	7.1

APPENDIX 5, Table 2

Differences between section A-M and section N-C1 according to
the Kolmogorov-Smirnov Two-sample Test* -

No pronominal suffix - One-tailed 0.01
3rd person pronominal suffix - One-tailed 0.05
3rd person - Two-tailed 0.01
1st person - Two-tailed 0.01
future - One-tailed 0.05
Waw conversive past to future - Two-tailed 0.01
Niph'al - One-tailed 0.05
1st verb in sentence - Two-tailed 0.01
2nd verb in sentence - One-tailed 0.05
3rd verb in sentence - One-tailed 0.05
4th verb in sentence - Two-tailed 0.01
5th verb in sentence - One-tailed 0.05
1-4 place in sentence - Two-tailed 0.01
1-3 place in sentence - One-tailed 0.05
verb before noun - Two-tailed 0.01
verb before verb - One-tailed 0.05
verb after noun - One-tailed 0.05
verb after non-verb and non-noun - One-tailed 0.05

S. Siegel, Nonparametrical statistics for the behavioral
Sciences, Tokyo 1956, pp. 127-135 and Tables L-M.

APPENDIX 6

	MICHA		HOSEA	
	Absolute	Percent	Absolute	Percent
1st verb in sentence -	94	31.9	185	31.3
2nd verb in sentence -	87	29.5	167	28.2
3rd verb in sentence -	57	19.3	119	20.1
4th verb in sentence -	31	10.5	67	11.3
5th verb in sentence -	10	3.4	28	4.7
Kal -	195	66.1	404	68.2
Niph'al -	10	3.4	27	4.6
Pi'el -	25	8.5	62	10.5
Pu'al -	0	.0	4	.7
Hiph'il -	51	17.3	71	12.0
Hoph'al -	1	.3	3	.5
Hitpa'el -	6	2.0	2	.3
No pronomial suffic -	275	93.2	521	88.0
No affix -	214	72.5	425	72.6
1st person, masc. singular -	53	18.0	120	20.3
3rd person masc. singular -	72	24.4	161	27.2
2nd person, fem. singular -	18	6.1	6	1.0
verb after noun -	110	37.3	225	38.0
verb after verb -	35	11.9	72	12.2
verb after non-verb and non-noun -	103	34.9	188	31.8
verb as 1st word in sentence -	47	15.9	107	18.1
verb before noun -	158	53.6	258	43.6
verb before verb -	35	11.9	70	11.8
verb before non-noun and non-verb -	83	28.1	200	33.8
verb as last word in sentence -	19	6.4	64	10.8

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A	P	Q	R	S	T	U
A	27.89	36.10	36.28	26.54	30.98	22.64
B	44.15	59.28	40.42	47.88	50.98	37.68
C	50.15	67.35	35.67	57.44	60.87	46.84
D	45.17	62.60	36.48	51.36	55.04	40.35
E	40.53	58.57	33.28	46.18	50.89	35.38
f	32.95	45.12	37.62	34.75	40.26	27.22
G	37.34	56.43	30.75	41.49	46.72	33.98
H	47.99	62.88	43.13	52.48	55.97	41.51
I	36.24	49.39	33.57	39.14	38.13	26.14
J	29.00	44.37	26.63	29.66	35.74	22.80

Appendix 7, Table 1 (Part.)

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	P	Q	R	S	T	U	V
Z	26.08	35.52	30.43	28.44	32.47	19.14	35.38
A1	34.84	41.37	30.44	32.26	31.93	25.53	31.96
B1	25.42	34.38	37.80	24.58	33.21	22.76	41.62
C1	35.31	45.46	41.49	37.33	42.15	29.75	43.53

Appendix 7, Table 2 (Part)

B A R I L A N U N I V E R S I T Y R A M A T G A N

W(1)=	-0.10		
W(2)=	0.54		
W(3)=	0.50		
W(4)=	-0.72		
W(5)=	0.45		
W(6)=	0.54		
W(7)=	-1.05		
W(8)=	0.17	Z(P)=	-34.19
W(9)=	-0.54	Z(Q)=	-58.31
W(10)=	0.52	Z(R)=	-15.18
W(11)=	0.46	Z(S)=	-41.30
		Z(T)=	-41.90
Z(A)=	-2.54	Z(U)=	-25.10
Z(B)=	38.74	Z(V)=	-14.10
Z(C)=	38.64	Z(W)=	-22.95
Z(D)=	40.27	Z(X)=	-10.96
Z(E)=	26.50	Z(Y)=	12.80
Z(F)=	4.03	Z(Z)=	-3.66
Z(G)=	7.88	Z(A1)=	3.59
Z(H)=	38.47	Z(B1)=	-17.55
Z(I)=	16.45	Z(C1)=	9.18
Z(J)=	5.03		
Z(K)=	27.12		
Z(L)=	5.50		
Z(M)=	10.13		
Z(N)=	-4.58		
Z(O)=	-37.30		

Appendix 7, Table 3

B A R I L A N U N I V E R S I T Y R A M A T G A N

W(1)= -0.07
 W(2)= 0.49
 W(3)= 0.45
 W(4)= -0.78
 W(5)= 0.43
 W(6)= 0.49
 W(7)= -0.10
 W(8)= 0.09
 W(9)= -0.35
 W(10)= 0.52
 W(11)= 0.31

SET I: B,C,D
 SET 2: N,O,P

Z(A)=-12.31
 Z(B)= 17.74
 Z(C)= 22.71
 Z(D)= 22.43
 Z(E)= 11.34
 Z(F)= -3.80
 Z(G)= -9.21
 Z(H)= 21.25
 Z(I)= 4.28
 Z(J)=-12.13
 Z(K)= 7.89
 Z(L)=-14.08
 Z(M)= -0.75
 Z(N)=-22.54
 Z(O)=-33.12

Z(P)=-27.61
 Z(Q)=-43.83
 Z(R)=-19.90
 Z(S)=-38.29
 Z(T)=-35.28
 Z(U)=-23.46
 Z(V)=-25.23
 Z(W)=-32.13
 Z(X)=-10.18
 Z(Y)= -0.65
 Z(Z)= -6.73
 Z(A1)=-13.67
 Z(B1)=-18.32
 Z(C1)= 3.22

Appendix 8 ,Table 9
 (8,1=7,1 ;8,2 =7,2)

B A R I L A N U N I V E R S I T Y R A M A T G A M

W(1)= -0.17

W(2)= -0.62

W(3)= -0.46

W(4)= -0.62

W(5)= -0.55

W(6)= 0.61

W(7)= -0.12

W(8)= 0.05

W(9)= -0.25

W(10)= -0.08

W(11)= 0.18

Z(A)= 27.22

Z(B)= 34.04

Z(C)= 7.83

Z(D)= 26.82

Z(F)= 34.56

Z(F)= 40.21

Z(G)= 34.29

Z(H)= 42.33

Z(I)= 24.28

Z(J)= 27.57

Z(K)= 35.42

Z(L)= 29.08

Z(M)= 28.11

Z(N)= 12.50

Z(O)= 3.27

Z(P)= 11.02

Z(Q)= 5.37

Z(R)= 6.56

Z(S)= 11.18

Z(T)= 2.60

Z(U)= 11.84

Z(V)= 1.43

Z(W)= 13.36

Z(X)= 4.62

Z(Y)= 24.95

Z(Z)= 20.73

Z(A1)= 1.75

Z(B1)= 34.55

Z(C1)= 38.74

Appendix 9, Table 3 (9,1=7,1;-9,2=7.2)

CONTENTS OF GROUP 1

STYLE SPACE: AS ABOVE

H I K M

CONTENTS OF GROUP 2

N O P Q R S T

6.95	18.75	4.32	63.77	4.32	18.75	6.40	34.00	3.25	12.35	92.07
10.99	1.27	3.79	81.56	4.12	1.27	20.49	28.41	4.16	4.53	84.43

CONTENTS OF GROUP 1

A B C D E F G H I J K L M Y Z C1

CONTENTS OF GROUP 2

N O P Q R S T U V W X A1 B1

6.41	16.05	4.66	67.39	4.69	16.30	8.04	35.12	2.22	10.33	94.64
8.43	3.15	4.74	79.20	5.00	3.20	16.87	28.16	7.19	6.27	86.12

CONTENTS OF GROUP 1

A B C D E F G H I J K L M Y Z C1

CONTENTS OF GROUP 2

N O P Q R S T U V W X A1 B1

MAXIMUM DISTANCE= 67.35

MAXIMUM DISTANCE IN GROUP 1 IS 47.09

MAXIMUM DISTANCE IN GROUP 2 IS 47.05

APPENDIX 10

CONTENTS OF GROUP 1

NAME	ITER NO	TOT / NEW / STR	CENTR
A	0	6 / 6 / 0	
B	21	4 / 3 / 0	F
D	41	0 / 0 / 0	H
E	41	4 / 1 / 0	H
F	11	5 / 2 / 0	A
G	51	0 / 0 / 0	E
H	31	6 / 2 / 0	B
J	21	0 / 0 / 0	F
K	31	0 / 0 / 0	B
L	31	0 / 0 / 0	B
M	11	0 / 0 / 0	A
Y	11	0 / 0 / 0	A
Z	11	0 / 0 / 0	A
B1	11	0 / 0 / 0	A
C1	11	0 / 0 / 0	A

CONTENTS OF GROUP 2

NAME	ITER NO	TOT / NEW / STR	CENTR
C	58	0 / 0 / 0	V
I	34	18 / 1 / 11	X
N	0	1 / 1 / 0	
O	45	27 / 0 / 15	S
P	17	28 / 0 / 15	R
Q	34	18 / 0 / 9	T
R	12	9 / 4 / 3	W
S	17	13 / 1 / 6	R
T	25	3 / 1 / 0	U
U	17	3 / 1 / 0	R
V	34	28 / 1 / 15	X
W	10	2 / 1 / 0	N
X	17	3 / 2 / 0	R
A1	45	27 / 0 / 15	I

APPENDIX 11-I
(Style space - cf. III)

CONTENTS OF GROUP 1

NAME	ITER NO	TOT / NEW / STR	CENTR
A	0	1 / 1 / 0	
F	9	6 / 1 / 2	G
G	4	3 / 2 / 0	A
J	17	12 / 1 / 7	F
L	9	0 / 0 / 0	G

CONTENTS OF GROUP 2

NAME	ITER NO	TOT / NEW / STR	CENTR
T	9	1 / 1 / 0	K
B	21	11 / 1 / 3	H
C	31	0 / 0 / 0	B
D	28	0 / 0 / 0	
E	16	12 / 0 / 4	I
H	9	1 / 1 / 0	K
I	12	1 / 1 / 0	T
K	6	5 / 2 / 1	M
M	0	1 / 1 / 0	

APPENDIX 11-II
(Style space - cf. III)

B A R I L A N U N I V E R S I T Y R A H A T G A N A S A K A S H E R
LEADER-CARD, M= 6 KO= 2 MISJ= 0 ICODE= -1 1 2 2 -2 ISTEPNT= A M

- T (31.6,68.0, 4.7, 5.0,68.0,32.0)
- A (24.3,74.8, 1.0, 1.0,74.8,25.2)
- B (39.1,60.9, 7.6, 7.6,60.9,39.1)
- C (49.4,50.6,18.1, 0.0,50.6,49.4)
- D (41.2,58.8,12.7, 9.7,58.8,41.2)
- E (34.5,65.5, 6.3, 1.7,65.5,34.5)
- F (27.5,72.5, 0.0, 9.4,72.5,27.5)
- G (23.0,76.1, 0.9, 0.0,76.1,23.9)
- H (40.7,59.3, 5.2, 3.7,59.3,40.7)
- I (33.9,66.1, 6.6, 4.1,66.1,33.9)
- J (21.3,78.7, 3.0,10.4,78.7,21.3)
- K (32.5,65.9, 2.4, 3.1,65.9,34.1)
- L (17.0,82.3, 0.0, 3.4,82.3,17.7)
- M (36.2,63.8, 3.1, 6.2,63.8,36.2)

STYLE SPACE

APPENDIX 11 - III