Epanastrophe refers to that stylistic feature wherein the final elements of a word or sentence are repeated as the initial elements of the following word or sentence (1). A case of monosyllabic epanastrophe occurs at *Aeneid* 2.27 (which ends with the words *Dorica castra*) which is notorious because of Servius' comment : "*mala est compositio ab ea syllaba incipere qua superior finitus est sermo; nam plerumque et cacenphaton facit, ut hoc loco.*" R.G. Austin notes : " . . . such collocations were not in fact avoided by Latin writers." (2). He then proceeds to cite a number of instances as support for his statement, and thus triggers the gentle polemic which follows. For Austin's citations will not help us decide whether or not Latin poets avoided monosyllabic epanastrophe. The notion of avoidance suggests that one expects to find a particular number of instances, and finds instead some significantly smaller number of actual occurrences. Perhaps "avoidance" for Austin suggests that one expects that no occurrences will be found. This, however, seems to confuse avoidance with outright prohibition. Austin's citations are sufficient to demonstrate that the practice was not prohibited. Whether or not the practice was avoided remains an open question which we intend now to examine.

In searching the corpus of materials available to me in machine-readable form (3), the computer was given a very simple set of instructions : list all cases where the final letters of a word (up to an arbitrary limit of five letters) are repeated in the same order at the beginning of the following word in the same line.

Extrait de la Revue (R.E.L.O.)
VIII, 1 à 4, 1972. C.I.P.L. - Université de Liège - Tous droits réservés.

Inspection of the results revealed a number of immediate problems of definition. For example, the first line of Lucretius so selected is :

inde ferae pecudes persultant pabula laeta (Lucr. 1.14)

This lovely line is an excellent example of Lucretian assonance, in which *pabula laeta* plays a part, but it is not clear that we have a case of monosyllabic epanastrophe given the difference of vowel quality.

Much the same objection can be raised against :

omnibus ornatus voluisti excellere rebus. (Lucr. 1.27)

where the final *e* in *excellere* is short while the *e* in *rebus* is long (4). Also problematical is the third instance found :

primum Graius homo mortalis tollere contra (Lucr. 1.66)

where the final syllable of *homo* is only part of the initial syllable of *mortalis*. The fifth instance seems unexceptionable :

quare religio pedibus subiecta vicissim (Lucr. 1.78)

but even here one could conceivably read *qua re* as two words, whereupon we have as much a case of alliteration as one of epanastrophe. It is only with the twelfth instance that we have an unquestionable example :

si cita dissiliant. nempe aer omne necessest. (Lucr. 1.385)

One could concoct a set of instructions or program which would select only unexceptionable instances (5), but it is not immediately clear that this would be to our advantage. For one thing, many interesting verses would not be brought to our attention, and we here cite the most unusual case our program listed :

confiteare et re et sonitu distare sonanti. (Lucr. 1.826)

There is no other line in the corpus quite like it.

In the second place, for the mode of argument about to be pursued, the program already described will be quite sufficiently precise. For, to adapt Thucydides' argument about the size of the Homeric navy (6), it will suffice to realize that the number of acceptable cases cannot be larger than the number of instances found by the computer search. And, as we shall see, even the larger figures will not justify startling conclusions, while the smaller figures are less significant still.

To revert to our original question, we wish to see whether or not monosyllabic epanastrophe is avoided by the poets. Similarly, it will be of interest if we find that the poets find it unusually attractive. In order to make our question quantitatively meaningful, we must formulate some hypothesis or propose some model whereby we may estimate the number of cases we can expect to find if monosyllabic epanastrophe is neither sought nor avoided. Our formulation is based upon the example of a tossed coin, and is exactly analogous to the case where labeled balls are drawn from an urn. If we toss a coin 100 times, our best estimate of the total number of "heads" is 50, but we shall not be surprised if the number is somewhere between 40 and 60, indeed less surprised than if the number turns out to be exactly 50. Turning to the example of the urn, let us imagine one filled with 100 balls of which 10 are red and 10 are black and the whole is, of course, thoroughly mixed (a problematic assumption when transferred to mixtures of words). Let us now perform the following operation 100 times : draw one ball and put it back, draw a second ball and put it back. How frequently in 100 trials may we expect to draw a red ball

followed by a black one ? The answer, by simple probability theory is once in 100 trials, but we shall not be surprised if it occurs 4 or 5 times, and it will not be at all surprising if it does not occur even once.

We turn now to a real case. Inspection of the results of the computer search reveals that by far the largest number of acceptable cases of monosyllabic epanastrophe involve the letter combination "re". Let us inspect *Aeneid* 1 more closely. If we eliminate the beginnings and endings of lines where monosyllabic epanastrophe by definition cannot occur, we find that there are 4094 internal junctures between words. There are 110 cases of initial "re" (excluding the beginnings of lines) and there are 156 instances of final "re" (excluding line-endings). It is therefore barely conceivable that we might find 110 cases of monosyllabic epanastrophe (one should allow for words both beginning and ending with "re"), but hardly likely. If we apply our model of an urn containing 4094 balls of which 156 are marked *"re"-final* and another 110 labelled *"re"-initial*, then our best estimate would be 4 occurrences (7). The actual number is 6. The disparity between 4 and 6 is measured by a statistic named chi-square which is 0.41 in this case (8). This value is not large enought to cause us either to reject our model as inapplicable or to be surprised at finding the actual number to be 6 rather than 4. *Table 1* contains a listing of our findings for a sizable part of our corpus. In no case are the numbers such as to cause us to reject our hypothetical model at even quite modest levels of significance. We should not be overly impressed by these findings. Our model may still be inappropriate, but that has not been demonstrated by the procedure described here. We may simply have used an inadequate procedure. Second, our data may be insufficient. Consider the example of Catullus 64. We have said that if

Catullus paid no attention to monosyllabic epanastrophe involving "re" we could in accordance with our model expect to find one or two cases occurring. In fact none occur, but we do not find that surprising. It is a bit sobering to note that if it were the case that Catullus deliberately avoided such collocation, the data could still not descend below the number zero. Finally, we have simply ignored the possibility that our authors choose or shun words beginning or ending with the syllable *"re"* Thus it is noteworthy that 4.96 % of the internal junctures in Lucretius 1 contain initial *"re"* while the corresponding figure for Catullus 64 is 1.73 %, a sizable disparity which we have not subjected to analysis. We have, instead, merely accepted such disparity as a given condition.

The importance of this given condition is seen with startling clarity in *Table 2* where the numbers are so puny that they would not justify tabulation, were it not for the fact that the syllable is *"ca"*, the genesis of this inquiry. The overwhelming factor here is the absolute scarcity of words ending with *"ca"*. Our procedure does suggest that syllabic epanastrophe was not deliberately sought, but the numbers are too small to suggest avoidance, for even with our model of random occurrence we should expect to find no cases.

The cases found are of some interest :

contendunt neque posse e terris in loca caeli
(Lucretius, 1.1062)
quocirca capere ante dolis et cingere flamma
(*Aeneid* 1.673)

nec civis meus est, in quem tua classica, Caesar
(Lucan 1.376)
Amphitryoniades, crudum quo Bebryca caestu
(*Achilleid* 1.190)

Not one is really respectable. We may, however, conclude that on the basis of the procedures described here, we have not demonstrated as false the hypothesis that cases of monosyllabic epanastrophe are neither sought nor avoided but are simply a random occurrence. From the nature of the case as explained above, we may be more confident in our belief that epanastrophe is not positively sought than in our belief that it is not avoided.

In the belief that it may be more instructive to work with hypotheses more amenable to falsification, we next determined to investigate uni-literal epanastrophe. We know of no notices of this stylistic feature in critical literature, but it was a natural extension of our computer search program, since cases where words begin with the same letter as the final letter of the preceding word were automatically produced.

The first two lines of the *Eclogues* are examples :

Tityre, tu patulae recubans sub tegmine fagi
silvestrem tenui musam meditaris avena

At first glance, at least, it does not seem farfetched to allege that some slight part of the charm of these lines is contributed by the junctures of

"recubans sub" and *"musam meditaris"*. But we shall see. To begin there is a great disparity between the distribution of initial and final letters in Latin. For example, the letters *'A, E, M, S, T'* constitute over 70 % of all the final letters in the internal junctures of the *Eclogues* but only about 35 % of the initials. It is, moreover, only with these five letters that we can expect to find, using the random mixture model, at least 10 cases of uniliteral epanastrophe in each of the works in the corpus at our disposal.

In *Table 3* are listed in percentage form the ratios of actual to expected values for cases of uniliteral epanastrophe involving *'A, E, M, S, T'*. *Table 3* is informative and suggestive in many ways and the following comments are addressed to points illustrated by that table.

1. The figures for Sallust in the bottom line indicate that our model of random combinations is quite a good fit for prose. Given our assumptions, it is no more than a coincidence that actual instances never outnumber predicted values.

2. It is clear that our model is not suitable for dactylic hexameter verse so far as the letter *'A'* is concerned. These are, of course, instances of elision, and it is worth noting that Lucretius' practice is significantly different from that of the other poets.

3. It is worth noting that the degree of avoidance increases as one moves down the list for *'A'*. The inference to be drawn from all this is that Sallust alone pays no attention to whether or not

epanastrophe occurs. Otherwise it seems to have become more and more fashionable to avoid elision of this sort.

4. In the case of *'E'*, avoidance is again the general rule, but not to the degree found for *'A'*. Obviously, Lucretius does not pay any attention to this sort of elision, or at least no more than Sallust. The rest of the poets tend to stabilize at a figure of about 50 % of the predicted values.

5. Epanastrophe with the letter *'M'* is neither sought nor avoided. The *Eclogues*, *Culex* and Ovid show a slight preference, if anything, but not significantly so at our chosen level of significance.

6. There is significant avoidance of epanastrophe with *'S'* in Lucretius and in *Metamorphoses* 1. Elsewhere, one detects a tendency toward avoidance except in the case of Catullus 64.

7. Practice with regard to *'T'* shows some variation. Lucretius seems to be avoiding *'T'* but the figures are not large enough to be significant at our chosen (and admittedly extreme) level. Otherwise the poets seem rather indifferent to epanastrophe with *'T'*.

Let us now hazard some guesses as to why our findings are what they are. With regard to the vowels *'A'* and *'E'*, it has long been noted that elisions involving *'E'* are avoided to a lesser degree than other sorts of elision (9). Just so we may say that epanastrophe with *'S'* is avoided, while instances with *'T'* and especially *'M'* are not. All this may be no

more than a matter of taste. There is however another possibility. Here, I refer simply to the peculiar formal demands of the dactylic hexameter verse. The hypothesis I propose to examine here is that it is not so much that epanastrophe with *'A'* or *'S'* is positively avoided, (although that may be true) as it is the case that these valuable letters are needed elsewhere, in particular, they are needed to form those short syllables so necessary to the meter. What is more, as a glance at *Table 4* will show, we are dealing with the juxtapositions of final-*S* with initial-*A* rather than the opposite. One can now see why the figures for epanastrophe with *M* are unaffected : final-*M* cannot be used with an initial vowel to establish a short syllable. All we get is ecthlipsis. The case for *'T'* is not so clear-cut, and it may be that the picture is muddied by the large proportion of words ending in "*--nt*".

Table 4, however, contains one peculiarity which is the stimulus for the final section of this paper. It is noteworthy that, unlike Vergil or Ovid, Lucretius avoids epanastrophe with *'S'* to a greater degree than epanastrophe with *'A'*. This led us to suspect that a closer examination of behavior with regard to the collocation *'S-A'* would be of interest.

This was carried out with the results shown in *Table 5* including a totally unexpected finding concerning the metrical practice of Lucretius. It is obvious that the shortness of a final syllable ending in *'S'* will be preserved whether the following initial *'A'* is scanned long or short.

Given the need to preserve short syllables, we were not surprised to find in Ovid and Vergil very high chi-square values for both *S1-A1* and *S1-A2.*

(This notation is explained at the foot of *Table 5*).

What is astounding is that while Lucretius is mightily attracted to *S1-A2*, he is apparently indifferent to the possibilities of *S1-A1*. (We might add that the same Lucretian peculiarity is found with regard to *T1-A1*).

We are presently at a loss to explain this huge difference in Lucretian practice. All that we have at the moment is tentative and no more than a partial explanation. We simply note that *S1-A1* entails a word juncture located between the two short syllables of a dactylic foot. As can be seen from *Table 6*, such junctures between words are found less frequently in Lucretius than in Vergil or Ovid, but this observation is not particularly helpful. We simply conclude by saying that the hexameter verse of Lucretius lacks a quality of suppleness and flexibility whose presence we can demonstrate quantitatively in the verse of Vergil and Ovid.

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NOTES

(1) *LSJ* s.v. with citation of Eustathius 1751.40.

(2) In his edition of *Aeneid* 2 (Oxford, 1964) p. 40.

(3) The corpus consists of Lucretius, *De Rerum Natura* I and III; Catullus 64; Vergil *Eclogues, Aeneid* I, IV, XII; *Culex*; Ovid, *Metamorphoses* I, XII; Lucan, *Pharsalia* I, X; Statius, *Achilleid*; excerpts from Sallust totalling about 10,000 words. I express here mu appreciation to the Repository of Machine-readable Texts of the American Philological Association and to the supervisor of the Repository, Dr. Stephen Waite, for supplying some of these texts.

(4) This case is cited without objection in A. Biese, *"De iteratis syllabis observatiuncula," RhM* 38 (1883) 634.

(5) For example, we might exclude all cases of monosyllabic epanastrophe involving a monosyllabic word, It would be necessary to be somewhat arbitrary about the boundaries of syllables in polysyllabic words.

(6) Thucydides I, 10.4.

(7) More exactly 4.19, the product of (11)(156)/(4094).

(8) The computation is $\frac{(|16-4.19|-0.5)^2}{4.19} + \frac{(|(4094-6)-(4094-4.19)|-0.5)^2}{(4094-4.19)}$

See Dixon and Massey, *Introduction to Statistical Analysis* (McGraw-Hill, 3rd ed., 1969) p. 239.

(9) Soubiran, J., *L'élision dans la poésie latine* (Paris, 1966) 272.

TABLE 1

Incidence of *"re"* in monosyllabic epanastrophe

Work	*Number internal junctures*	*"re" initial*	*"re" final*	*Cases observed*	*Estimate*	*Chi-square*
Lucretius 1	6043	300	303	7	15.04	3.79
Catullus 64	2019	35	87	0	1.51	0.67
Aeneid 1	4094	110	156	6	4.19	0.41
Metam. 1	4293	95	135	4	2.99	0.09
Lucan 1	3682	60	172	6	2.80	2.60
Lucan 10	2973	58	107	3	2.09	0.08
Achilleid 1	5185	97	189	5	3.54	0.26

With one degree of freedom for each entry, chi-square at the 95% level of significance is 3.84.

TABLE 2

Incidence of *"ca"* in monosyllabic epanastrophe

Work	*Number internal junctures*	*"ca" initial*	*"ca" final*	*Cases observed*	*Estimate*	*Chi-square*
Lucretius 1	6043	72	6	1	0.07	2.57
Catullus 64	2019	41	3	0	0.06	0.0
Aeneid 1	4094	65	5	1	0.08	2.23
Metam. 1	4293	105	7	0	0.17	0.0
Lucan 1	3682	91	9	1	0.22	0.35
Lucan 10	2973	101	3	0	0.10	0.0
Achilleid 1	5185	98	9	1	0.17	0.64

TABLE 3

Uniliteral Epanastrophe

Work	*A*			*E*			*M*			*S*			*T*		
	Obs	*Est*	%	*Obs*	*Est*	%	*Obs*	*Est*	%	*Obs*	*Est*	%	*Obs*	*Est*	%
Lucretius 1	32	58	55	72	80	90	32	36	89	45	86	52*	16	37	44
Lucretius 3	38	64	59	79	102	78	47	48	97	46	85	54*	22	39	56
Catullus 64	8	24	33	8	18	44	16	15	107	29	32	91	12	15	80
Eclogues	9	58	15*	17	45	38*	51	36	146	52	78	67	41	43	95
Aeneid 1	18	60	30*	27	48	58	18	24	75	50	68	73	30	41	73
Aeneid 4	16	56	29*	30	51	59	32	30	107	39	59	66	42	36	117
Aeneid 12	27	73	37*	34	64	51*	35	36	97	62	78	80	48	56	86
Culex	0	29	0*	8	18	44	17	11	155	31	40	77	19	19	100
Metam. 1	3	53	6*	28	56	50*	22	18	123	43	74	58*	43	50	86
Metam. 12	5	39	13*	20	46	44*	24	17	141	26	47	55	26	35	74
Lucan 1	3	36	8*	16	33	48	20	25	80	54	73	74	31	34	91
Lucan 10	1	30	3*	10	22	45	17	15	113	34	58	58	21	30	70
Achilleid	15	85	18*	40	77	52	30	34	88	56	93	60	70	65	107
Sallust	74	86	86	97	109	89	91	97	94	127	138	92	34	34	100

* with a chi-square value significant at the 99.95% level.

TABLE 4

Literal Collocations at Word-junctures

	A-A				*S-S*				*S-A*				*A-S*			
	Obs	*Est*	%	X^2	*Obs*	*Est*	%	X^2	*Obs*	*Est*	%	X^2	*Obs*	*Est*	%	X^2
Lucretius 3	38				46				179				61			
		64				85				113				49		
			59				54				137				125	
				10.31				18.18				38.29				3.00
Aeneid 4	16				39				133				55			
		56				59				74				45		
			29				66				180				122	
				29.08				6.52				47.43				1.86
Aeneid 12	27				62				190				58			
		73				78				106				54		
			37				80				179				107	
				28.98				3.40				67.04				0.18
Metam. 12	5				26				111				39			
		39				47				55				34		
			13				55				202				114	
				29.14				9.58				57.16				0.62

X^2 with 1 degree of freedom at 99.95 % level= 12.12

TABLE 5

Collocation of Final S and Initial A

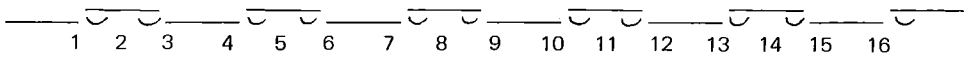
	Actual	*Expected*	*Chi-square*
Lucretius 3			
S1-A1	11	16	1.42
S1-A2	89	22	201.17
S2-A1	52	35	8.07
S2-A2	45	47	0.05
Aeneid 4			
S1-A1	29	6	95.46
S1-A2	47	15	70.71
S2-A1	22	17	1.41
S2-A2	48	44	0.33
Aeneid 12			
S1-A1	33	7	66.07
S1-A2	89	27	145.27
S2-A1	22	20	0.05
S2-A2	66	63	0.10
Metam. 12			
S1-A1	37	8	92.89
S1-A2	58	15	126.64
S2-A1	11	14	0.49
S2-A2	16	24	2.55

1 = terminating or initiating a syllable scanned short

2 = terminating or initiating a syllable scanned long

TABLE 6

Positions for juncture in the hexameter verse



Percentage of verses with word juncture at the position indicated

Position	*Lucretius 3*	*Aeneid 4*	*Aeneid 12*	*Metam. 12*
2	14	16	16	26
5	14	18	13	17
8	7	11	16	14
11	2	4	4	7
14	48	52	47	45
Totals for comparison	85	101	96	109