AND *IN ISAIAH*

That language is an almost decisive criterion in cases of dubious, contested and heterogeneous authorship has been recognized in the past in various literatures and also in the Hebrew Bible. However, attempts to separate the wheat from the chaff have in the main been based on intuition. It is only recently that use has been made of exact and scientific methods and that a new discipline has come into existence : statistical linguistics. A notable example is an experiment performed by the Rev. A.Q. MORTON.

Morton was struck by the consistency of Greek writers in their use of the particle *kai*. He submitted the Pauline Epistles to this form of statistical investigation and reached the conclusion that, by virtue of their significant deviation from Paul's 'normal' use of *kai*, Pastorals, I, II Thessalonians, Colossians, Ephesians and Philippians could not have been written by Paul (1). It is a moot point whether or not this conclusion is to be considered as final (2), but it is certainly useful to test the applicability of Morton's criterion to other languages and literatures, to other authors and to other literary genres. This paper is an attempt to do so in the Hebrew Bible in general, and for the intricate question of the unity of the Book of Isaiah in particular (3).

It is of course understood that the use of *and*, i.e. the proleptic *waw*, in Hebrew differs from the use of the Greek *kai*. This difference, however, does not constitute an obstacle in principle so long as a certain criterion

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is examined consistently and uniformly throughout all samples. In addition
to this reservation, there is the difficulty of clearly distinguishing between
the conjunctive and the conversive *waw*. The latter occurs frequently in nar-
ration, and since its use is correlated with a certain literary type, this fact is
likely to detract from the author-specifying discriminative power of the *waw*-
test. The conversive *waw* occurs as a bound morpheme before verbal forms
in the perfect and imperfect. In the imperfect, this *waw* carries a special vo-
calization and may therefore easily be defined if one is prepared to rely on
this admittedly late vocalization. When the conversive *waw* precedes a verb
in the perfect, it is identical with the conjunctive *waw* except for an occa-
sional shift of stress on the ultima. This stress is again only a matter of tra-
dition, albeit ancient, and not of spelling. Moreover, it occurs only in two
(the 1st and 2nd persons masculine singular) out of the nine possible verbal
forms. In short, in at least three quarters of all instances, the two kinds of
waw can practically not be distinguished from each other except by exege-
sis - and exegesis should in no circumstances have a place in statistical lin-
guistics, since it would entail substituting one sort of intuition for another.
The only way to overcome this difficulty is to count the two kinds of *waw*
together first and possibly repeat the count later while eliminating from it
at least the unambiguous conversive *waw* before verbal forms in the imper-
fect.

As the first step (4), it is imperative to test whether the frequency of *waw* -
this term is now taken to include both kinds of *waw* unless specifically
stated otherwise - remains constant in Biblical control groups (5). For this
purpose, at least two random samples, spread over their entire lengths,
were drawn from all books except for the Books of Joel, Obadiah, Jonah,
Nahum, Habakuk, Haggai, Zechariah, Malachi and Ecclesiastes which were

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scanned in their entireties, and the Book of Isaiah which is to be treated separately. In those books where a change of literary type occurs, two samples were drawn from each type, provided that the text size permitted it. The occurrences of *waw* were counted and the relative frequencies (*f*) calculated, as shown in Table 1. The sum of the words of a 11 samples is approximately 45.000 words or one sixth of the canonical books.

The first impression obtained from Table 1 is that the frequency of *waw* in each book is rather constant. In cases where this is not so, the discrepancy between f_A and f_B is obviously due to a change in subject matter, e.g. in Ezekiel where Part I contains visions and parables and Part II deals with matters of cult, sacrifices and architecture. The same *caesura* in subject matter occurs also in Joshua : cha. 1-12 are narrative and cha. 13-24 a detailed geographical description of the Land of Canaan. In other instances, where the frequency is not constant, such as in Jonah, Hosea and Habakuk, it is found that there is a remarkable decrease of *f* in the poetic sections. This phenomenon when considered together with the low values of *f* in Psalms, Canticles and Lamentations, indicates - as a secondary result of this investigation - that *f* may serve as a very rough measurement of poeticity.

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TABLE 1

Composition of Samples from Biblical Books and Relative Frequencies of *waw* therein

Book	Sample A Chapters	n° of words	Sample B Chapters	n° of words	f_A	f_B	$\overline{f}$
Genesis	1-4, 6-9, 11-28	1000	29-48, 50	1000	19.8	21.3	20.5
Exodus	1-14, 16-19	500	32-34	500	17.6	19.0	18.3
Leviticus	1-13	500	14-27	500	21.2	19.2	20.2
Numbers	1-18	500	19-22, 25-36	500	17.8	16.6	17.2
Deuteronomy	1-15	1000	16-30	1000	15.6	15.0	15.3
Joshua I	1-6	400	7-11	380	13.3	15.3	14.3
Joshua II	12-22	500					24.0
Judges	2-4, 6-16	500	17-21	500	18.2	17.6	17.9
I Samuel	1,3-15	500	16-31	500	20.8	18.8	19.8
II Samuel	1-12	1000	13-21	1000	22.5	17.8	20.1
I Kings	1-12	500	13-22	500	13.6	17.4	15.5
II Kings	1-13	800	14-25	800	22.1	18.6	20.3
Jeremiah	1-16	985	17-31	985	20.6	20.0	20.3
Ezekiel I	1-21	500	22-39	490	20.2	20.6	20.4
Ezekiel II	40-43	450	44-48	466	17.2	16.8	17.0
Hosea I	1-3	300					22.7
Hosea II	4-8	400	9-11	400	10.1	11.5	10.8
Joel	1-2	500	3-4	425	13.8	10.0	11.9
Amos	1-4	535	5-9	535	7.8	7.6	7.7
Obadiah	1	291					11.7
Jonah	1,3-4	555	2	81	12.8	0.9	6.8
Michah	1-3	500	4-7	500	13.2	17.4	15.3
Nahum	1-2	240	2-3	330	12.9	13.9	13.4
Habakuk	1-2	352	3	308	17.6	5.5	11.5
Zephaniah	1-2	300	2-3	300	17.6	9.6	13.6
Haggai	1	200	2	200	16.5	15.0	15.7
Zechariah	1-8	1735	9-14	1371	16.5	18.2	17.4
Malachi	1-2	445	2-3	445	14.5	15.9	15.2

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TABLE 1 (suite)

Book	Sample A Chapters	n° of words	Sample B Chapters	n° of words	f_A	f_B	$\overline{f}$
Psalms	1-75	1000	76-150	1000	7.7	8.7	8.2
Proverbs	1-15	500	16-31	500	15.4	12.8	14.1
Job	2-21	1000	22-39	1000	13.2	13.1	13.2
Canticles	1-4	500	5-8	500	5.4	7.0	6.2
Ruth	1-2	500	3-4	500	20.0	20.4	20.2
Lamentations	1-2	500	3-5	500	7.0	7.0	7.0
Eccles	1-6	1466	7-12	1466	13.6	9.4	11.5
Esther	1-5	500	6-10	500	17.6	16.2	17.9
Daniel	1-6	500	7-12	500	10.0	10.8	10.4
Ezra	1-6	480	7-10	480	14.6	17.7	16.1
Nehemiah	1-2, 4-5	500	6,8-9,13	500	19.0	17.2	18.1
Chronicles	I	500	II	500	20.6	21.0	20.8

In order to decide whether the use of *waw* may serve not only as a criterion of literary type and quality, but also as an author-specifying one, it is of course not enough to say that *f* remains fairly constant 'within' the same author or book. This claim has to be substantiated by a statistical test, the purpose of which is to show whether the observed fluctuations of *f* in two random samples of the same book should be ascribed to chance only or rather to a change of authorship. Statistically speaking, the test must show whether the hypothesis that the two samples were drawn from the same statistical population is valid.

The appropriate statistical test to apply is the arcsin test. A description of its theoretical background and procedure is not within the province of this report. In short, the variable *z* is calculated from the two frequency values

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observed in each sample pair. The critical borderline value of the absolute value of $_A z$ is 1.96. This means that whenever the absolute value of z for a certain sample pair is greater than 1.96 ($|z| > 1.96$), the so-called null hypothesis which assumes an identical original statistical population is to be rejected. Contrariwise, whenever $|z|$ is smaller than 1.96 ($|z| < 1.96$), there is no sufficient reason to reject the null hypothesis and the homogeneity of the two samples may be assumed.

Thus, z was calculated for the sample pair of each book. When more than two samples were drawn from one and the same book, z_1 was first calculated for the first sample pair, then z_2 for the second (if there were two more samples), and finally for comparison between z_1 and z_2. Since the Book of Obadiah is too short to be divided into two samples, it was treated as one single sample. This procedure resulted in thirty-nine values of z. To facilitate inspection, they were arranged in two tables : values of $|z| < 1.96$ in Table 2 and those of $|z| > 1.96$ in Table 3.

TABLE 2

Biblical Books showing Values of $z < 1.96$

Genesis	0.86	I Samuel	0.79	Michah	1.85	Canticles	1.05
Exodus	0.57	I Kings	1.66	Nahum	0.35	Ruth	0.16
Leviticus	0.79	II Kings	1.74	Haggai	0.15	Lamentations	0.00
Numbers	0.51	Jeremiah	0.29	Zechariah	0.53	Esther	0.68
Deuteronomy	0.36	Ezekiel I	0.08	Malachi	0.65	Daniel	0.84
Joshua I	0.50	Ezekiel II	0.12	Psalms	0.80	Ezra	1.31
Judges	0.25	Hosea II	0.57	Proverbs	1.18	Nehemiah	0.54
		Amos	0.11	Job	0.06	Chronicles	0.15

In the great majority (78 %) of all Biblical books, z fell short of 1.96. Moreover, the mean is $z = 0.663$, i.e. z does not reach more than one third of the critical value. Table 2 thus corroborates the claim that, in general, the use of *waw* in the same book remains surprisingly constant and uniform.

TABLE 3

Biblical Books showing Values of $z > 1.96$

Book	z	Book	z	Book	z
Habakuk	5.02	Ecclesiastes	3.65	II Samuel	2.64
Hosea I/II	4.72	Jonah	3.51	Joel	2.52
Joshua I/II	4.67	Zephaniah	2.69	Ezekiel I/II	2.11

Table 3 which lists values of $z > 1.96$ in their decreasing order is both interesting and puzzling. In Habakuk, Hosea, Joshua, Jonah and Ezekiel, the excessive z is clearly caused by a change in subject matter and literary type which overshadow any possible change of authorship. The same may be said of Ecclesiastes : there, the reader will find such varied genres as autobiography, proverbs and sentential and meditational literature in a curious mixture. The Book of Joel presents a different case : it is uniform in type, but scholars have long ago suspected a change of authorship between chs. 2 and 3. This suspicion finds support in the value of $z = 2.52$. As to Zephaniah and II Samuel, it must be admitted that their presence in Table 3 instead of Table 2 is a problem. The high value of z in Zephaniah may perhaps be explained by the exceedingly small size of the samples, yet that of II Samuel is inexplicable, unless one views the book as being composite in character, a not improbable possibility. These two

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perplexing results, however, among thirty-nine are not sufficient to invalid-
ate the conclusions which should now be examined.

It has already been mentioned that the frequency of *waw* is a very simple
and unsophisticated, but at the same time just passable, yardstick for mea-
suring poeticity. In cases of plural or *incerta paternitas* of a text, this yard-
stick is not subtle enough. Still, the experiment is not wholly discouraging :
if in a book the following conditions are met, then the present criterion may,
despite of what has been just said, be taken as a sign of heterogeneity of
authorship :

a)   there should be no substantial change of literary type within the book;

b)   the occurrence of the conversive *waw* before verbs in the imperfect
     should be so rare as not to distort the findings;

c)   the values of z should considerably surpass the critical point.

Does the Book of Isaiah fulfill these conditions ?

Concerning a), the answer is manifestly in the affirmative : different types
of prophecies such as visions, auditions, *Drohworte* etc. notwithstanding,
the book considered in its totality (and especially when chs. 36-39 are ex-
cluded) is prophetic and poetic and deals with the same subject matter
throughout.

Condition b) is most certainly met : of the 2370 *waws* in Isaiah, only 34,

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i.e. no more than 1.43 % are of the conversive kind bound to verbs in the imperfect.

Whether stipulation c) applies in Isaiah is the subject of the following discussion.

In order to obtain values of z, the book was divided into six sections :

Section I	chs. 1-12	Section III	chs. 24-35	Section V	chs. 49-57
Section II	chs. 13-23	Section IV	chs. 40-48	Section VI	chs. 58-66

The reasons for this particular division and no other are stated elsewhere (6). Here, contrary to the control groups, the entire sections served as samples. The counts resulted in the data of Table 4.

TABLE 4

Occurrences of *waw* in Isaiah

Section	N° of words	N° of *waw*	f (in %)	Section	N° of words	N° of *waw*	f (in %)
I	3363	624	18.5	IV	2447	361	13.2
II	2351	329	13.6	V	2077	296	13.3
III	2989	403	13.4	VI	2279	357	15.7

All sections were compared with each other and z for each pair was calculated. Table 5 shows the results with values greater than 1.96 in italics.

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TABLE 5

Values of z in Section Pairs in Isaiah

	I	II	III	IV	V	VI
I	-	4.61	5.53	5.79	4.15	2.83
II	-	-	0.55	0.89	0.27	1.60
III	-	-	-	0.37	0.81	2.24
IV	-	-	-	-	1.14	2.55
V	-	-	-	-	-	1.28

The one unquestionable fact revealed by Table 5 is that Section I behaves, in its use of *waw*, in a greatly exceptional way. Moreover, most values of z found for Section I not only exceed 1.96, but are, when compared with those of Tables 2 and 3, of a quite different order of magnitude : among five, two surpass, and two more reach, the maximum value found there. In other words, chs. 1-12 of Isaiah differ more from chs. 13-57 than Habakuk's visions from his Prayer, Hosea's prophecies from his biography, and Joshua's dramatic account of the conquest of the Land of Canaan from his dry geographical lists.

There is of course the curious fact that Section VI also stands apart, although much less so than Section I, and seems to approach slightly the behaviour of the latter. Whatever its reason, it does not diminish the striking isolation of Section I, particularly when this is proved by the following double check.

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When the first three sections (I, II, III) *in toto* were compared with the second three sections (IV, V, VI) taken together, the arcsin test gave $z = 2.29$, i.e. the two sets may be viewed as heterogeneous in relation to each other. When, on the other hand, Section I was left out altogether and the arcsin test applied to the sample pair Sections II, III : Sections IV, V, VI, z was found to be as low as 0.89.

To make even more sure, all those conversive *waw* that are clearly definable, namely those before verbs in the imperfect, were eliminated from the count and Table 4 was consequently corrected as shown in Table 6.

TABLE 6

Occurrences of *waw* in Isaiah (corrected)

Section	N° of *waw*	f (in %)	Section	N° of *waw*	f (in %)
I	569	16.9	IV	336	12.3
II	315	13.4	V	283	13.9
III	394	13.2	VI	339	14.9

With these new data, the arcsin test was repeated and the matrix of Table 7 received. Values above 1.96 are again marked by italics.

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TABLE 7

Values of z in Section Pairs in Isaiah (corrected)

	I	II	III	IV	V	VI
I	-	*3.68*	*4.17*	*5.20*	*3.29*	*2.08*
II	-	-	0.21	1.24	0.23	1.45
III	-	-	-	1.10	0.48	1.73
IV	-	-	-	-	1.44	*2.73*
V	-	-	-	-	-	1.17

When compared with Table 5, the main surprise of Table 7 is how few surprises it contains. Values of z increased in general where they lay below the critical value, and decreased where they lay above it. This sort of levelling was only to bé expected, particularly because Section I comprises several narrative passages where the incidence of the conversive *waw* with verbal forms in the imperfect is of course high.

Whereas Section VI displayed, according to Table 5, a rather puzzling behaviour inasmuch as it resembled that of Section I, the same section looks less 'maverick' in Table 7 and more conforming with Sections II-V. On the other hand, the characteristic behaviour of Section I, distinct from all the rest regarding the use of *waw*, is firmly established again in Table 7.

One more point should be stated here : the second count resulting in Tables 6 and 7 was performed for the sake of completion only. Actually, it was superfluous since whatever may be said of the functions of the conversive *waw*, one among them is doubtlessly conjunctive which justifies couating it

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together with the conjunctive *waw*.

Before drawing any conclusions, it may be asked how reliable the arcsin test is.

Since statistics is concerned with probabilities only, one should, at this point, ascertain to what measure one may err when drawing conclusions from Table 5. It is customary in statistics to agree to risk wrongly rejecting a correct null hypothesis in five out of one hundred cases (Type I error, $\alpha = 5\ \%$). The answer to the question 'What is the probability of having wrongly rejected the correct hypothesis that any sample pair from which a value of $|z| > 1.96$ was obtained originated in the same population ?' may be looked up in tables of the normal distribution in any manual of statistics. There, the probability values as shown in Table 8 were found.

TABLE 8

Probability of Type I Error

	II	III	IV	V	VI
I	0.0000	0.0000	0.0000	0.0000	0.0046
II	-	0.5824	0.3734	0.7872	0.1096
III	-	-	0.7114	0.4180	0.0250
IV	-	-	-	0.2542	0.0108
V	-	-	-	-	0.2006

Without going into further details, it should suffice to state that inspection of Table 8 shows that the risk mentioned above is extremely low, particularly regarding Section I. The probability of having been wrong in viewing Section I as heterogeneous in relation to Sections II, III, IV and V is practically zero, and in relation to Section VI less than 0.5 %.

Finally, the question arises : what does the present investigation contribute to the two-hundred years old complex and heated discussion concerning the unity of the Book of Isaiah ? Both camps, the unitarians and the divisionists, agree at least in one detail, i.e. that Section I (chs. 1-12) may be regarded, with very few exceptions and reservations, as Isaiah's authentic *ipsissima verba* and hence as a norm with which the language of the following chapters may be compared. The distinctness of Section I clearly emerges from the *waw*-experiment. It follows that, should one rely on the latter only, different hands must have been at work from ch. 13 on. For deciding to what degree this happened, the *waw*-filter is probably not refined enough. However, it should be recalled that the first doubts about the unity of the book arose with regard to chs. 40 ff. where two suspicious mentions of King Cyrus's name occur (ch. 44 : 28; ch. 45 : 1). Now it is precisely in this section (Section IV) where Tables 5 and 7 expose a maximum dissimilarity in relation to the 'normal' Section I.

To sum up :

First, the answer to the question whether Morton's *kai*-test is applicable to the Hebrew Bible is generally in the negative. Yet, in flagrant cases of

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pseudonymous or pseudo-epigraphic additions to an original work of litera-
ture, such as seem to have happened in Isaiah, the use of *waw* is a discri-
minant;

Second, the incidence of *waw* proved to be an inaccurate, but still not
altogether unusable, measurement of poeticity;

Third, with the lamentable gap between the humanities and the exact
sciences lately being slowly, but hopefully, bridged, and with Biblical
research becoming ever more computer-orientated, scholars are in dire
need of numerical and statistical data. Such were, it is hoped, amply,
though on a rather limited point of issue, supplied here (7).

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* The authors are jointly responsible for this paper. The task of the first was
   mainly in its biblical and linguistic aspects and compiling the data while the
   other processed the data and evaluated them statistically.

NOTES

(1)   A.Q. MORTON and J. McLEMAN, *Christianity and the Computer,*
       London 1964; idem, *Paul, the Man and the Myth,* London 1966;
       A.Q. MORTON, *The Authorship of the Pauline Corpus,* in *The*
       New Testament in Historical and Contemporary Perspective, ed.
       W. Barclay, Oxford 1963; idem, *The Integrity of the Pauline*
       Epistles, in *Journal of the Manchester Statistical Society,* March
       1965.

(2)   For recent criticism, see H.K. McARTHUR, *Kai Frequency in*
       Greek Letters, in *New Testament Studies* 15 (1969), pp. 339-
       349.

(3)   For an extensive investigation of the Isaiah problem by using a
       score of other, but essentially similar, criteria, see Y.T. RADDAY,
       The Unity of Isaiah in the Light of Statistical Linguistics, Hildes-
       heim 1973.

(4)   It is interesting to note that there is a rudimentary precedent for
       using the frequency of *waw* in a case of contested authorship
       in Hebrew literature : it concerns the correspondence between
       Hasday ibn Shaprut (10th cent.C.E.) with the King of Khazars.
       See D.M. DUNLOP, *The History of the Khazars,* Princeton 1954
       (paperback, Schocken New York 1967, p. 163).

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(5)   The following discussion of the use of *waw* in Biblical books
       other than Isaiah is an abridged version of a paper presented
       by the authors in August 1973. See *Waw coniunctivum - an
       Author - and/or Type-specifying Discriminant in Biblical Lite-
       rature*, in *Proceedings of the Sixth World Congress of Jewish
       Studies* (forthcoming), where a detailed description of the
       linguistic theory, the manner of sampling and the statistical
       procedure may be found.

(6)   RADDAY, *op. cit.,* pp. 49, 59, 85.

(7)   The computer used in this enquiry was the IBM 370/165 and
       the program was written in PL/1.