HIATUS AS A MEASUREMENT OF STYLE[1].

In English the inflectional system has been largely lost and most vowels at word endings are permanently elided. Ancient Greek, however, an inflected language, usually requires distinct pronunciation of terminal vowels. Thus, when the text of such a language is read aloud the collocation of vowels at word boundaries produces a glottal stop, a "gap" or hiatus in the flow of speech.

When in the fourth century B.C. Greek rhetoricians became sensitive to hiatus the flexible word order of ancient Greek enabled them to avoid it at will in prose composition. Eventually an author's treatment of hiatus became recognized as a characteristic of style. On this basis three centuries later Dionysius of Halicarnassus classified Greek literary texts as "rough", "middle" and "smooth"[2]. In our own age, a contemporary critic of the classics has remarked that "hiatus is a serviceable measure of literary pretensions", and that "it often becomes clear quite soon whether a writer generally avoids hiatus . . ."[3].

Quite recently, the question of how small a text sample is required in order to justify inferences about hiatus has arisen in discussions of the authenticity of a papyrus fragment[4]. In antiquity Dionysius (*De Comp. Verb.* 22) considered 30 instances of hiatus sufficient to place Thucydides in the "rough" category. Thus even small texts as furnished for example by epistles and inscriptions may prove susceptible to computerized hiatus analysis. In this study we are investigating the provenance of a Greek text of 1,818 words showing 293 cases of hiatus.

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Chronological Possibilities

Avoidance of hiatus came into vogue at Athens about 360 B.C. under the influence of Isocrates. It should therefore be possible to estimate the chronology of passages of Greek in much the same way as English prose works of the Victorians can be distinguished from works of modern writers by their stricter avoidance of the split infinitive(5). Tests by computer to specify in what manner and to what degree Greek hiatus is admitted or avoided should thus yield countable indicators of style - clues that can point to an author, to a rhetorical school or to a literary epoch. Evidence thus collected may then be applied to problems of authorship.

Defining Hiatus

In certain circumstances (e.g. as after KAI etc.) juxtaposed vowels may be regarded as admissible and are therefore not counted as true instances of hiatus. However, the problem of which cases are to be so regarded must await the establishment of basic facts. In fundamental data-gathering procedures such as these described here it is better to spread a wide net. Then with diagnosis of hiatus properly objectified subsidiary questions can be settled at convenience. For example, we can then examine problems such as the effect of punctuation and orthography (e.g. movable NU and SIGMA) on the recorded frequencies of hiatus. In my experience, many of these effects are trivial. Frequently they make a difference of a fraction of one percent, smaller than the standard error. By amassing large quantities of data it is possible to override unavoidable fluctuations in accuracy, as for example when different manuscripts vary slightly in orthography. Questions of sample size can be solved as they arise by statistical tests, provided all texts are treated uniformly and are judged by the same criteria.

A Working Hypothesis

Let "absolute hiatus" represent the collocation of any vowels whatever at word junctures after crasis has been resolved and elision removed(6). We can now anticipate that many Greek texts will fall under two main headings :

1) Type I : Weak avoidance of hiatus may be effected through minor coadjustments of vowels wich do not significantly alter the absolute rate - i.e. by blending the conflicting vowels or by providing for the elimination of one or the other, in practice usually the first by elision but also the second by aphaeresis. Textual elision (e.g. D'AN for DE AN) has been considered separately by Morton and Michaelson in respect to its occurrence in certain function words(7).

2) Type II : As much as possible, no vowels of any kind whatever are permitted to occur at word junctures. Under these radical constraints Type II texts register a decline in the rate of absolute hiatus approaching zero, while such vowels as do occur at junctures are susceptible to smoothing (elision, etc.). The touchstone for this style would be Isocrates' *Areopagiticus* (355 B.C.). The *Athenaion Politeia*, (hereafter = *APol*) which is nearly ninety years older, shoud be a Type I text. It is likely that in practice different texts will fall on a continuum between admission and avoidance. However, in circumstances where the hiatus rate is left entirely to chance it should remain statistically stable. This would throw Type I texts together. On the other hand Type II texts, which strongly avoid hiatus, may do so in different ways and to different extents.

Some Consequences

If, as Benseler believed, type II avoidance was introduced by Isocrates(8), the

only manner of avoidance before that author would then be that of the Type I text. This would make our work easy, because we could reject as spurious any Greek text showing strong avoidance and at the same time claiming fifth century authorship. In fact, it would be rash to do so, since it is evident from a prose fragment that Thrasymachus, in the fifth century, avoided hiatus(9). Thus the test for hiatus described here cannot be used by itself as a standard of authenticity. It does however measure a valuable aspect of style, and in the following pages we shall apply it to a literary question.

Rationale

Five Greek letters have come down to us from antiquity claiming as their author the fifth century B.C. Athenian dramatist Euripides. Perhaps, however, these letters are rhetorical display pieces dating from the time of the Empire. Hiatus in the *Letters of Euripides*, as they are called, should therefore be compared to hiatus in the *APol* (mentioned above), a text of acknowledged fifth century B.C. authorship. If the letters are authentic they too would have to originate in the fifth century and should show the same rate of avoidance. If they thus compare favorably with other documents of fifth century authorship, presumption of their authenticity is strengthened. Naturally, if they are spurious their fabricator might have affected a rough style. In that case, we should like to know how accurately in this respect he was able to imitate fifth century writers, if in fact such a person, creating a literary impression of Euripides, had desired to do so.

Methods of Analysis

For the investigations described in this study interactive programs available on the Bell Laboratories time-sharing UNIX system were employed. These methods and

their underlying philosophy are explained more fully in another article(10).

Absolute Hiatus Ratio

We have seen how many basic cases of hiatus are contained in each of the two main texts being compared. Making a word count by computer we can now derive a ratio. Let N represent the size of the sample in number of words with O standing for the occurrences of hiatus and R representing the ratio, e.g. -

$$\frac{O}{N} = R$$

which can also be expressed as a percentage : Text A (*APol*) consists of 3,188 words showing 511 cases. Text B, the *Letters of Euripides* (hereafter = *LEur*) consists of 1,818 words showing 293 cases of hiatus. Hence :

Text A : 511 is to 3,188 as X is to 100 = 16.03%
Text B : 293 is to 1,818 as X is to 100 = 16.12%

Texts A and B are therefore virtually identical in their admission of hiatus. Another way to look at it would be to apply a factor of .5703 to the larger number of cases in Text A.

	Text A Normalized to Text B	Text B
Vocabulary	3,188 x .5703 = 1818 words	1,818 words
Hiatus	511 x .5703 = 291 cases	293 cases

It seems remarkable that the results for the two texts so nearly coincide. Did neither of these authors eliminate hiatus by avoiding vowel concurrence ? It is

possible to do so merely by transposing a few words. What part did chance play ? Did the two authors simply permit stochastic linguistic processes to govern the occurrence of hiatus ?

With these questions in mind a third text of 737 words was selected for comparison to Texts A and B. This was the letter of the Athenian general Nicias (= *LNic*) read publicly to the senate during the Peloponnesian War and recorded by Thucydides in his *History*. If Thucydides altered or rewrote the text, or even if he composed it, this letter nevertheless exemplifies fifth century B.C. epistolary style. Besides the recently discovered lead letter of Berezan (120 words) and some brief metrical versions of letters in Euripides' plays, few examples survive from that early date. The earliest known letter comparable to the *LEur* and generally accepted as genuine is an epistle of Isocrates datable to 369 B.C. If the *LEur* are also genuine the latest one (Epistle V) would then be about 37 years older than the earliest letter of Isocrates. The *LNic* in Thucydides would not be much earlier (414 B.C.).

Using the procedures described above, the *LNic* was analyzed into 102 runs of hiatus of which 15 were multiple, i.e. consisting of two or more cases linked in succession. These 15 multiple examples yielded 32 separate cases which when added to the 87 single cases deliver a total of 119, as follows :

LETTER OF NICIAS

Strings of Hiatus		Cases
Single :	87	87
Multiple :	15	32
	102	119

Computing a ratio for the 737 words of the letter of Nicias and comparing it to the other two texts we derive :

Text A : 511 is to 3,188 as X is to 100 = 16.03%
Text B : 293 is to 1,818 as X is to 100 = 16.12%
Text C : 119 is to 737 as X is to 100 = 16.15%

These regular proportions indicate a high rate of hiatus.

The individual Types

One can also ask whether the *APol* and *LEur* differ in their treatment of the combinations of vowels. Tables 1 and 2 (below) provide information to judge whether this is so.

TABLE 1

Hiatus in the Constitution of the Athenians

	A	E	H	I	O	W	U	AI	AU	EI	EU	OI	OU	
A	14	30	9	1	3	0	1	2	2	6	0	2	5	= 75
E	10	19	1	1	10	0	2	1	4	10	3	5	5	= 71
H	14	21	3	2	5	2	2	0	4	2	0	5	6	= 66
I	8	8	3	2	2	1	0	0	1	2	0	3	8	= 38
O	6	10	3	0	0	1	0	0	1	0	1	0	5	= 27
W	6	7	7	0	3	1	0	1	0	1	0	2	0	= 28
U	0	0	2	0	0	0	0	0	0	0	0	0	0	= 2
AI	22	23	8	5	11	2	0	1	2	9	3	20	9	= 115
AU	0	0	0	0	1	0	0	0	0	0	0	0	0	= 1
EI	2	4	6	0	5	0	0	0	1	0	2	2	0	= 22
EU	0	1	0	0	0	0	0	0	0	2	0	1	0	= 4
OI	11	7	1	0	3	3	1	0	2	9	2	2	1	= 42
OU	8	5	0	1	2	1	0	0	2	1	0	0	0	= 20
	101	135	43	12	45	11	6	5	19	42	11	42	39	= 511

TABLE 2

Hiatus in the Letters of Euripides

	A	E	H	I	O	W	U	AI	AU	EI	EU	OI	OU		
A	14	16	6	0	4	3	2	0	2	5	0	2	7	=	61
E	18	13	6	0	5	1	3	0	2	3	2	0	5	=	58
H	8	7	0	0	7	0	1	0	0	1	0	0	1	=	25
I	6	9	6	1	4	0	0	1	3	1	1	2	7	=	41
O	4	5	2	0	0	1	0	0	1	0	0	0	1	=	14
W	2	3	0	0	0	0	1	0	0	1	1	0	0	=	8
U	1	0	1	0	0	0	0	0	0	0	0	0	0	=	2
AI	10	12	8	5	7	1	3	1	1	3	1	1	6	=	59
AU	0	0	0	0	0	0	0	0	0	0	0	0	0	=	0
EI	2	1	2	0	0	0	0	0	0	0	0	0	1	=	6
EU	0	0	0	2	0	0	0	0	0	0	0	0	0	=	2
OI	1	0	0	1	1	0	0	0	1	3	2	0	1	=	10
OU	1	2	2	0	0	0	2	0	0	0	0	0	0	=	7
	67	68	33	9	28	6	12	2	10	17	7	5	29	=	293

Vowels and diphthongs in the vertical column (ending words) occur before vowels and diphthongs in the horizontal column (at word beginnings). The single-character-to-single-character system of transliteration illustrated above is intended to be easily interpreted by students of Greek. However, a few explanations are in order. Greek ETA and OMEGA are represented by "h" and "w" (H and W), and XI, CHI, and PSI respectively by "x" (X), "c" (C), and "y" (Y). The internal and final SIGMA are transliterated "s" (S). The IOTA subscript is written as "j" (J). The one to one correspondence between Greek and English characters - e.g. THETA = "q" (Q) not "th", PHI = "f" (F), not "ph" - is based on mnemonic principles. The first row of figures in Table 1 reads "A before A : 14 occurrences, A before E : 16 occurrences, A before H : 6" and so on. For example if in German we had "eine Apfel" that would be a case of E before A. Starting in the same row in both tables and tracing comparisons one finds that A before A in both texts occurs 14 times. A before E shows 30 occurrences in the *APol* (Text A), but only 16 in the *LEur* (Text B). However, these comparisons lose significance because of the disparity in size between the two texts.

Normalization of Texts

To place both texts on the same basis we should multiply frequencies in the *LEur* by a factor of .3413 and frequencies in the *APol* by a factor of .1957. For example, applying the factors to the totals -

Text A : 511 cases x .1957 = 100
Text B : 293 cases x .3413 = 100

We can now normalize the tentative comparisons :

Text A : A before A = 14 x .1957 = 2.74
Text B : A before A = 14 x .3413 = 4.78

Here there is some difference. However -

Text A : A before E = 30 x .1957 = 5.87
Text B : A before E = 16 x .3413 = 5.46

If then we try H before E -

Text A : H before E = 21 x .1957 = 4.11
Text B : H before E = 7 x .3413 = 2.39

there appears to be a difference in favor of Text A. And if we try E before A -

Text A : E before A = 10 x .1957 = 1.96
Text B : E before A = 18 x .3413 = 6.14

a marked difference in favor of Text B appears.

Each of the possible 169 (13 x 13) combinations in both texts was compared in the normalized manner just illustrated. Cases where the proportional frequency is higher in one text than in the other were marked with a "+". The complete listing may be obtained from the author(11). Some examples follow (Table 3) :

TABLE 3

Normalized Comparison of Hiatus Types

	"A"		"B"	
	ATH. POL.		LETTERS	
	Times .1957		Times .3413	
A-A	14 x .1967 = 2.74		14 x .3413 = 4.78	+
A-E	30	5.87 +	16	5.46
A-H	9	1.76	6	2.05 +
A-I	1	.20 +	0	--
A-O	3	.59	4	1.37 +
A-W	0	--	3	1.02 +
A-U	1	.20	2	.68 +
A-AI	2	.39 +	0	--
A-AU	2	.39	2	.68 +
A-EI	6	1.17	5	1.71 +
A-EU	0	--	0	--
A-OI	2	.39	2	.68 +
A-OU	5	.98	7	2.39 +
	75	14.68	61	20.82 +

		Times .1957			Times .3413	
E-A	10 x .1957 =	1.96		18 x .3413 =	6.14	+
E-E	19	3.72		13	4.44	+
E-H	1	.20		6	2.05	+
E-I	1	.20	+	0	--	
E-O	10	1.96	+	5	1.71	
E-W	0	--		1	.34	+
E-U	2	.39		3	1.02	+
E-AI	1	.20	+	0	--	
E-AU	4	.78		2	.68	
E-EI	10	1.96	+	3	1.02	
E-EU	3	.59		2	.68	+
E-OI	5	.98	+	0	--	
E-OU	5	.98		5	1.71	+
	71	13.92		58	19.79	+

		Times .1957			Times .3413	
H-A	14	x .1957 =	2.74 +	8	x .3413 =	2.73
H-E	21		4.11 +	7		2.39
H-H	3		.59 +	0		--
H-I	2		.39 +	0		--
H-O	5		.98	7		2.39 +
H-W	2		.39 +	0		--
H-U	2		.39 +	1		.34
H-AI	0		--	0		--
H-AU	4		.78 +	0		--
H-EI	2		.39 +	1		.34
H-EU	0		--	0		--
H-OI	5		.98 +	0		--
H-OU	6		1.17 +	1		.34
	66		12.91 +	25		8.53

	Times .1957		Times .3413	
OI-A	11 x .1957 =	2.15 +	1 x .3413 =	.34
OI-E	7	1.37 +	0	--
OI-H	1	.20 +	0	--
OI-I	0	--	1	.34 +
OI-O	3	.59 +	1	.34
OI-W	3	.59 +	0	--
OI-U	1	.20 +	0	--
OI-AI	0	--	0	--
OI-AU	2	.39 +	1	.34
OI-EI	9	1.76 +	3	1.02
OI-EU	2	.39	2	.68 +
OI-OI	2	.39 +	0	--
OI-OU	1	.20	1	.34 +
	42	8.23 +	10	3.40

	Times .1957		Times .3413	
OU-A	8 x .1957 =	1.57 +	1 x .3413 =	.34
OU-E	5	.98 +	2	.68
OU-H	0	--	3	1.02 +
OU-I	1	.20 +	0	--
OU-O	2	.39 +	0	--
OU-W	1	.20 +	0	--
OU-U	0	--	2	.68 +
OU-AI	0	--	0	--
OU-AU	2	.39 +	0	--
OU-EI	1	.20 +	0	--
OU-EU	0	--	0	--
OU-OI	0	--	0	--
OU-OU	0	--	0	--
	20	3.93 +	8	2.72

Significance of the Comparisons

We have compared the unknown *LEur* to the known *APol* in terms of each of seven possible vowel combinations in hiatus, including the six diphthongs, as displayed in the adjacency matrices (Above, Tables 1 and 2) and recorded in the normalized examples (Table 3). How does one interpret the comparisons ? Perhaps we can ask what is happening between elidible vowels.

One obvious fact about elision is simply that short vowels are elided before long. Fortunately, Greek distinguishes certain long vowels. While "a" (ALPHA), "i" (IOTA) and "u" (UPSILON) are ambiguous in respect to quantity, "e" (EPSILON) and "o" (OMICRON) each have a long version, that of EPSILON being ETA (transliterated "h" or "H") and that of OMICRON being OMEGA ("w" or "W"). Thus in both texts we should count long vowels before short and short before long in all cases where the involved vowels are unambiguously long or short. If a text tends to annul hiatus it should place short vowels in the elidible first position (Table 4) :

TABLE 4

Quantitative Vowel Collocations

	TEXTS	
I. LONG BEFORE SHORT	A	B
H before E :	4.11 +	2.39
W before O :	.59 +	--
	4.70 +	2.39
II. SHORT BEFORE LONG	A	B
E before H :	.20	2.05 +
O before W :	.20	.34 +
	.40	2.39 +

Text A, the *APol*, places the unelidible long syllable first, leaving the short syllabe in second position where it is elidible only by aphaeresis. Text B, consisting of the five *LEur*, usually places the short syllabe first, where it is subject to elision. Hartvig Frisch, (*The Constitution of Athens*, Copenhagen, 1942, p.183) says of the "Constitution" (i.e. *APol*) "As for hiatuses, they occur in so large a number that the author does not seem to have had any stylistic intention to avoid them". That indicates a Type A text. Our computer findings confirm Frisch's impression. For example, let us test both texts in respect to combinations of hiatus involving only the long vowels. These combinations form the strongest types (Table 5).

TABLE 5

Involvement of Long Vowels

	TEXTS	
III. LONG BEFORE LONG	A	B
H before H	.59 +	--
H before W	.39 +	--
W before W	.20 +	--
W before H	1.37 +	--
	2.55 +	--

Table 5 shows that the *APol* (Text A) does indeed admit strong hiatus. The *LEur* (Text B) do not include harsh collocations of vowels.

We have seen that while both texts admit hiatus at the same rate they differ somewhat in their manner of admission, in that the *LEur* seem to provide for elision. Inductively, there are several minor features of the results that invite explanation.

Group Totals

The matrices in Tables 1 and 2, which were summed around the edges, showed that the *LEur* compared to the *APol* favor in first position A (difference = + 6.07), E (= + 5.84), and I (= + 6.50). As noted, the *APol* leads in hiatuses beginning with harsh and unelidible diphthongs and vowels (OI, AI, EI, H and W). However, in the type beginning with H an anomaly appears. H before O is higher for the *LEur*. This is owing to a number of comparisons involving "H" ("than"). Similarly, the high figure for AI before OI in the *APol* stems from enumerations leading off with KAI ("and") followed by article-noun groups in the masculine plural.

Regularity of Occurrence

The latest editor of the *LEur* determines only 21 instances of hiatus in all five epistles(12). In his opinion (p.) they show a certain "Regellosigkeit". Thus when comparing the fourth and fifth letters he finds twelve instances of hiatus in the fifth but in the fourth, "nicht wesentlich kurzer", only one. This seeming unruliness may result merely from an arbitrary definition of hiatus. Dionyius, an Atticist and a contemporary of the presumed Roman forger of the *Leur* diagnosed

hiatus freely (Dem. 43; cf. Reeve, below, n.2, p. 155). Moreover, the fourth letter is in fact essentially shorter. It consists of 544 words, as compared to the 737 words of the fifth. Indeed, despite the bother, all conceivable examples ought to be carefully tabulated. Tested on this basis the five *LEur* show consistent usage. For example, say that a run of hiatus consists of two or more occurrences in unbroken succession. For instance,

dia - - auto - - enomizomen

contains two cases : (1) dia - - auto and (2) auto - - enomizomen. Now, dividing the number of runs of hiatus in all five letters into the total word count we derive (Table 6) :

TABLE 6

Letter	No. of Words	Runs	%
I	181	21	11.60
II	159	20	12.58
III	195	30	15.38
IV	544	67	12.32
V	739	95	12.86
TOTAL	1,818	241	

To this we may add the letter of Nicias (mentioned above; = *LNic*) :

Nicias	737	102	13.84

As noted, the items counted here are not reduced into single cases. For example, the total of 241 runs of hiatus in the *LEur*, because they contain some multiple examples, yield altogether 293 cases. The variation between letters I, II and III arises from statistical fluctuations in small samples. It can be illustrated by sample grouping that these differences are not significant. Again, the *LNic* has been added for comparison (Table 7) :

TABLE 7

Hiatus Runs Regrouped

Groups	No. of Words	Runs	%
I, II, III	535	71	13.27
III, IV	739	97	13.13
IV, V	1,283	170	13.25
All Letters	1,818	241	13.26
Nicias	737	102	13.84

We shall now discuss separate instances.

Hiatus as a Measurement of Style

Here the results obtained for Texts A, B and C have been reintroduced for comparison to additional texts. This time the standard error (SE) of the percentage has been calculated by

$$\sqrt{\left(\frac{PQ}{N}\right)}$$

where P = the frequency of the item counted expressed as a proportion, Q = the proportion of possibilities not showing that item, and N = the total number of possibilities (here equated with words).

Strictly speaking, a "possibility" is an opportunity for hiatus. Thus in a text say of ten words there are really only nine sites for hiatus, since it occurs only between words. Also, if this text of ten words consists of two sentences and one is discounting hiatus at full stops, permissible sites will be reduced to eight. When thousands of words are being tested these considerations are less crucial, however, it is important that a consistent policy be followed. Tests reported in this article take into account cases not coinciding with punctuation.

For example, if among 3,188 possibilities (N) ,16.03% (P) show hiatus and 83.97% (Q) do not, then the standard error (SE) is calculated by taking the square root of : (16:03) x (83.97) / 3,188. The square root of this (.42) is .65 (below, Text A in Table 8).

TABLE 8

Comparison of Texts

CASES	WORDS	RATIO	SE
Text A : 511	3,188	16.03%	.65
Text B : 293	1,818	16.12%	.86
Text C : 119	737	16.15%	1.36
Text D : 112	1,837	6.10%	.31
Text E : 51	614	8.31%	1.11
Text F : 364	1,955	18,77%	.88

CASES	WORDS	RATIO	SE
I. Fifth century texts A, C, F : 994	5,880	16,90 %	.49
II. First century texts D, E : 163	2,451	6,65 %	.50
III. *LEur* (B) : 293	1,818	16.12 %	.86

Texts A, B and C group significantly in their avoidance of hiatus, the greatest internal difference (.12% between A and C) amounting to less than one tenth of the greater standard error (1.36%). Texts D and E represent separate samples extracted from Dionysius of Halicarnassus, a first century Atticist (below, n. 1). Text F (n. 1) shows highest admission. Texts of first and fifth century authorship fall into separate categories, the *LEur* grouping with the fifth century.

Summary

(1) Two fifth century B.C. Greek texts, the oligarchic *Constitution of the Athenians* (Text A = *APol*) and the letter of Nicias in Thucydides VII. 11-15 (Text C = *LNic*) were compared on specified grounds to the *Letters of Euripides* (Text B = *LEur*), also claiming fifth century authorship (Table 8). Hiatus occurrence in the two fifth century texts was matched by the *LEur* to within hundredths of one percent (16.03% and 16.15% as compared to 16.12%.

(2) Since A, B and C were similar in respect to frequency of hiatus, we compared the two main texts (A and B) for the manner in which hiatus is admitted. B (the *LEur*) tends to admit combinations of vowels susceptible to elision and aphaeresis.

(3) Two more samples were added from a first century B.C. author, Dionysius of Halicarnassus (Text D = 6.10% and E = 8.31%). As a further check another, fifth century B.C. text was added to the stock of controls, the *De Reditu* (ca. 410 B.C.) of the Attic orator Andocides (= 18.77%). We then summarized results for the fifth and first centuries B.C. Average avoidance for the fifth-century texts was 16.9% and for the two first-century texts 6.65%.

For the fifth-century texts the standard error was .49%; for the first-century texts it was .50% (14). The two chronological groups differed by about twenty times the greater standard error. 10,149 words comprised the experimental corpus.

Conclusion

In respect to hiatus close linguistic affinity is indicated between the *LEur* and two fifth century B.C. prose texts. In consistency of usage all five Euripidean epistles appear to be no more irregular than the individual sample sizes warrant. In this regard, the 739 word fifth letter and the 737 word letter of Nicias are virtually identical. Although this study is not intended to prove that the Euripidean epistles really are by Euripides, it does show that their authenticity is not disputable on grounds of treatment of hiatus.

Of course, texts from the first century B.C. by presumably non-Atticist authors may resemble the fifth century B.C. group. Precision results will depend on large scale batch processing of very many fifth and first century texts, which must themselves be compared to texts of other centuries. Nevertheless, I believe that this pilot study indicates that computer analysis of hiatus will indeed prove to be a valuable adjunct to other stylistic tests.

Dr. Wesley Walton
Department of Classics
University of California
Berkeley, California USA

NOTES

(1) The present article is a revised version of "Computerized Analysis of Greek Hiatus" presented for the author by Tanya Joyce at Dartmouth College, New Hampshire, USA, August 22, 1979, to the Fourth International Conference on Computing in the Humanities.

(2) Dionysius of Halicarnassus, *De Compositione Verborum*, Chaps. 21-24

Control texts entered into machine-readable form for this study were :

1. G.W. Bowersock (ed.), "Pseudo-Xenophon", *Harvard Studies in Classical Philology*, 71, 1967, 47-55, for the text of the *Constitution of the Athenians* (Text A = *APol*);
2. Hanns-Ulrich Gösswein, *Die Briefe des Euripides, Beiträge zur klassischen Philologie*, 55, Meisenheim am Glan, Verlag Anton Hain, 1975, for the Euripidean epistles (Text B = *LEur*);
3. H.S. Jones and J.E. Powell (ed.), *Thucydidis Historiae*, Oxford Univ. Press, 1942; rpt. London and New York, 1958, for the Nicias letter (Text C = *LNic*);
4. W. Rhys Roberts (ed.), *Dionysius of Halicarnassus : The Three Literary Letters*, Cambridge Univ. Press, 1901, 88-96, for portions of the first letter to Gnaeus Pompeius (Text D);
5. H. Usener and L. Radermacher (ed.), *Dionysii Halicarnasei Quae Exstant*, Vol. 5, Stuttgart, B.G. Teubner, 1899; rpt 1965, p. 3 ff., for portions from "On the Ancient Orators" (Text E);
6. Umberto Albini (ed.), *Andocide : De Reditu*, Firenze, Felice Le Monnier, 1961, 35-41, for the speech by Andocides (Text F).

(3) M.D. REEVE, *Hiatus in the Greek Novelists*, in *Classical Quarterly*, 21, 1971, p. 537, p. 516.

(4) R. RENEHAN, *Studies in Greek Texts* in *Hyponemata*, 43, 1976, pp. 153-55.

(5) J. HARWARD, *The Platonic Epistles*, Cambridge Univ. Press, 1942, p. 90.

(6) For the tests reported here all texts were pre-edited to eliminate editorial marks of elision by restoration of the elided vowels. In the resolution of crasis TALLA becomes TA ALLA.

(7) A.Q. MORTON and S. MICHAELSON, *Elision as an Indicator of Authorship in Greek Writers*, in *Revue de l'Organisation internationale pour l'Etude des Langues anciennes par Ordinateur*, no 3, 1973, pp. 33-56.

(8) G.E. BENSELER, *De Hiatu in Oratoribus Graecis*, Freiberg, Engelhardt, 1841, p. 185.

(9) H. DIELS and W. KRANZ, *Die Fragmente der Vorsokratiker*, Berlin, 1951-4, 85 B I.

(10) W. WALTON and J. JOYCE, "Computer Analysis of Hiatus", ALLC *Bulletin.* In press.

(11) Complete numerical data are available from the author, mainly in agreement with the recommendations of D. ROSS and B. BRAINERD, "Proposed Criteria for Publishing Statistical Results", ALLC *Bulletin*, Vol 6, no 3, 1978, p. 233.

(12) GOSSWEIN, *Die Briefe des Euripides*, p. 131 (above n. 1).

(13) For discussion and references see C.W. HAYES, "Sentence-level Measures", in L. DOLOZEL and R.W. BAILEY (eds.), *Statistics and Style*, New York, Elsevier, 1969, pp. 85-6.

(14) To the first century texts we may add Text G : The Letter of Augustus to the Cnidians (Last half of 6 B.C) from R.T. SHERK, *Roman Documents from the Middle East : Senatus Consultae and Epistulae*, Baltimore, Johns Hopkins University Press, 1969, p. 342. This text of 277 words contains 33 cases of hiatus yielding a proportion of 8.39%.