Letter-Distribution and Authorship in Early Greek Epics

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Résumé. Pour cette recherche, les épopées grecques sont divisées en 80 portions de texte. Celles-ci sont classées selon une analyse de groupes basée sur une comparaison des occurrences de lettres par paires au moyen du χ^2. Dans ce but, chaque occurrence d'une lettre dans un mot peut être comptée, ou on peut ne prendre en compte qu'une occurrence par mot, mais il semble préférable d'utiliser un système de pondération à poids décroissants. Bien qu'une certaine homogénéité soit attestée aussi bien dans l'*Iliade* que dans l'*Odyssée*, certains des passages les plus suspects de l'Iliade apparaissent hors du groupe de l'*Iliade*. Plus significative est la différence entre la première et la seconde moitié du poème *Les Travaux et les Jours*, habituellement attribués à Hésiode. Ces deux parties pourraient difficilement être l'œuvre du même auteur.

Keywords: Greek epics, Homer, Hesiod, authorship problems, Homeric Question, cluster analysis, letter-distribution, sound usage.

Mots-clés : Épopées grecques, Homère, Hésiode, problèmes d'attribution, question homérique, analyse de cluster, fréquence des lettres, utilisation sonore.

1. Introduction

Astonishing and not easily explained is the fact that based exclusively on letter-distributions, text portions of *ca.* 1,000 words (or more) can be attributed with a high degree of certainty to the correct author and often even to the appropriate work[1]. A few years ago, G.R. Ledger could demonstrate this

[1] *I.e.* the simple frequencies of the letters of the alphabet.

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phenomenon for quite some number of prose works of classical Attic[2], but he did not give an explanation. Later, in his book on the chronology of Plato's works[3], he tried to explain a special case in the appendix. Having found that an increasing frequency of ν and a decreasing frequency of ι at the end of words are most important in the chronology of Plato's works, he compared the frequencies of words like εἰ, ἐστί, ὅτι, μοι etc. in Plato's *Euthyphro* and *Critias*. Indeed they proved to be more frequent in the *Euthyphro*, which is an early work. By this type of argument, sound characteristics must appear to be a mere consequence of the choice of words. Ledger did not take into account phenomena such as the more cautious avoidance of hiatus in Plato's later works: an avoidance partly connected with the more frequent use of movable ν.

On the other hand, an argument can be made that in some respect the choice of sounds may have influenced the choice of words and endings. In my *Sprachstatistische Untersuchungen zu den Briefen und Reden des Libanios*[4], I arranged the *Epistles* into groups according to the year when they were written, and I classified these year-groups just as Ledger classified his 1,000-word-portions of classical Attic prose, *i.e.* by cluster analysis. In the classification obtained, the various parts of the corpus of *Epistles* appeared in a system of groups and subgroups, which corresponds well to the actual chronology. In the following example, the parts of the *Epistle*-corpus are represented by the year they were written, and the grouping obtained is represented by a system of parentheses:

$$\Big(\Big(\big((355(356,357)),(359(358,360))\big),\big((362(361,363),(364,365))\big)\Big),$$
$$\big((388,390),(391(392,393))\big)\Big)$$

As can be seen, the late *Epistles* (second line) are well separated from the earlier ones (first line), and only the groups 359 and 362 deviate slightly

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[2] LEDGER (Gerard R.): 1985, "A New Approach to Stylometry", *Association for Literary and Linguistic Computing Bulletin*, XIII, 3, pp. 67–72. Within each word, Ledger counted only the mere occurrence of any letter (instead of using the exact letter frequencies). He obtained similar results, when taking into account only the last three letters of a word.

[3] LEDGER (Gerard R.): 1989, *Re-counting Plato. A Computer Analysis of Plato's Style* (Oxford: The Clarendon Press).

[4] My 'Habilitationsschrift', hitherto unpublished. Other than Ledger, I started from the exact letter-frequencies.

from the correct chronological order. If Libanius' *Speeches*, too, are arranged in certain groups and introduced into the classification, the *Epistle*-groups remain clearly separated from the *Speech*-groups. So far Ledger's results are confirmed by my own, and it may be added that letter-distributions yield meaningful classifications not only as far as authors and individual works are concerned, but also with respect to chronology[5]. Furthermore, in the *Epistles* of Libanius long term trends of increasing or decreasing frequency of the letters ν, ρ, ξ, ψ, χ and φ can be detected. These trends cannot be sufficiently explained by any influence of single words[6]. It must be assumed that a multitude of words exerts a similar influence, and this would mean that the choice of words is influenced by certain trends in the use of sounds. Such tendencies may correspond to changes in euphonic feeling.

It is not the purpose of this paper to come to a clear decision of whether letter-distributions are mainly influenced by the simple choice of words and endings or whether this choice is in its turn influenced by principles of sound usage in a characteristic way. At present I would favour the second possibility. From this point of view, a letter-distribution may be understood as a type of sound-spectrum. It describes what might be called the overall sound or acoustical forming of a text. Yet whatever may be the right explanation of the characteristics of letter-distributions, the above remarks hopefully show that they are of some importance.

Does it make sense to transfer a statistical procedure, which has proved successful for authors of Attic and Atticistic prose, to epic language? My initial doubts came less from the fact that epic language is an artificial one, a mixture not only of different dialects but also of older and younger layers. More important seemed to be that older text-passages might have been penetrated by younger sections. The main obstacle, however, could be that the formulaic character of epic language and the influence of rhapsodic tradition might not have left enough freedom for individual formulation and acoustic formation. On the other hand, one could hope that the use of sounds was observed more diligently in poetry than in prose. In any case it was necessary to include

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[5] In the case of Libanius, a restriction to the last three letters of a word yields less satisfying results.

[6] An influence of single words should appear at least in the case of καί and of the article, the most frequent words in Libanius. καί becomes more and more frequent in the *Epistles*, and it shows the strongest trend of all words. Thus the letters κ, α and ι should become more frequent in the later *Epistles*, but they do not so. Similar observations can be made in the case of the article. Less frequent words and words with weaker trends will obviously not reach any conceivable influence of καί or the article.

control groups in the study, *i.e.* text portions where the relationships are clear and the authors known. Only such control groups would provide the possibility of comparison, so that, *e.g.*, the classification of the text portions of *Iliad* and *Odyssey* could be judged and interpreted. For this purpose I have included the *Argonautica* of Apollonius Rhodius, divided into nine parts. First I intended to concentrate on the Homeric Question and to use the works of Hesiod as a second control group, but the results show that the Homeric poems can better be regarded as a control group for the works usually attributed to Hesiod. Anyway, the parts of the *Argonautica* should form a special subgroup in the classification, and this subgroup should stand rather apart from the old hexametric poetry, since Apollonius Rhodius belongs to the Hellenistic period. This is the most important criterium that a meaningful result should fulfill. The control groups and the texts studied must of course be works of the same literary genre, since the example of Libanius' *Epistles* and *Speeches* has shown that the genre, too, may influence the letter-distributions.

2. The method

The basic material for my study are the machine readable texts of the *Thesaurus Linguae Graecae* in Irvine (California), in particular *Iliad* and *Odyssey*, the four longer *Homeric Hymns* (to *Demeter*, *Apollo*, *Hermes* and *Aphrodite*), the works attributed to Hesiod (*Theogony*, *Works and Days*, *Scutum*, *Fragments*) and the *Argonautica* of Apollonius Rhodius. These texts, however, had to be prepared for my special purposes, *i.e.* title-lines and other non-text had to be deleted, adscript ι (in the Fragments of Hesiod) and subscript ι (in the other texts) had to be unified, reference numbers had to be generated, and the files had to be split into small ones, namely into the text portions which were to be classified by cluster analysis. In the simplest case, these text portions or sections correspond to single books of the *Iliad* or the *Odyssey*, but where Analysts had isolated a major part of a book, the book had to be divided into two parts, at least in the more important cases. It is clear that this partitioning must follow the lines of analytic theses, since my aim is to check a variety of such theses by means of automatic classification according to letter-distributions, *i.e.* by means of an independent criterion. As to Hesiod and Apollonius Rhodius, the text sections are chosen mainly according to the contents. The four *Homeric Hymns* have not been split. Following is a list of the various text sections and of the corresponding abbreviations used.

Iliad:

Il. 1	A	
Il. 2c	B_2	(494–779) catalogue of Achaean ships.
Il. 2r	B_1	(1–493, 780–877) remainder.
Il. 3	Γ	
Il. 4	Δ	
Il. 5	E	
Il. 6h	Z_2	(237–502) scene between Hector and Andromache.
Il. 6r	Z_1	(1–236, 503–529) remainder.
Il. 7a	H_1	(1–322) duel between Hector and Aeneas.
Il. 7b	H_2	(323–482) burials, the wall is built.
Il. 8g	Θ	(1–52, 350–484) scenes with gods.
Il. 8r	Θ	(53–349, 485–565) remainder.
Il. 9p	I	(430–605) speech of Phoenix.
Il. 9r	I	(1–429, 606–713) remainder.
Il. 10	K	Doloneia.
Il. 11a	$Λ_1$	(1–596) three Achaean leaders wounded.
Il. 11b	$Λ_2$	(597–848) Nestoris.
Il. 12	M	
Il. 13	N	
Il. 14	Ξ	
Il. 15	O	
Il. 16	Π	
Il. 17	P	
Il. 18a	$Σ_1$	(1–467)
Il. 18b	$Σ_2$	(468–617) the shield of Achilles.
Il. 19	T	
Il. 20a	$Υ_1$	(156–308) perhaps from Aeneas-poem.
Il. 20b	$Υ_2$	(1–155, 309–503) remainder.
Il. 21	Φ	
Il. 22	X	
Il. 23a	$Ψ_1$	(1–257) funeral of Patroclus.
Il. 23b	$Ψ_2$	(257–897) funeral games.
Il. 24	Ω	

Odyssey (only the last book is split):

Od. 24a	$ω_1$	(1–204) scene in the nether world.
Od. 24b	$ω_2$	(205–548) remainder.

Theogony:

Th. 1	*Theogony* 1–616, introduction and genealogy of the gods.
Th. 2	*Theogony* 617–964, fights of the gods.
	[*Theogony* 965–1022, liaisons of goddesses and mortals, excluded]

Works and Days:

Op. 1 *Opera* 1–382, introduction, exhortation and myths.
Op. 2 *Opera* 383–693, instructions for farming and shipping.
[*Opera* 694–763, practical advices, perhaps genuine, but precautionarily excluded]
[*Opera* 764–828, good and bad days, excluded as spurious]

Fragments of the Catalogue:

Fr. 1 *Fragments* 1–121, 123, 245, Aeolidae.
Fr. 2 *Fragments* 122, 124–159, Inachi progenies,
Fragments 160–168, Pelasgi progenies,
Fragments 205–244, Catalogi fragmenta incertae sedis.
Fr. 3 *Fragments* 169–204, Atlantides.

Other Fragments:

Fr. 4 *Fragments* 246–262, Megalai Eoiai,
Fragments 263–342, various contents.
[*Fragments* 343–363, Fragmenta dubia, excluded]
[*Fragments* 364–413, Spuria, excluded]

Argonautica:

Arg. 1a book I, 1–608.
Arg. 1b book I, 609–1362.
Arg. 2a book II, 1–647.
Arg. 2b book II, 648–1285.
Arg. 3a book III, 1–743.
Arg. 3b book III, 744–1407.
Arg. 4a book IV, 1–551.
Arg. 4b book IV, 552–1222.
Arg. 4c book IV, 1223–1781.

Experience shows that each of the text sections considered should have at least 1,000 words, and this quantity is usually reached with *ca.* 150 hexametric verses. Therefore the following suspected passages could not be treated as separate text portions:

B	336–397	speeches of Nestor and Agamemnon.
B	459–493	similes and address to the Muses.
Z	119–236	perhaps from a Glaucus-poem.
σ	214–243	according to Schadewaldt an addition.
τ	395–466	according to Wilamowitz an interpolation.
ψ	297–372	ψ_2.

Th. 411–452 Hecate-passage.
Th. 820–880 Typhoeus-passage.

The letter-distributions of the examined text portions are shown in a set of four tables. Tab. 1 records the mere occurrence of the letters in the words. For each text part and each letter of the alphabet it gives the number of words which contain this letter. In a way, this table counts only the first (or only the last) occurrence of a letter in a word; it provides the type of information used by Ledger in his investigation of Attic writers. Tab. 2 shows how many words contain a given letter at least twice; thus it counts the second (or second from last) occurrence of a letter in a word[7]. In the same way, Tab. 3 and Tab. 4 count the third and the fourth occurrences, respectively. If these four tables are cellwise summed up, the real letter-frequencies are obtained with sufficient accuracy, since very few words contain a given letter five times[8].

The tabulation of the letter-frequencies in separate tables, just as in layers, enables us to start our investigation with the simple occurrence of the letters in the words and to add stepwise the second, the third and the fourth occurrences. This yields a series of four classifications, the first corresponding to the way chosen by Ledger and the last corresponding to my way of proceeding in the case of Libanius. In this way, a premature decision for one method or the other can be avoided, however the problem of choice and judgment arises.

From any two rows of a letter-distribution-table, as obtained by cellwise summation, a dissimilarity coefficient has been calculated for the corresponding pair of text portions. For this coefficient I have chosen the χ^2-value which results from testing two distributions for equality. The more different the distributions, the higher the χ^2-value, so that it resembles a distance measure. Indeed, as the Euclidean distance is the square root of a sum of squares (cf. Pythagoras), so the χ^2-value is a sum of squared differences, but these differences are normed, so that text portions of different length may well be compared. The dissimilarity coefficients have been gathered in a table, which much resembles a table of distances between towns. This dissimilarity table has been taken as the basis for automatic classification by cluster analysis,

[7] Note that first, last, second etc. do not necessarily refer to the natural order of the letters in the word. The results would be the same for any permutation of the letters within a word.

[8] Indeed these words are so few that any possible effect is eliminated by the weighting procedure described below and by mere rounding off in the subsequent calculation steps. There is, by the way, no word in the texts regarded which contains a letter six or more times.

Table 1

Frequencies of the first occurrence of a letter in a word

	a	b	g	d	e	z	ē	th	i	sub	k	l	m	n	x	o	p	r	s	t	y	ph	ch	ps	ō
Il.1	1838	133	325	659	2049	46	807	346	1770	158	600	613	694	1483	63	1627	702	843	1319	1156	800	213	249	21	567
Il.2c	786	37	144	249	830	17	397	152	775	60	303	304	272	846	17	856	265	392	559	596	328	91	134	3	235
Il.2r	1809	102	347	617	1835	56	759	327	1633	142	605	570	610	1504	71	1487	624	829	1287	1082	760	223	249	18	613
Il.3	1419	57	229	529	1485	29	591	243	1370	142	541	461	518	1125	66	1181	453	708	985	841	536	185	207	17	424
Il.4	1604	97	262	565	1748	48	643	324	1540	134	549	561	610	1328	66	1495	629	835	1353	1034	654	183	233	21	557
Il.5	2668	184	444	1068	2925	79	1111	482	2467	242	853	908	1030	2265	141	2524	961	1348	1932	1654	1226	336	452	33	869
Il.6b	835	32	139	277	844	16	348	167	792	87	315	273	307	595	26	706	306	377	568	483	336	85	107	8	213
Il.6r	771	55	126	288	818	17	346	164	732	74	282	257	278	671	45	711	280	387	540	477	341	113	113	9	236
Il.7a	944	45	160	386	1038	28	365	173	941	93	337	289	363	795	38	825	339	461	701	607	406	110	151	9	340
Il.7b	470	22	76	187	504	10	212	88	460	28	174	133	174	422	20	459	179	238	329	301	206	45	59	11	145
Il.8g	514	28	96	181	621	20	234	128	500	55	184	170	204	472	20	481	238	271	405	362	287	64	63	7	186
Il.8r	1066	85	166	400	1222	24	471	200	1011	80	391	329	388	962	54	1002	450	606	787	690	490	147	163	7	396
Il.9p	514	28	92	160	536	14	215	117	490	50	196	216	205	427	20	493	215	225	351	302	238	66	56	7	147
Il.9r	1615	73	265	617	1826	41	703	312	1617	146	553	573	616	1286	71	1395	552	704	1219	955	687	191	198	15	472
Il.10	1639	95	272	714	1832	31	766	334	1631	137	573	558	658	1457	74	1597	640	822	1298	1093	797	239	182	29	564
Il.11a	1739	131	280	716	1920	51	675	303	1609	136	595	583	615	1480	97	1631	678	907	1328	1116	813	253	251	20	599
Il.11b	725	48	117	285	861	16	305	138	722	60	225	290	267	629	20	688	327	359	540	453	312	78	101	8	240
Il.12	1427	97	199	479	1519	41	520	264	1339	107	442	452	477	1113	70	1310	579	751	1082	910	643	171	241	28	461
Il.13	2488	173	370	933	2633	44	997	475	2375	234	807	838	959	2075	104	2373	902	1262	1903	1553	1089	308	432	37	788
Il.14	1501	97	258	586	1668	47	690	312	1398	153	514	486	614	1325	61	1441	607	760	1098	952	707	213	216	26	472
Il.15	2201	134	340	768	2397	51	921	471	2044	192	724	682	795	1922	86	2071	824	1088	1694	1374	964	301	327	29	726
Il.16	2480	192	350	992	2762	64	1054	469	2287	252	930	911	962	2163	95	2425	1082	1381	1914	1604	1141	360	410	48	860
Il.17	2321	128	339	825	2461	59	856	454	2096	192	779	772	830	1899	73	2053	852	1164	1685	1460	967	306	363	28	808
Il.18a	1448	47	227	496	1559	41	573	293	1324	114	500	494	553	1100	49	1198	557	700	971	899	670	206	203	20	434
Il.18b	452	33	60	190	529	13	176	80	390	40	152	151	155	417	17	404	172	229	302	304	179	54	64	4	105
Il.19	1320	62	217	460	1394	30	541	249	1206	110	417	428	503	1082	47	1113	462	646	949	798	544	155	185	20	375
Il.20a	461	25	84	191	502	10	190	96	433	36	151	153	159	372	16	414	163	224	353	267	188	36	69	4	128
Il.20r	1057	64	141	379	1149	21	435	259	969	76	327	374	396	833	52	936	396	479	772	628	457	131	179	20	348
Il.21	1824	100	313	689	2014	55	723	363	1705	144	609	627	700	1396	86	1731	733	932	1354	1092	858	241	285	41	536
Il.22	1495	59	254	586	1706	27	646	299	1446	139	578	575	583	1215	60	1424	601	716	1156	966	695	184	225	30	496
Il.23a	790	38	101	302	856	24	294	157	726	53	280	267	293	618	22	683	341	381	542	468	363	111	120	16	205
Il.23b	1853	105	308	800	2079	26	744	391	1762	154	585	653	674	1595	69	1757	738	889	1438	1226	835	210	296	32	599
Il.24	2476	117	435	881	2688	67	1003	450	2365	235	871	804	864	1999	114	2210	918	1213	1804	1528	1058	300	295	42	710
Od.1	1291	65	218	452	1440	35	614	311	1339	124	417	397	506	1151	49	1283	517	611	966	872	553	160	142	15	355
Od.2	1299	47	213	471	1404	25	632	270	1237	107	420	403	535	1084	26	1202	487	544	957	892	599	142	140	20	331
Od.3	1568	75	270	542	1651	40	626	381	1419	105	469	516	533	1292	62	1374	561	680	1088	945	634	144	193	24	396
Od.4	2510	144	429	940	2791	65	1115	562	2387	221	818	838	1034	2164	100	2350	929	1152	1822	1574	1122	325	249	32	742
Od.5	1549	74	244	585	1642	38	684	340	1350	133	514	479	569	1219	59	1285	579	706	1036	902	653	200	146	40	435
Od.6	1053	55	169	365	1026	21	460	212	936	102	355	350	401	804	34	812	377	422	708	607	444	150	107	10	279
Od.7	1060	47	193	385	1177	21	465	254	988	87	381	319	396	913	41	920	403	450	742	635	457	131	92	14	281
Od.8	1804	88	268	723	1859	37	739	357	1717	139	639	591	630	1426	94	1679	635	861	1296	1085	709	286	272	21	500
Od.9	1689	89	271	582	1873	43	723	366	1579	132	580	612	712	1470	63	1582	613	789	1243	1004	802	224	159	51	471
Od.10	1786	93	277	638	1974	26	804	376	1534	158	634	560	710	1518	71	1463	598	862	1211	1035	747	251	183	31	471
Od.11	1867	115	336	646	2170	49	869	361	1781	168	669	625	796	1686	73	1701	694	851	1265	1169	803	229	235	40	569
Od.12	1307	110	290	456	1557	38	728	283	1210	146	485	449	524	1167	63	1172	494	624	927	862	643	171	111	37	365
Od.13	1354	74	227	492	1423	30	618	274	1305	131	445	429	483	1121	38	1159	537	565	983	808	526	183	129	18	382
Od.14	1568	110	272	577	1814	48	680	302	1564	126	564	525	614	1370	71	1489	581	683	1168	1003	722	206	171	29	458
Od.15	1623	95	283	621	1822	39	750	341	1616	156	578	573	646	1392	78	1553	618	766	1176	1067	752	210	184	23	493
Od.16	1413	81	272	540	1591	44	627	313	1401	103	452	416	589	1183	43	1323	467	640	1054	925	694	192	165	15	398
Od.17	1821	135	321	692	1977	63	786	320	1701	138	611	580	702	1488	84	1667	689	837	1297	1197	896	207	179	33	544
Od.18	1294	67	218	483	1384	33	558	245	1278	106	445	395	531	1061	45	1143	451	618	946	782	509	158	157	14	370
Od.19	1724	86	255	705	1979	44	811	314	1705	172	645	576	713	1501	91	1711	678	801	1332	1127	822	242	176	33	550
Od.20	1213	62	185	480	1287	45	503	239	1126	91	436	357	487	942	45	1063	399	526	855	784	535	141	126	15	333
Od.21	1245	69	180	506	1418	32	574	277	1195	106	463	396	491	1022	118	1146	447	545	945	877	592	171	143	16	363
Od.22	1537	92	253	628	1620	44	611	314	1282	128	505	482	606	1205	74	1365	536	681	1145	953	725	195	206	20	444
Od.23	1129	55	190	409	1188	32	534	244	989	90	379	384	444	884	34	1017	437	514	814	660	523	171	123	21	326
Od.24a	669	26	102	204	654	8	278	122	560	63	199	215	246	524	22	541	201	270	416	416	261	68	83	13	181
Od.24b	966	47	182	445	1162	25	423	204	944	69	355	309	378	849	43	991	387	469	785	677	476	147	126	18	316
Th1	1859	107	364	606	1936	53	904	446	1667	169	734	557	630	1570	69	1584	655	943	1265	1352	808	219	190	29	518
Th2	1067	73	180	337	1172	30	489	240	933	89	330	296	324	894	34	914	343	549	783	740	472	146	128	15	245
Op1	1114	80	241	473	1257	60	506	271	1175	134	482	369	368	962	34	1039	405	589	843	695	476	131	108	24	331
Op2	912	80	143	316	976	43	448	185	859	103	310	285	341	774	31	846	359	517	661	604	393	107	113	14	277
Sc	1385	97	236	553	1530	41	578	260	1330	121	506	502	516	1211	41	1337	523	730	1021	906	696	231	257	20	443
Fr1	1419	89	250	482	1351	34	703	314	1267	122	541	497	458	1244	55	1231	502	710	950	891	594	160	163	13	409
Fr2	582	46	98	219	584	13	291	119	561	43	255	222	189	558	21	520	209	319	407	352	259	82	59	10	175
Fr3	844	54	139	296	756	20	386	160	714	62	346	310	287	698	20	687	266	420	546	495	319	119	85	8	254
Fr4	503	32	82	172	510	21	269	105	480	31	196	138	182	423	11	432	178	249	355	300	199	74	54	5	142
Dem	1540	80	256	571	1466	47	717	401	1308	123	535	449	581	1208	53	1296	577	761	1023	886	683	215	152	18	458
Ap	1642	136	222	501	1683	38	748	415	1578	116	608	557	529	1374	72	1502	674	779	1188	999	690	209	178	24	451
Herm	1745	170	239	648	1759	65	776	338	1576	133	632	607	700	1469	54	1678	628	866	1291	1021	849	231	165	37	544
Aphr	909	51	156	311	923	36	430	216	845	92	293	255	322	705	33	759	308	398	684	592	388	127	90	16	210
Arg.1a	1734	116	267	656	1858	45	865	378	1784	183	606	631	656	1551	71	1654	676	880	1380	1057	730	218	152	21	471
Arg.1b	2196	143	333	785	2359	60	1071	448	2203	195	709	730	826	2007	100	2034	852	1095	1756	1406	1016	255	219	58	506
Arg.2a	1906	138	282	709	2065	45	889	378	1850	178	586	565	729	1683	97	1702	737	968	1495	1228	846	261	159	45	520
Arg.2b	1836	136	271	670	1936	49	866	351	1869	180	618	597	719	1718	101	1729	683	855	1369	1214	845	255	181	43	448
Arg.3a	2151	110	318	838	2424	42	1073	471	2263	205	722	681	868	1813	113	1998	803	1054	1672	1383	906	305	236	32	592
Arg.3b	1998	117	286	746	2034	57	983	402	1876	208	640	639	752	1709	91	1801	731	930	1504	1165	827	275	175	29	520
Arg.4a	1604	90	270	568	1693	40	830	319	1590	192	520	501	635	1501	81	1496	601	790	1239	965	728	207	188	37	383
Arg.4b	2069	130	311	676	2075	45	1012	370	1982	191	690	687	718	1753	89	1712	681	952	1563	1190	900	255	223	35	439
Arg.4c	1616	136	262	589	1759	49	819	336	1662	137	515	551	672	1467	68	1460	614	802	1270	1013	718	227	226	40	409

Table 2

Frequencies of the second occurrence of a letter in a word

	a	b	g	d	e	z	ē	th	i	sub	k	l	m	n	x	o	p	r	s	t	y	ph	ch	ps	ō
Il.1	475	4	9	7	464	0	77	11	279	0	13	144	53	217	1	276	41	36	197	82	38	1	1	0	15
Il.2c	239	3	1	8	178	0	33	1	116	0	8	42	23	148	0	189	16	21	115	46	22	1	1	0	8
Il.2r	452	2	17	8	427	0	45	8	285	0	25	90	55	223	0	287	39	31	201	61	36	1	5	0	21
Il.3	318	1	12	8	384	0	35	3	222	0	24	71	21	169	1	233	46	37	143	48	27	0	3	0	22
Il.4	355	4	14	12	424	0	59	2	223	0	24	84	42	185	3	292	48	32	197	78	32	0	3	0	33
Il.5	605	8	22	69	631	0	100	3	383	0	33	151	62	293	3	449	94	68	234	109	50	1	1	0	43
Il.6b	190	3	5	8	211	0	38	5	129	2	18	57	15	92	1	136	26	7	88	23	7	0	1	0	8
Il.6r	173	3	5	13	209	0	18	2	143	0	12	53	25	100	3	124	26	14	81	34	18	0	0	0	14
Il.7a	238	1	6	8	233	0	35	3	160	0	8	44	21	120	1	162	26	19	91	37	22	0	1	0	15
Il.7b	115	0	7	7	104	0	9	0	84	0	7	21	13	68	0	81	10	12	40	21	9	0	1	0	6
Il.8g	122	0	5	1	140	0	27	7	74	0	11	33	7	53	0	106	23	12	49	26	19	0	0	0	6
Il.8f	235	3	12	23	256	0	31	2	173	0	13	58	20	154	2	178	48	26	111	37	27	1	2	0	23
Il.9b	113	1	2	3	125	0	14	2	73	0	13	58	10	65	0	90	18	15	49	20	8	0	0	0	6
Il.9r	429	3	15	23	386	0	42	12	261	0	17	119	50	180	0	206	33	25	193	81	36	3	0	0	11
Il.10	396	4	20	37	464	0	59	8	256	0	20	101	50	196	0	233	69	36	211	70	51	5	3	0	29
Il.11a	436	6	25	24	395	0	38	4	266	1	27	93	36	215	6	294	69	38	190	60	38	4	1	0	23
Il.11b	157	10	7	5	206	0	26	7	136	0	13	52	19	76	0	124	31	13	66	27	22	1	1	0	5
Il.12	347	3	11	8	343	0	20	9	199	0	13	82	28	158	1	215	45	45	169	74	33	0	3	0	16
Il.13	625	12	27	17	641	0	71	8	360	0	28	134	73	287	4	413	65	53	287	109	43	0	4	0	36
Il.14	381	4	12	9	382	0	55	5	214	0	17	68	36	213	2	276	37	39	169	80	42	0	1	0	13
Il.15	511	4	25	12	588	0	61	7	334	1	31	128	44	302	3	362	67	45	248	95	48	1	4	0	27
Il.16	597	18	18	15	669	0	88	7	334	1	35	143	64	327	2	444	90	65	276	105	47	2	2	0	31
Il.17	529	8	21	12	568	0	46	5	327	3	29	108	50	265	1	370	63	37	241	83	30	0	4	0	31
Il.18a	357	0	16	12	328	0	39	9	269	1	18	72	33	159	0	221	38	24	139	55	24	0	1	0	19
Il.18b	103	0	3	5	109	0	8	0	77	0	5	28	8	46	0	94	9	24	55	21	6	0	0	0	9
Il.19	345	3	12	15	300	0	32	5	205	0	12	90	41	158	0	194	30	19	169	62	25	1	1	0	6
Il.20a	115	1	4	7	121	0	14	3	73	0	9	37	11	59	1	72	10	6	56	18	4	0	0	0	5
Il.20r	251	0	8	8	259	0	37	3	159	0	17	75	17	108	3	158	31	15	117	37	20	0	0	0	13
Il.21	404	1	5	11	526	0	50	7	248	0	31	130	30	196	3	317	34	57	178	65	45	0	1	0	16
Il.22	344	3	17	11	373	0	49	3	199	4	28	111	31	166	1	240	37	27	153	80	24	1	1	0	21
Il.23a	189	1	6	4	186	0	13	3	120	0	8	66	24	102	0	151	20	8	83	23	12	2	0	0	8
Il.23b	448	6	15	26	520	0	66	3	293	0	19	127	32	177	1	325	124	57	206	106	46	0	1	0	29
Il.24	497	2	32	21	603	0	58	6	329	2	40	167	46	248	2	383	56	35	209	80	31	1	1	0	17
Od.1	267	1	6	12	342	0	49	3	209	0	20	75	22	175	0	252	29	21	150	67	28	0	1	0	13
Od.2	284	1	7	7	356	0	62	5	207	0	28	75	23	154	0	211	21	24	176	61	39	3	0	0	6
Od.3	362	2	4	13	394	0	62	7	210	1	19	97	23	160	1	260	53	21	156	75	30	0	1	0	10
Od.4	566	2	17	14	711	0	76	12	344	2	35	140	54	308	1	450	90	49	275	107	65	2	1	0	20
Od.5	353	2	5	17	345	0	37	3	188	0	18	96	21	159	0	210	29	27	194	59	38	0	0	0	7
Od.6	224	2	9	7	222	0	36	1	164	0	16	54	9	105	0	183	13	21	105	27	29	1	0	0	8
Od.7	222	1	9	5	265	0	42	2	156	0	12	61	14	132	0	174	18	20	125	38	36	1	0	0	10
Od.8	368	4	16	24	431	0	43	3	288	1	27	103	28	159	1	314	40	33	185	89	58	2	0	0	10
Od.9	383	2	12	14	462	0	19	5	273	0	54	109	32	195	0	263	35	41	212	74	29	2	0	0	15
Od.10	428	2	13	13	448	0	29	9	211	0	69	94	28	184	0	253	40	46	189	77	51	0	0	0	10
Od.11	444	4	6	11	519	0	67	7	276	0	28	110	62	235	1	313	48	41	177	93	48	0	0	0	17
Od.12	306	5	10	6	333	0	22	8	220	0	35	91	21	159	1	207	22	31	132	68	38	1	0	0	4
Od.13	321	3	8	10	325	0	48	5	205	0	20	79	21	131	0	183	39	16	150	52	33	1	0	0	8
Od.14	358	1	14	14	392	0	34	4	235	0	20	125	25	191	1	241	38	26	210	63	48	1	0	0	13
Od.15	363	3	11	8	419	0	50	3	262	1	18	114	25	188	0	247	58	27	167	72	45	2	0	0	18
Od.16	310	1	17	5	380	0	52	5	216	1	20	96	29	184	0	220	41	22	175	58	50	1	0	0	9
Od.17	406	4	9	17	494	0	66	3	255	2	35	106	23	225	0	306	61	32	211	84	48	1	0	0	15
Od.18	319	2	5	14	337	0	51	5	209	0	28	84	26	151	0	202	33	23	160	45	40	0	0	0	10
Od.19	401	4	4	14	432	0	52	5	263	1	24	113	43	217	0	317	52	38	214	76	99	2	0	0	13
Od.20	272	2	4	11	280	0	57	3	166	2	24	77	30	144	0	208	30	33	156	44	38	1	0	0	16
Od.21	234	2	5	3	374	0	55	5	198	0	20	72	19	172	0	273	27	27	178	48	51	0	0	0	9
Od.22	374	5	11	13	411	0	59	3	208	2	21	71	27	184	1	279	46	22	213	67	70	0	0	0	14
Od.23	253	1	8	6	308	0	31	4	148	0	25	81	15	121	0	144	34	24	111	50	44	0	0	0	9
Od.24a	169	0	5	2	127	0	23	0	82	0	13	44	28	86	0	114	15	13	60	23	12	1	0	0	7
Od.24b	225	0	8	6	292	0	38	6	151	1	14	46	19	116	0	171	26	11	114	50	36	0	0	0	2
Th1	407	2	12	8	415	0	68	3	296	0	37	69	26	251	2	339	43	53	182	105	64	1	0	0	22
Th2	252	0	11	4	250	0	32	3	174	0	16	49	14	161	0	197	13	43	126	100	45	0	0	0	10
Op1	256	2	8	9	267	0	21	4	213	0	41	60	14	113	1	182	18	21	118	48	31	0	0	0	16
Op2	237	1	5	6	194	0	29	6	137	0	23	46	13	120	0	198	20	25	96	61	20	1	0	0	14
Sc	282	8	9	21	335	0	48	1	219	0	23	65	27	169	0	283	44	43	158	75	42	0	1	0	15
Fr1	324	3	9	10	266	0	59	0	208	0	15	79	31	190	1	207	36	27	115	64	44	0	0	0	21
Fr2	159	0	1	3	128	0	20	2	107	0	7	26	13	78	0	99	17	18	59	32	21	0	1	0	8
Fr3	180	1	7	21	187	0	34	1	138	0	9	52	21	119	1	138	19	15	63	32	29	1	1	0	13
Fr4	106	0	5	2	102	0	10	1	83	0	13	16	6	59	0	90	15	12	41	24	11	2	0	0	7
Dem	381	0	20	10	366	0	52	7	203	0	25	78	16	185	0	240	42	34	146	66	42	2	0	0	22
Ap	409	5	13	16	416	0	51	7	281	0	18	120	29	196	0	267	35	47	182	63	40	1	0	0	21
Herm	453	5	21	14	438	0	51	1	237	0	12	109	20	209	0	302	36	51	138	79	36	0	0	0	12
Aphr	222	0	11	7	211	0	32	2	157	0	12	38	16	104	0	144	22	14	77	45	24	1	0	0	9
Arg.1a	393	1	19	15	474	0	79	6	342	1	26	86	33	234	1	388	45	43	249	65	42	0	0	0	13
Arg.1b	524	5	19	24	585	0	86	8	430	0	25	124	36	336	0	455	67	54	270	80	58	1	0	0	12
Arg.2a	481	11	14	19	517	0	63	9	338	1	27	93	38	267	0	380	40	51	253	89	37	1	0	0	11
Arg.2b	457	7	12	14	495	0	52	3	348	0	24	97	29	293	2	418	47	47	259	95	32	2	0	0	11
Arg.3a	492	4	19	17	644	0	92	8	391	0	35	112	57	250	1	371	66	51	267	104	36	0	0	0	7
Arg.3b	495	7	24	13	494	0	87	8	334	0	27	107	46	255	1	379	58	65	268	86	32	1	0	0	20
Arg.4a	322	4	13	6	394	0	57	3	289	0	24	67	29	226	0	340	37	33	219	70	29	0	0	0	6
Arg.4b	467	2	15	10	480	0	77	5	379	1	32	108	34	283	0	435	33	35	251	66	45	3	0	0	8
Arg.4c	406	6	15	8	442	0	59	3	291	0	23	68	38	204	0	322	55	28	204	86	25	2	0	0	9

Table 3

Frequencies of the third occurrence of a letter in a word

	a	b	g	d	e	z	ē	th	i	sub	k	l	m	n	x	o	p	r	s	t	y	ph	ch	ps	ō
Il.1	34	0	0	0	77	0	0	0	25	0	1	1	0	8	0	28	0	0	25	5	0	0	0	0	0
Il.2c	27	0	0	0	27	0	4	0	8	0	0	0	0	2	0	16	0	0	7	3	5	0	0	0	0
Il.2r	45	0	2	0	92	0	2	0	26	0	2	2	0	4	0	36	2	0	24	4	5	0	0	0	0
Il.3	24	0	0	1	54	0	1	0	35	0	0	6	0	5	0	31	0	1	14	4	0	0	0	0	0
Il.4	27	0	1	0	74	0	0	0	17	0	1	6	0	5	0	32	1	0	29	6	1	0	0	0	0
Il.5	54	0	0	1	112	0	4	0	30	0	0	14	6	9	0	72	2	1	27	10	5	0	0	0	0
Il.6h	13	0	1	0	45	0	0	0	13	0	1	2	0	0	0	18	0	0	10	0	0	0	0	0	0
Il.6r	21	0	0	0	49	0	1	0	13	0	0	6	1	3	0	27	0	0	8	1	2	0	0	0	0
Il.7a	29	0	0	0	46	0	0	0	7	0	1	2	0	2	0	34	0	0	12	2	1	0	0	0	0
Il.7b	16	0	0	1	26	0	0	0	5	0	0	2	0	2	0	9	0	0	4	2	0	0	0	0	0
Il.8g	15	0	0	0	38	0	0	0	8	0	0	0	0	0	0	19	0	0	4	2	1	0	0	0	0
Il.8r	26	0	0	0	48	0	0	0	10	0	0	3	0	2	0	17	0	1	9	3	2	0	0	0	0
Il.9p	9	0	0	0	32	0	0	0	3	0	1	1	1	3	0	15	0	1	9	0	0	0	0	0	0
Il.9r	32	0	1	0	72	0	0	0	25	0	1	0	2	4	0	23	0	0	30	5	1	0	0	0	0
Il.10	36	0	0	0	86	0	2	0	28	0	1	3	1	8	0	25	1	2	26	6	2	0	0	0	0
Il.11a	53	0	0	2	65	0	3	0	23	0	0	6	0	8	0	39	2	1	29	4	4	0	0	0	0
Il.11b	17	0	0	1	34	0	1	0	7	0	2	1	0	0	0	11	0	0	12	2	6	0	0	0	0
Il.12	31	0	0	0	50	0	1	0	16	0	0	3	0	4	0	20	0	0	20	5	3	0	0	0	0
Il.13	67	0	0	1	99	0	0	0	26	0	0	8	1	12	0	56	2	1	35	8	1	0	0	0	0
Il.14	36	0	0	0	60	0	1	0	17	0	1	6	0	8	0	41	4	2	24	7	5	0	0	0	0
Il.15	60	0	0	0	105	0	2	0	27	0	0	6	1	14	0	45	0	0	27	7	3	0	0	0	0
Il.16	61	0	0	0	112	0	1	0	34	0	0	9	0	13	0	49	0	0	27	8	2	0	0	0	0
Il.17	53	0	1	0	91	0	2	0	22	0	1	4	3	7	0	58	0	0	27	8	1	0	0	0	0
Il.18a	37	0	0	2	43	0	0	0	10	0	0	3	1	5	0	30	0	1	17	2	0	0	0	0	0
Il.18b	13	0	0	0	7	0	0	0	6	0	0	5	0	2	0	4	0	1	5	3	1	0	0	0	0
Il.19	31	0	0	0	43	0	1	0	22	0	0	0	1	3	0	29	0	1	27	3	1	0	0	0	0
Il.20a	12	0	0	0	18	0	0	0	4	0	0	6	1	4	0	7	0	0	4	2	0	0	0	0	0
Il.20r	20	0	0	0	44	0	0	0	7	0	0	3	2	8	0	20	0	0	13	1	3	0	0	0	0
Il.21	35	0	0	1	90	0	2	0	17	0	0	3	0	15	0	47	1	1	20	6	1	0	0	0	0
Il.22	38	0	0	1	71	0	1	0	14	0	0	3	2	7	0	26	0	0	17	7	1	0	0	0	0
Il.23a	26	0	1	0	33	0	0	0	6	0	2	1	0	6	0	27	1	0	9	1	1	0	0	0	0
Il.23b	48	0	0	0	101	0	0	0	33	0	0	4	0	7	0	29	0	0	18	10	0	0	0	0	0
Il.24	51	0	0	4	123	0	2	0	19	0	0	3	6	12	0	44	0	0	19	6	1	0	0	0	0
Od.1	27	0	0	0	40	0	1	0	19	0	1	2	1	7	0	29	0	0	25	1	0	0	0	0	0
Od.2	26	0	1	0	69	0	0	0	18	0	0	1	0	6	0	21	0	0	32	3	0	0	0	0	0
Od.3	32	0	0	0	64	0	3	0	17	0	1	2	0	3	0	30	0	0	31	1	0	0	0	0	0
Od.4	65	0	0	0	126	0	0	0	26	0	2	3	3	10	0	40	0	1	49	9	2	0	0	0	0
Od.5	31	0	0	0	68	0	1	0	9	0	1	7	0	2	0	20	2	1	34	3	0	0	0	0	0
Od.6	36	0	0	0	41	0	0	0	24	0	1	1	0	3	0	19	1	0	14	1	0	0	0	0	0
Od.7	27	0	0	0	51	0	0	0	12	0	2	1	0	2	0	17	0	0	26	2	2	0	0	0	0
Od.8	39	0	0	0	77	0	0	0	21	0	0	2	3	1	0	49	0	1	33	7	0	0	0	0	0
Od.9	38	0	0	0	84	0	0	0	20	0	1	4	0	4	0	33	0	1	28	4	1	0	0	0	0
Od.10	37	0	0	0	80	0	1	0	14	0	0	6	2	7	0	25	3	2	33	3	1	0	0	0	0
Od.11	37	0	0	0	94	0	1	0	21	0	1	0	1	5	0	27	1	2	19	11	4	0	0	0	0
Od.12	27	0	0	0	45	0	0	0	17	0	0	1	0	3	0	18	0	1	13	3	0	0	0	0	0
Od.13	31	0	1	0	71	0	0	0	16	0	1	1	1	6	0	23	0	0	28	3	1	0	0	0	0
Od.14	32	0	0	0	66	0	1	0	12	0	0	2	1	9	0	26	2	0	32	2	0	0	0	0	0
Od.15	31	0	0	0	68	0	0	0	21	0	1	2	0	2	0	36	2	0	27	1	1	0	0	0	0
Od.16	34	0	0	0	72	0	0	0	15	0	0	3	2	5	0	15	0	0	34	4	1	0	0	0	0
Od.17	39	0	0	0	88	0	0	0	20	0	0	3	0	11	0	23	0	1	42	3	1	0	0	0	0
Od.18	33	0	0	0	65	0	0	0	19	0	1	4	0	5	0	26	0	0	25	2	0	0	0	0	0
Od.19	44	0	0	0	89	0	0	0	17	0	0	2	1	7	0	36	2	1	52	5	3	0	0	0	0
Od.20	22	0	0	0	49	0	0	0	21	0	0	4	0	4	0	20	1	0	28	2	0	0	0	0	0
Od.21	27	0	0	0	72	0	1	0	18	0	0	2	0	15	0	35	0	1	33	2	0	0	0	0	0
Od.22	32	0	0	0	72	0	0	0	8	0	1	3	1	4	0	30	1	1	43	3	1	0	0	0	0
Od.23	27	0	0	0	60	0	0	0	8	0	0	5	1	5	0	19	0	0	22	5	2	0	0	0	0
Od.24a	14	0	0	0	30	0	0	0	7	0	1	3	1	5	0	12	1	0	13	2	0	0	0	0	0
Od.24b	20	0	0	0	53	0	0	0	17	0	0	2	1	3	0	18	2	0	27	1	0	0	0	0	0
Th1	81	0	0	0	69	0	3	0	35	0	2	1	1	14	0	31	0	5	16	3	2	0	0	0	0
Th2	40	0	0	0	43	0	1	0	15	0	0	6	0	5	0	18	0	0	22	2	1	0	0	0	0
Op1	30	0	0	0	31	0	1	0	13	0	0	3	1	2	0	17	1	1	12	1	1	0	0	0	0
Op2	34	0	0	0	19	0	0	0	8	0	2	0	4	4	0	21	0	1	18	6	1	0	0	0	0
Sc	40	0	0	0	43	0	6	0	16	0	1	7	1	4	0	23	1	1	25	6	3	0	0	0	0
Fr1	54	0	0	0	36	0	5	0	22	0	1	3	0	9	0	26	0	0	9	0	2	0	0	0	0
Fr2	26	0	0	1	23	0	1	0	6	0	0	1	1	3	0	8	0	1	5	1	2	0	0	0	0
Fr3	30	0	0	0	35	0	2	0	6	0	0	1	0	0	0	20	1	0	11	0	5	0	0	0	0
Fr4	12	0	0	0	22	0	1	0	13	0	1	0	0	0	0	18	1	0	3	0	1	0	0	0	0
Dem	61	0	1	0	58	0	11	0	12	0	3	5	0	7	0	23	1	1	20	6	1	0	0	0	0
Ap	45	0	1	0	63	0	0	0	22	0	1	3	0	7	0	24	0	0	25	2	0	0	0	0	0
Herm	64	0	0	0	76	0	1	0	18	0	0	4	0	6	0	45	0	2	22	6	1	0	0	0	0
Aphr	38	0	0	1	26	0	0	0	12	0	1	0	1	4	0	15	0	2	5	1	2	0	0	0	0
Arg.1a	38	0	0	1	76	0	0	0	34	0	2	3	0	14	0	39	0	2	33	6	3	0	0	0	0
Arg.1b	34	0	0	0	109	0	0	0	34	0	0	2	0	17	0	49	2	0	29	6	0	0	0	0	0
Arg.2a	50	0	0	0	83	0	0	0	28	0	0	5	1	9	0	29	0	0	35	5	1	0	0	0	0
Arg.2b	36	0	0	0	86	0	0	0	41	0	1	5	1	19	0	55	1	0	34	8	0	0	0	0	0
Arg.3a	61	0	0	0	132	0	0	0	41	0	2	4	1	14	0	34	2	1	38	10	0	0	0	0	0
Arg.3b	69	0	0	0	81	0	0	0	36	0	1	5	2	10	0	48	0	0	32	3	1	0	0	0	0
Arg.4a	37	0	0	0	60	0	0	0	26	0	1	1	0	9	0	42	0	1	31	10	0	0	0	0	0
Arg.4b	42	0	0	1	67	0	0	0	31	0	0	3	1	11	0	60	0	0	28	3	0	0	0	0	0
Arg.4c	34	0	1	0	75	0	0	0	22	0	2	0	0	13	0	38	1	1	20	4	1	0	0	0	0

Table 4

Frequencies of the fourth occurrence of a letter in a word

	a	b	g	d	e	z	ē	th	i	sub	k	l	m	n	x	o	p	r	s	t	y	ph	ch	ps	ō
Il.1	1	0	0	0	11	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Il.2e	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.2r	2	0	0	0	7	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.3	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
Il.4	3	0	0	0	8	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.5	3	0	0	0	13	0	0	0	0	0	0	2	0	0	0	6	0	0	1	0	0	0	0	0	0
Il.6h	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Il.6r	0	0	0	0	6	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Il.7a	1	0	0	0	7	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Il.7b	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Il.8g	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Il.8r	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Il.9p	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Il.9r	3	0	0	0	14	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.10	2	0	0	0	13	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Il.11a	2	0	0	0	5	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.11b	2	0	0	0	8	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Il.12	2	0	0	0	4	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.13	6	0	0	0	4	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
Il.14	1	0	0	0	8	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Il.15	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0
Il.16	6	0	0	0	8	0	0	0	0	0	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0
Il.17	5	0	0	0	7	0	0	0	1	0	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0
Il.18a	2	0	0	0	5	0	0	0	2	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
Il.18b	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Il.19	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Il.20a	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Il.20r	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Il.21	3	0	0	0	8	0	0	0	1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
Il.22	4	0	0	0	3	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Il.23a	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Il.23b	3	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Il.24	4	0	0	0	13	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
Od.1	4	0	0	0	3	0	0	0	1	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0
Od.2	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Od.3	6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Od.4	4	0	0	0	10	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
Od.5	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Od.6	1	0	0	0	2	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Od.7	3	0	0	0	10	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Od.8	6	0	0	0	7	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Od.9	1	0	0	0	9	0	0	0	3	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Od.10	3	0	0	0	14	0	0	0	3	0	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0
Od.11	2	0	0	0	8	0	0	0	1	0	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0
Od.12	2	0	0	0	11	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Od.13	3	0	0	0	5	0	0	0	1	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
Od.14	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
Od.15	0	0	0	0	12	0	0	0	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
Od.16	5	0	0	0	5	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Od.17	4	0	0	0	12	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Od.18	1	0	0	0	4	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Od.19	7	0	0	0	13	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Od.20	4	0	0	0	9	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Od.21	4	0	0	0	8	0	0	0	2	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
Od.22	3	0	0	0	11	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Od.23	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Od.24a	0	0	0	0	6	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Od.24b	0	0	0	0	10	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Th1	2	0	0	0	4	0	0	0	4	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0
Th2	1	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Op1	4	0	0	0	5	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Op2	2	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2	0	0	1	0	0	0	0	0	0
Sc	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0
Fr1	5	0	0	0	5	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Fr2	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Fr3	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Fr4	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Dem	3	0	0	0	12	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0
Ap	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
Herm	1	0	0	0	14	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Aphr	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Arg.1a	2	0	0	0	6	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Arg.1b	1	0	0	0	10	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Arg.2a	4	0	0	0	11	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Arg.2b	3	0	0	0	10	0	0	0	3	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0
Arg.3a	4	0	0	0	11	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Arg.3b	9	0	0	0	8	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Arg.4a	3	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Arg.4b	6	0	0	0	3	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Arg.4c	3	0	0	0	5	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0

following the average-linkage pair-group method. The resulting system of groups and subgroups is usually represented by a dendrogram. For the present study, I have standardized my dendrograms[9] so that the last union, *i.e.* that of the most dissimilar groups, occurs always at a standardized dissimilarity of 100. The corresponding scales are given together with the dendrograms.

3. Results

In this section, I shall describe the mainlines of my proceeding from the first result (Fig. 1) to the last (Fig. 4), which also seems to be the best one. Fig. 2 and Fig. 3 are not the only intermediate results, but the others (so far as they are of any interest) can be described with a few words by reference to these four dendrograms. It is important to show how the results partly fluctuate and partly remain stable, as the basic data and the way of using this data changes. Furthermore, it is necessary to discuss the arguments for any preference of one result over another.

The dendrogram of Fig. 1 is based on Tab. 1 only, *i.e.* on the simple occurrence of the letters in the words. The nine parts of the *Argonautica* form a well separated cluster, which does not include other text portions. Obviously the classification is meaningful, and this is corroborated by some features of interest:

1) There is a large Homeric cluster, which contains almost all of *Iliad* and *Odyssey*, but very little of other authors. This cluster differs from the group of other old epics almost as much as from the *Argonautica*.
2) There is a very homogeneous *Iliad*-cluster, which contains 24 of the 33 *Iliad* parts.
3) Both parts of the *Theogony* and all three parts of the *Catalogue* constitute the correct groups. The first part of *Works and Days*, however, is very isolated.
4) There is also an *Odyssey*-cluster, but it contains eight parts of the *Iliad* (*Il.* 3, *Il.* 9r, *Il.* 24, *Il.* 19, *Il.* 6h, *Il.* 9p, *Il.* 7b, *Il.* 10), two of the *Homeric Hymns* (Dem., Aphr.) and the fourth section of the Hesiodic fragments (*Fr.* 4 [10]). Four books of the *Odyssey* appear rather isolated (*Od.* 2, *Od.* 8, *Od.* 3, *Od.* 9), while *Od.* 12 and *Od.* 21 stand outside the Homeric cluster.

[9] The standardization is obtained by simple linear transformation.

[10] Fragments of various works and doubtful authority.

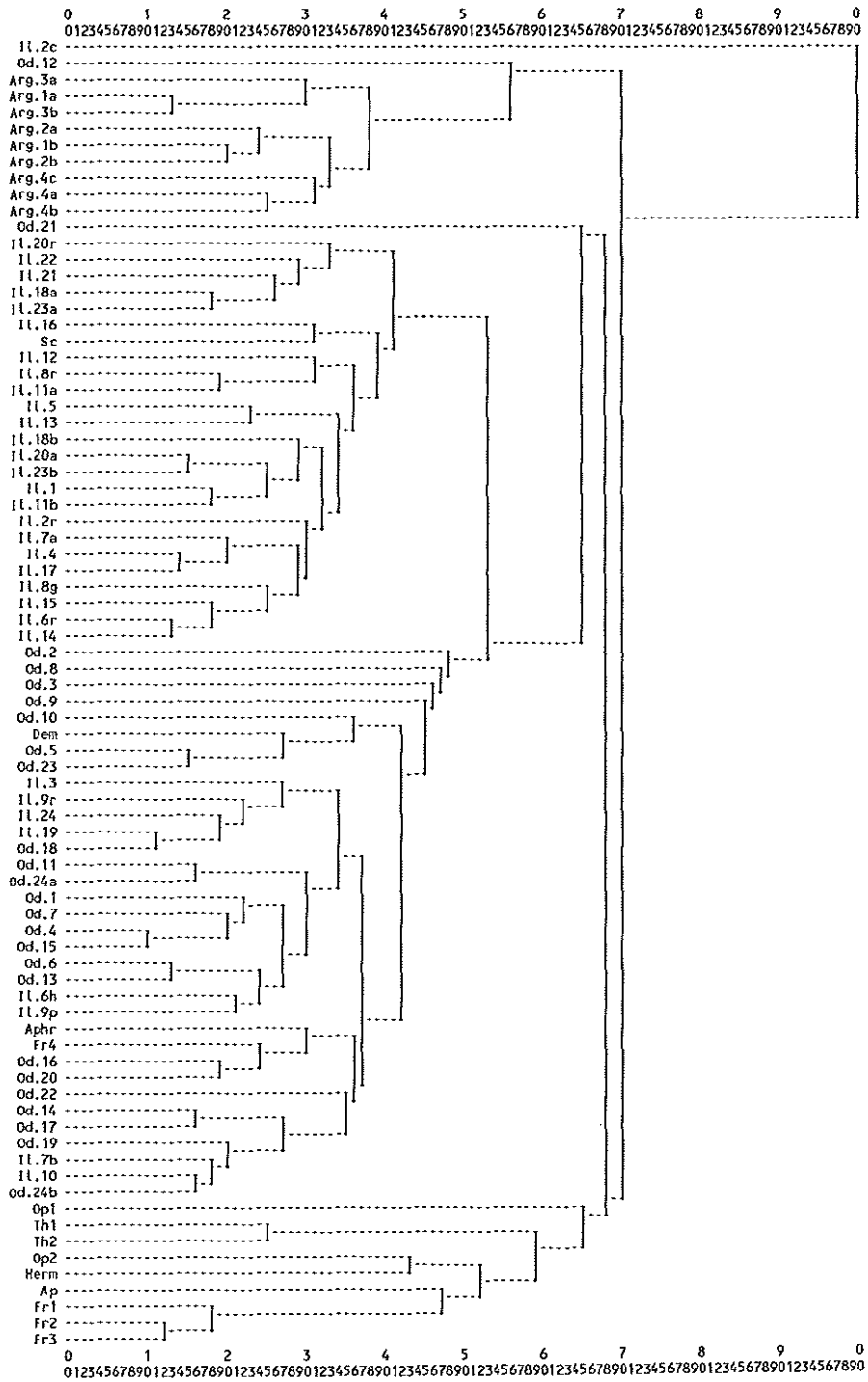

Fig. 1.– Only one occurrence of a letter in a word counted; scale value 100 = cluster-distance 108.3

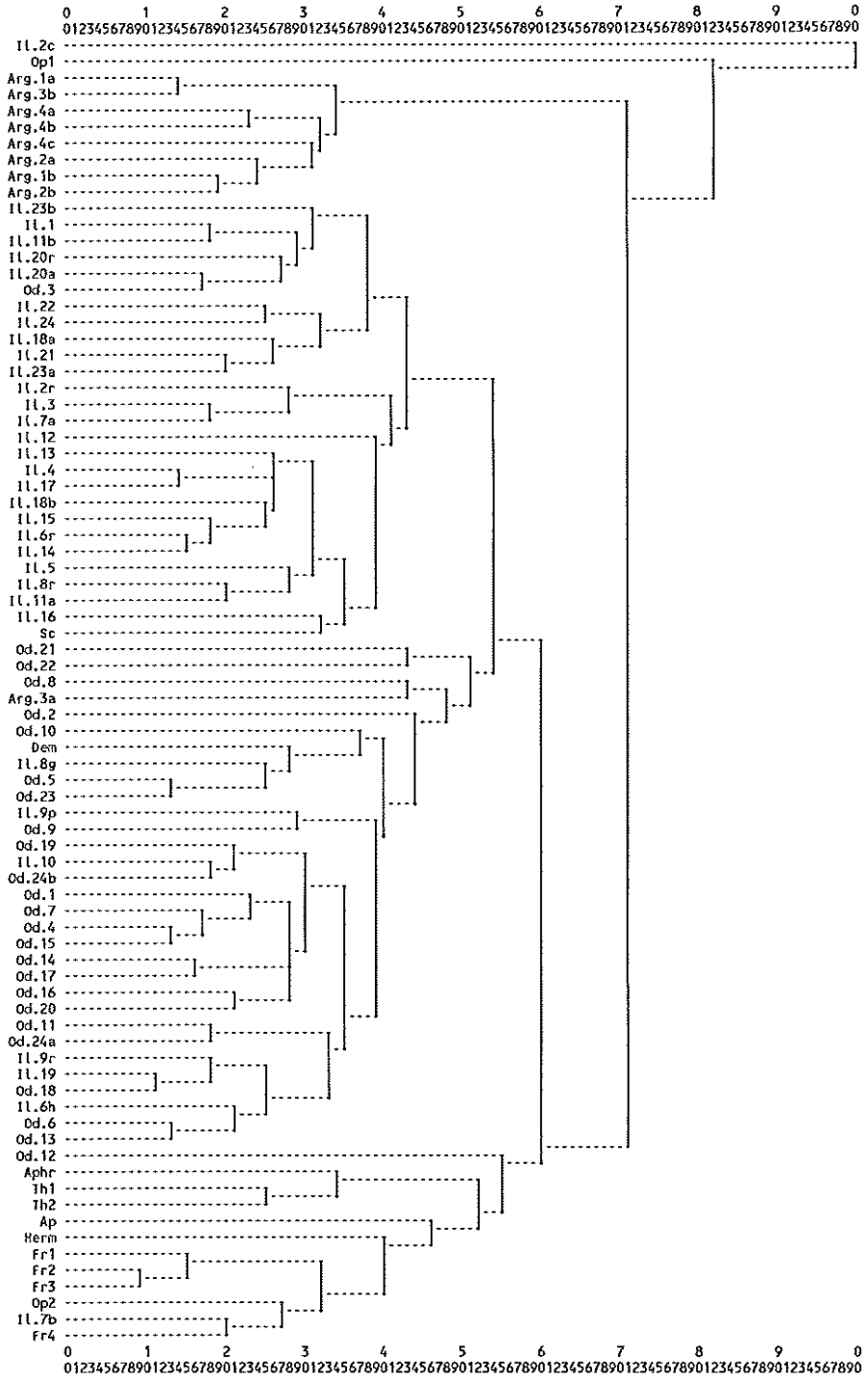

Fig. 2.– Up to two occurrences of a letter in a word counted; scale value 100 = cluster-distance 124.7

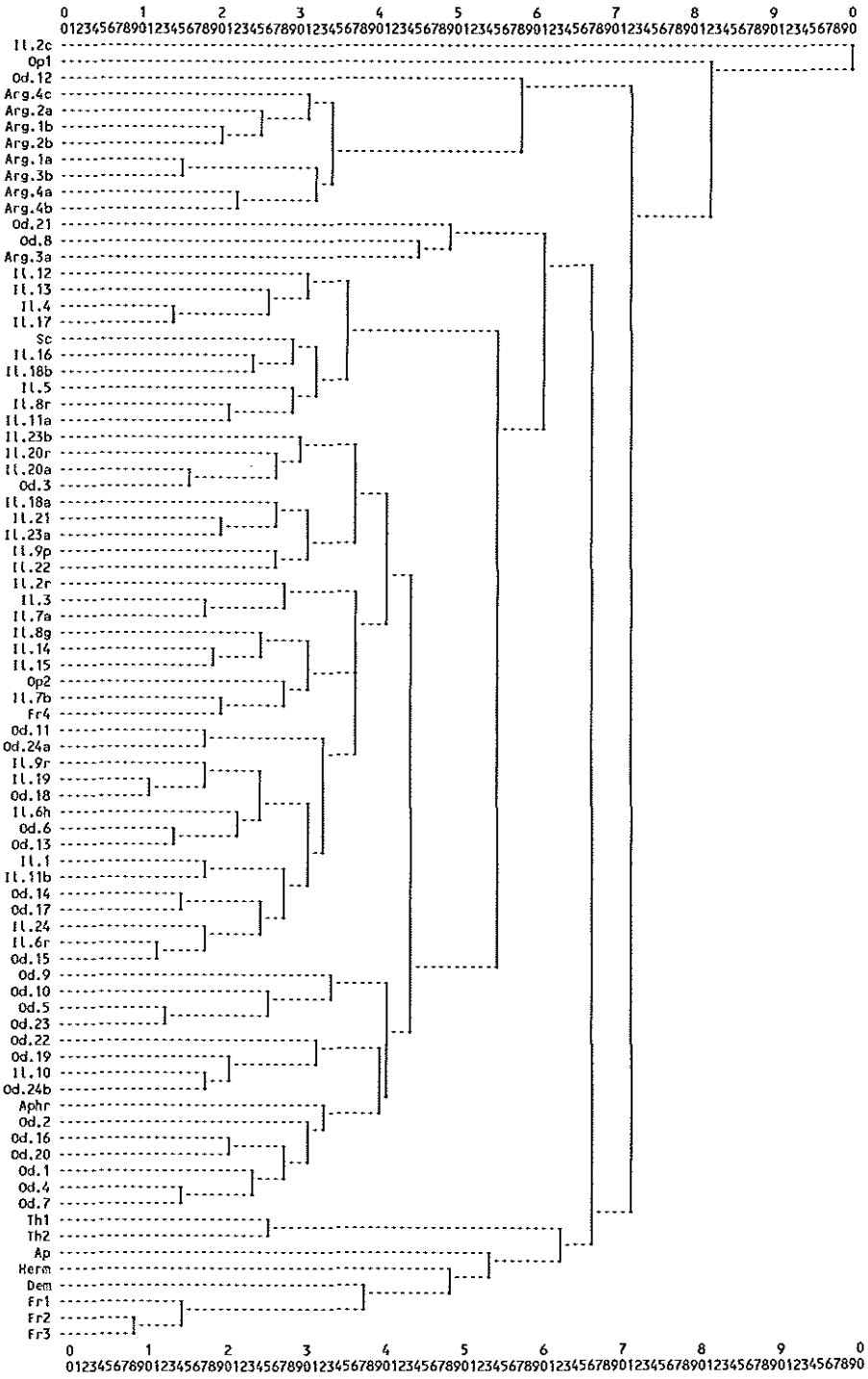

Fig. 3.– Up to three occurrences of a letter in a word counted; scale value 100 = cluster-distance 125.7

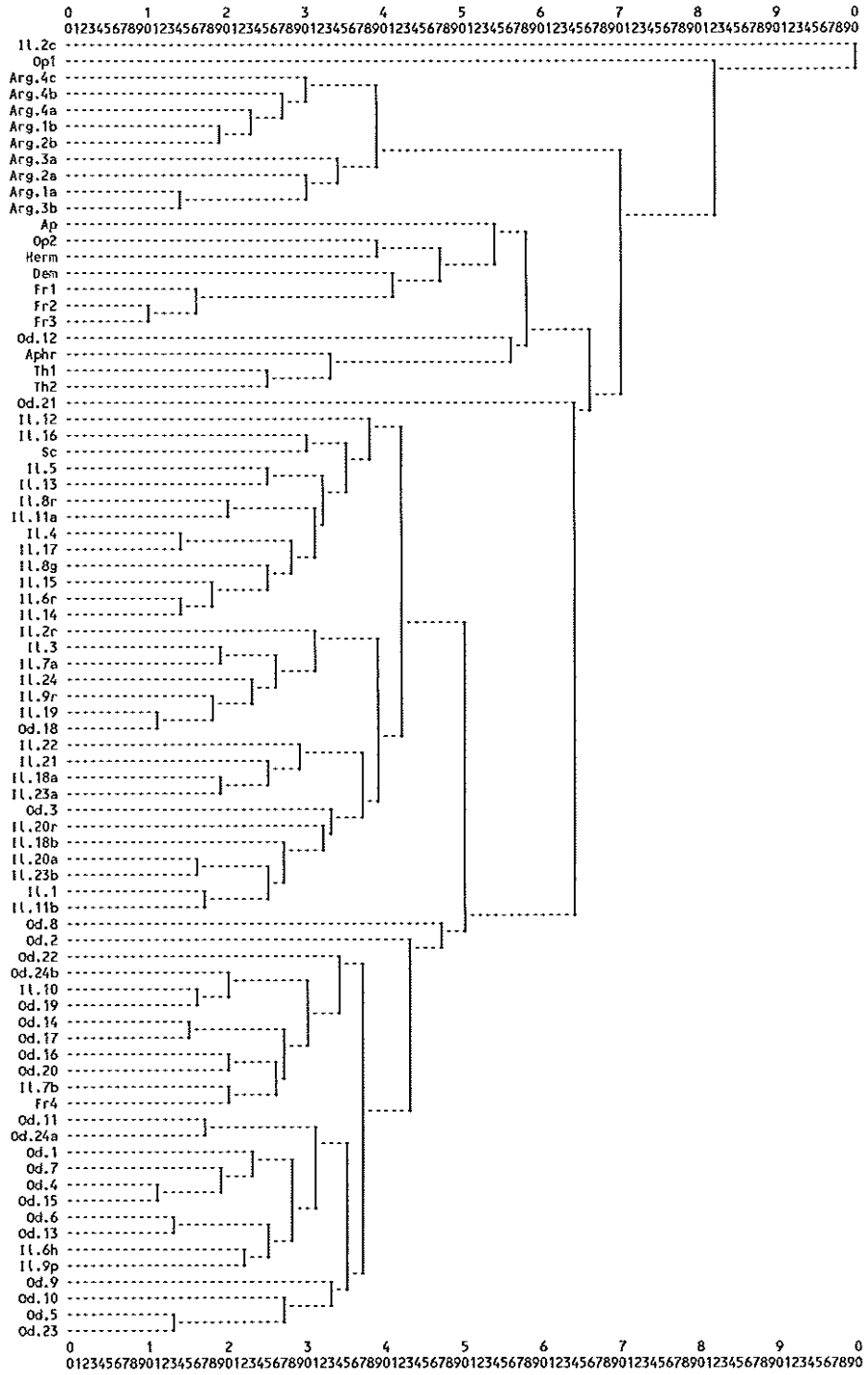

Fig. 4.– Up to four occurrences of a letter in a word counted, with weights 1, ½, ⅓, ¼; max dist. 115.7

5) The Achaean catalogue (*Il.* 2c) stands apart from all the other text parts. Even the *Argonautica* are more similar to the old epics.

The dendrogram of Fig. 2 is based on the 'first' and the 'second' occurrence of a letter in a word. It differs from the previous one mainly in the following respects:

1) There emerges an old-epics-cluster as opposed to the *Argonautica* (with the exception of *Arg.* 3a).
2) The *Odyssey*-cluster is more homogeneous; it contains only six parts of the *Iliad* (*Il.* 8g, *Il.* 9p, *Il.* 10, *Il.* 9r, *Il.* 19, *Il.* 6h) and only a single *Homeric Hymn* (Dem.), but it also contains one part of the *Argonautica* (*Arg.* 3a). All in all, the *Odyssey*-cluster now contains less alien material (3 parts less).
3) The *Iliad*-cluster appears slightly fuller; it now contains 25 parts of the *Iliad*, but also a book of the *Odyssey* (*Od.* 3).

While the clusters of *Iliad* and *Odyssey* are better separated in Fig. 2, the Homeric cluster as a whole has undergone little change. *Od.* 21 has been caught by the *Odyssey*-cluster, but now *Il.* 7b stands outside the Homeric cluster. Apart from the *Achaean catalogue*, *Op.* 1, too, is placed far apart from all the other texts. So far the improvements over Fig. 1 seem to prevail, but the intrusion of *Arg.* 3a into the *Odyssey*-cluster is a serious disadvantage. While much more information has been used for the classification of Fig. 2, it would be difficult to maintain that the result as a whole is better. We must conclude, therefore, that the full use of the 'second' occurrence of a letter in a word includes an influence that counteracts the improvement which should be expected from the use of more complete information. This effect becomes even more clear in the classification based on up to three occurrences of a letter in a word.

The dendrogram of Fig. 3 is based on the 'first', the 'second' and the 'third' occurrence of a letter in a word. Among the minor changes, it may be noted that *Fr.* 4 and the *Hymn to Aphrodite* again enter the Homeric cluster (as in Fig. 1), and that *Arg.* 3a, together with two isolated books of the *Odyssey* (*Od.* 8, *Od.* 21) finds its place on the edge of the Homeric cluster. Important, however, is the fact that *Iliad* and *Odyssey* are no longer well separated. There remains a distinct subgroup of the *Iliad* (*Il.* 12, *Il.* 13, *Il.* 4, *Il.* 17, *Il.* 16, *Il.* 18b, *Il.* 5, *Il.* 8r, *Il.* 11a + *Scutum*), and there remains a rather homogeneous subgroup of the *Odyssey* (*Od.* 9, *Od.* 10, *Od.* 5, *Od.* 23, *Od.* 22, *Od.* 19, *Od.* 24b, *Od.* 2, *Od.* 16, *Od.* 20, *Od.* 1, *Od.* 4, *Od.* 7 + *Il.* 10 and *Aphr.*), but the latter group is rather closely linked with further Iliadic subgroups and with subgroups mixed from books of both *Iliad* and *Odyssey*.

The poor separation of the great Homeric poems could be used as an argument in favour of the view that they are both works of one and the same author. It has been shown, however, both by Ledger and by myself, that the method applied tends to separate not only different authors, but also individual works. Thus the classification of Fig. 3 must be regarded as a deterioration in comparison with that of Fig. 2 (and of Fig. 1).

But how can more complete data yield less adequate results? It must be supposed that the additional information contained in the second and especially in the third occurrence of a letter in a word is used in an inadequate way when counted in the same manner as the first occurrence. Since the third occurrences are mainly vowels, as an experiment, I made a classification based on consonants only. *Iliad* and *Odyssey* were again largely separated, but not as well as before; furthermore, I could not find a really convincing argument as to why vowels should be less important than consonants in a letter-distribution. More plausible appeared a model in which the second occurrence of a letter counts less than the first, the third less than the second, etc. Accordingly, I used the second occurrence with the factor ½, the third with the factor ⅓ and the fourth with the factor ¼; a simple weighting scheme, which may be regarded as an analogue to the Weber-Fechner law. This law states that the intensity of perception does not increase linearly with the intensity of a stimulus, but only logarithmically (*i.e.* with decreasing increments). Similar laws have also been formulated for repeated stimuli and for the duration of a stimulus[11]. It is not necessary, however, to refer to the laws mentioned. The reader may imagine a small white table which has to be covered with some spots of various colours and which bears already some blue and some yellow spots. The first red spot will appear very impressive, since it adds a new element, but the second one will certainly appear less so. — Indeed the weighting scheme described seems to yield the best results.

The dendrogram of Fig. 4 is based on the 'first', the 'second', the 'third' and the 'fourth' occurrence of a letter in a word, weighted with factors 1, ½, ⅓ and ¼ respectively[12]. The main features of the classification are the following ones:

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[11] MEILI (Richard) and ROHRACHER (Hubert): 1972, *Lehrbuch der experimentellen Psychologie*, p. 37 (Bern: Hans Huber). GREGORY (Richard L.): 1987, ed. *The Oxford Companion to the Mind* (Oxford: University Press).

[12] Without these weights, the dendrogram is very similar to Fig. 3. If, on the other hand, only up to three occurrences of a letter in a word are counted, and if this is done with weights 1, ½ and ⅓, the result comes already close to Fig. 4.

1) All parts of the *Argonautica* (inclusive *Arg.* 3a) form a single cluster, well separated from the old-epics-cluster
2) Within the old-epics-cluster, there is a distinct Homeric cluster, which contains almost all of *Iliad* and *Odyssey*, but only two alien text parts (the pseudo-Hesiodic *Scutum* and the heterogeneous set of fragments designated by *Fr.* 4). Only *Od.* 21, *Od.* 12 and *Il.* 2c (in the order of increasing dissimilarity) are outside the Homeric cluster.
3) *Iliad* and *Odyssey* are separated slightly better than in the previous classifications. The *Iliad*-cluster now contains 28 *Iliad* parts, but it includes two books of the *Odyssey* (*Od.* 3, *Od.* 18). The *Odyssey*-cluster, on the other hand, now contains only four parts of the *Iliad* (*Il.* 10, *Il.* 7b, *Il.* 6h, *Il.* 9p); three of these parts have often been regarded as separate songs or later additions to the *Iliad* (*Il.* 6h, *Il.* 9p, *Il.* 10). Rather isolated in the Homeric cluster, but slightly closer to the *Odyssey*, are *Od.* 8 and *Od.* 2.
4) Apart from the Homeric cluster, there is a less distinct group comprising the four major *Homeric Hymns* and most of Hesiod. The parts of the *Theogony* (*Th.* 1, *Th.* 2) and of the *Catalogue* (*Fr.* 1, *Fr.* 2, *Fr.* 3) constitute two well-built subgroups, but they don't unite in a special Hesiodic cluster. The second part of *Works and Days* (*Op.* 2) is more closely linked with the *Hymn to Hermes* than with the *Theogony* or with the *Catalogue*.
5) The four major *Homeric Hymns* appear rather scattered; while the *Hymn to Apollo* is very isolated, each of the other *Hymns* is associated with a different work of Hesiod.
6) Far apart from all other texts are the *Achaean catalogue* (*Il.* 2c) and the first part of *Works and Days* (*Op.* 1), each of them in extreme isolation.

The classification described (Fig. 4) corresponds better to the traditional differentiation of authors and works than all previous ones. Since it is known that the method applied tends to separate authors and works, and since the weighting scheme applied has some intrinsic plausibility, we may assume that the good correspondence is not a chance effect, but that the data has been exploited in a more appropriate way. Nevertheless, the present classification, too, will contain some minor chance effects; but in a lesser degree than the previous ones.

Although I am convinced that Fig. 4 deserves more confidence than Figures 1 to 3, the latter ones are still of some importance; they can be used to infer different degrees of stability and robustness. Identical results in all four classifications can certainly be regarded as stable. Those results which are identical in three of the four classifications, and which are supported by Fig. 4 in particular, will be called here almost stable. Less stable will be the category

of the results which coincide only in two classifications; if one of these is Fig. 4, they are certainly of some interest, but the evidence leaves some doubts in such cases. Here follows a list of the various results according to the different degrees of stability.

Stable results:

1) The *Argonautica*, except *Arg.* 3a, form a distinct cluster. In the better classifiations, *Arg.* 3a joins this cluster, too.
2) There exists a Homeric cluster.
3) The *Theogony* and the *Catalogue* constitute the appropriate groups, but there is no special Hesiodic cluster.
4) The second part of *Works and Days* (*Op.* 2) is never grouped together with the first (*Op.* 1).
5) The *Scutum* always joins the *Iliad.*
6) The *Hymns to Apollo* and *to Hermes* form a loose group together with works of Hesiod.
7) The *Achaean Catalogue* (*Il.* 2c) stands completely isolated.
8) The *Doloneia* (*Il.* 10) always joins the *Odyssey*-cluster.
9) *Od.* 12, rather isolated, is outside the Homeric cluster.

Almost stable results:

10) *Iliad* and *Odyssey* are largely separated[13] (Figures 1, 2, 4; partly in Fig. 3, too).
11) *Il.* 6h, the interchange of Hector and Andromache, and *Il.* 9p, the speech of Phoenix, join the *Odyssey*-cluster (Figures 1, 2, 4).
12) *Od.* 21, rather isolated, is only loosely associated with the Homeric cluster (Figures 1, 3, 4).
13) *Od.* 8 and *Od.* 2 are loosely associated with the *Odyssey*-cluster (Figures 1, 2, 4).
14) *Op.* 1 stands apart from all other texts, almost as isolated as the *Achaean catalogue* (Figures 2, 3, 4; also very isolated in Fig. 1).
15) *Op.* 2 is associated with the loose group of Hesiod and the *Homeric Hymns* (Figures 1, 2, 4); twice forming a subgroup with the *Hymn to Hermes*, twice with *Fr.* 4 and *Il.* 7b (the latter subgroup joins the *Iliad* in Fig. 3).

[13] The good separation of *Iliad* and *Odyssey* shows that a distinction of direct discourse and narrative passages would hardly influence our results. The percentage of direct discourse in the single books and parts distinguished here is rather different, but nevertheless an *Iliad*-cluster and an *Odyssey*-cluster emerge.

Less stable results:

16) *Arg.* 3a twice joins the *Argonautica*-cluster (Figures 1, 4); when forming a subgroup with *Od.* 8, *Arg.* 3a is loosely associated with the Homeric cluster (Fig. 3) or with the *Odyssey*-cluster (Fig. 2).
17) *Il.* 7b twice joins the *Odyssey*-cluster (Figures 1, 4); otherwise *Il.* 7b constitutes a subgroup together with *Op.* 2 and *Fr.* 4 (this group joins the *Iliad* in Fig. 3 and the loose group of Hesiod and the *Homeric Hymns* in Fig. 2).
18) *Il.* 9r and *Il.* 19 twice join the *Odyssey*-cluster (Figures 1, 2; in Fig. 3, they are in a mixed subgroup of *Iliad* and *Odyssey*); always together with *Od.* 18.
19) The *Hymns to Aphrodite* and *to Demeter* twice join the loose group of Hesiod and the other *Homeric Hymns* (Fig. 4, Figures 2 and 3 respectively); otherwise, they are associated with the *Odyssey*.

These results refer to the main features of the classifications. The details, *i.e.* the small subgroups, are more subject to chance and side effects[14], but they are less important with respect to the authorship problems discussed here. Nevertheless the small groups, too, are often meaningful. This is clearly shown by the *Theogony* (*Th.* 1, *Th.* 2) and the Hesiodic *Catalogue* (*Fr.* 1, *Fr.* 2, *Fr.* 3).

[14] Since the fusion levels of the clusters correspond to χ^2-values (with 24 degrees of freedom), it is possible to estimate the number of misclassifications which must be expected at certain fusion levels. For error probabilities 0.1 %, 1 %, 5 % and 10 %, the tabulated percentage points of χ^2 with 24 degrees of freedom are 51.18, 42.98, 36.42 and 33.20 respectively, corresponding to scale-values 44.24, 37.15, 31.48 and 28.69 in Fig. 4. Thus partitioning the dendrogram by a vertical cut at scale-value 44, we arrive at a distinction of groups which is most probably not affected by chance, while a vertical cut at scale-value 37 will probably yield one distinction, or bifurcation, which is due to random deviations, and a cut at scale-value 31 should yield about 4 such distinctions. This means, for example, that the distinction of two or even three main groups within the *Iliad*-cluster seems to be of some importance, whereas the distinction of two main groups within the *Odyssey*-cluster (at level 37) looks more like a chance effect; and many distinctions at lower levels will, indeed, most probably be due to chance. All this must be taken in the sense of a more or less rough estimation, both because we are dealing only with means of χ^2-values and because the bifurcations of the dendrogram are not independent of one another, but the present conclusions agree remarkably well with the more intuitive interpretation of the dendrogram.

4. Conclusions

Both the great mass of the *Iliad* and the great mass of the *Odyssey* show an astonishing homogeneity. They resemble in this respect the *Argonautica*, as can be gathered from the dissimilarity levels of the respective unions (cf. Fig. 4):

Argonautica	dissimilarity 39
Iliad-cluster	dissimilarity 42
Odyssey-cluster without *Od.* 2 & *Od.* 8	dissimilarity 37
Odyssey-cluster without *Od.* 8	dissimilarity 43
Odyssey-cluster with *Od.* 2 & *Od.* 8	dissimilarity 47
Homeric cluster	dissimilarity 50

Thus both the *Iliad* and the *Odyssey* clusters show a degree of homogeneity which may be expected for a single poet, and although the Homeric cluster is established only at level 50, the great mass of both poems might even appear as the work of one and the same person. An additional argument for this view might be taken from the fact that the Homeric cluster is well separated from Hesiod and the *Homeric Hymns*. But the relative similarity of the *Iliad* and the *Odyssey* clusters may as well have been effected by a special rhapsodic tradition, namely that related with the Trojan theme. In any case, the good separation of *Iliad* and *Odyssey* suggests that these poems, unless they must be assigned to different periods in the life of a single poet, should be regarded as the works of different authors. Since this is the view not only of Analysts, but also of most Unitarians, those few parts of the *Iliad* that appear in the *Odyssey*-cluster deserve some special attention.

Il. 10, the *Doloneia*, joins the *Odyssey*-cluster with absolute stability, and it is the only *Iliad* part to do so. Ancient critics remarked that *Il.* 10 was included in the *Iliad* during the time of Pisistratus, and today many Unitarians also regard this book as spurious. Thus the most suspected part of the *Iliad* appears most clearly outside the *Iliad*-cluster. Similarly *Il.* 9p, the speech of Phoenix, and *Il.* 6h, the interchange of Hector and Andromache, join the *Odyssey*-cluster with high stability. These parts, too, have often been excluded from the *Iliad*, and indeed they are among the most suspected passages. Apparently any stable or almost stable inclusion in the *Odyssey*-cluster should be regarded as a strong argument against a genuine Iliadic origin[15]. It seems that these parts must be attributed to a somewhat later stage in the rhapsodic

[15] This follows from the coincidence of the most important theses of traditional Homeric criticism with the most conspicuous results of classification according to letter-distributions.

tradition connected with the Trojan events. *Il.* 7b joins the *Odyssey*-cluster with less stability; this may still be of some importance, but the evidence is not sufficient for an exclusion from the main body of the *Iliad*.

Il. 2c, the *Achaean Catalogue*, presents a special problem. Apart from the frequent repetition of certain words caused by enumeration, the most conspicuous peculiarity of the catalogue is the abundance of proper names, mostly of the geographical type. Many of these names can be traced back to the Mycenean epoch, so that a high amount of pre-Homeric material seems to have entered the catalogue[16]. Unfortunately we cannot decide whether these peculiarities of the *Achaean Catalogue* sufficiently explain its position far apart from all texts regarded here. The *Theogony*, too, contains many proper names, but these are of a different type; thus the *Theogony* is not fully comparable with the catalogue in this respect. But the *Theogony* shows so completely different a behaviour that I tend to assume additional peculiarities in the *Achaean Catalogue*. Such additional peculiarities might well be due to post-Homeric editing or rewriting.

Almost as isolated as the *Achaean catalogue* appeares *Op.* 1, that part of *Works and Days*, which contains a moral address to Perses and the kings, including the myths of Prometheus and Pandora and of the five creations of man. This exhortation part is followed by an instruction part, *Op.* 2, which refers to the various tasks of the farmer in the course of the year. Some critics of the last century[17] regarded *Op.* 2, the proper Erga, as genuine and *Op.* 1 as a heterogeneous compilation, but nowadays their views have almost been forgotten. Now our classifications show that *Op.* 1 and *Op.* 2 can hardly be attributed to the same author. *Op.* 1 does not contain such peculiarities as the *Achaean catalogue*, so that its isolation in the dendrograms will mainly follow from differences in authorship. Indeed, if the classifications contain any reasonable distinction between the authors of *Iliad* and *Odyssey*, or between Homeric and non-Homeric poetry, then *Op.* 1 cannot be attributed to the author of *Op.* 2; nor to the author, or authors, of the *Hesiodic Catalogue* and of the *Theogony*.

The remaining works usually ascribed to Hesiod, *Theogony*, the *Catalogue* and *Op.* 2, never constitute a Hesiodic cluster. The *Theogony* and the

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[16] This may well have happened during early epic tradition, but the same proper names may also be part of later additions to the *Iliad*; cf. also KIRK (G.S.): 1962, *The Songs of Homer* (Cambridge: The University Press).

[17] SUSEMIHL (Franz): 1864, „Zur Literatur des Hesiodos", *Neue Jahrbücher für Philologie und Pädagogik* 89, pp. 1–10, 729–753.

Catalogue appear more distant from one another than *Iliad* and *Odyssey*, and so do *Theogony* and *Op.* 2. Only *Op.* 2 and the *Catalogue* appear less distant, but each of these poems seems to have even closer connections (though less stable ones) with one of the *Homeric Hymns*. Thus the dendrograms support the view that, unless *Iliad* and *Odyssey* are the work of a single poet, the *Theogony* and the *Catalogue*, and possibly *Op.* 2, too, have to be assigned to different authors; otherwise, Hesiod would appear as so variable a poet that he spoke with the tongues of many. Yet this conclusion is less stringent than the separation of *Op.* 1 from all other works ascribed to Hesiod.

A last conclusion refers to Wilamowitz' analysis of Homer[18], but the type of argument might well be applied to other analytical theses, too (*e.g.* to those of Mazon, Theiler or Von der Mühll[19]). Wilamowitz divided the *Iliad* into nine parts of different origin:

a) Pre-Homeric:
   group 1: *Il.* 2, *Il.* 3, *Il.* 4, *Il.* 5.
   group 2: *Il.* 11a.
   group 3: In *Il.* 12, *Il.* 13, *Il.* 14, *Il.* 15 remainders of a Hector-poem.
   group 4: *Il.* 16 (Patrocly).
b) Homer:
   group 5a: *Il.* 1.
   group 5b: In *Il.* 13, *Il.* 14, *Il.* 15 the scenes with gods.
   group 5c: *Il.* 21, *Il.* 22, *Il.* 23a.
c) Post-Homeric:
   group 6: *Il.* 18, *Il.* 19, but *Il.* 18b taken from an older source.
   group 7: much in *Il.* 20 and *Il.* 21.
   group 8: *Il.* 23b, *Il.* 24.
   group 9: *Il.* 8, *Il.* 9, *Il.* 10, but *Il.* 9 and *Il.* 10 largely taken from earlier poets.

Since the great mass of the *Iliad* forms a well defined cluster in most of our dendrograms, we should expect that differences of authorship appear at dissimilarity levels which at least come close to the above mentioned levels of the *Argonautica*, the *Iliad* and the *Odyssey* clusters. This is to say that any

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[18] WILAMOWITZ-MOELLENDORFF (Ulrich von): 1920, *Die* Ilias *und Homer* (Berlin: Weidmann); WILAMOWITZ-MOELLENDORFF (Ulrich von): 1927, *Die Heimkehr des* Odysseus (Berlin: Weidmann). Good overviews can be found in HEUBECK (Alfred): 1974, *Die Homerische Frage* (Darmstadt: Wissenschaftliche Buchgesellschaft).

[19] MAZON (Paul) *et alii*: 1959, *Introduction à l'*Iliade (Paris: Soc. d'éd. Les Belles Lettres), pp. 137–299. THEILLER (W.): 1947, „Die Dichter der *Ilias*", *Festschrift Edouard Tièche* (Bern: Lang & Cie), pp. 125–167. VON DER MÜHLL (P.): 1952, *Kritisches Hypomnema zur* Ilias (Basel: Reinhardt). Cf. also HEUBECK pp. 15s., 19s. and 26s. To check the theses of Mazon, Theiler and Von der Mühll, further books would have to be split.

partitioning proposed by an analytical thesis should be largely compatible with the main groups of the *Iliad*-cluster. Referring to Fig. 4, we see that Wilamowitz' group 5c indeed constitutes a subgroup in the dendrogram (albeit together with *Il.* 18a), and that his group 5a, too, belongs to the same main group; group 5b, finally, cannot be separated from group 3 here, so that *Il.* 13, *Il.* 14 and *Il.* 15 may well be allowed to appear in a different branch of the *Iliad*-cluster. So far the parts ascribed to Homer himself appear compatible with the classification, but they have been associated with parts ascribed to later poets (*Il.* 18a, *Il.* 18b, *Il.* 20, *Il.* 23b). Furthermore, the reader will see that most of Wilamowitz' pre- and post-Homeric groups are not compatible with the main groups of the *Iliad* in Fig. 4. Admittedly, the internal grouping of the *Iliad*-cluster is not very stable, but I would expect that a valid analysis corresponds better to Fig. 4, at least.

Within the *Odyssey*, Wilamowitz recognizes the following special groups:

group 1: *Od.* 2, *Od.* 3, *Od.* 4.
group 2: *Od.* 13, *Od.* 14.
group 3: *Od.* 18, *Od.* 19.
group 4: *Od.* 21, *Od.* 22, *Od.* 23.

Od. 13 and *Od.* 14 appear in different branches of the *Odyssey*-cluster, possibly a chance effect. Groups 1, 3 and 4, however, are not compatible with the isolated position of certain books outside the *Odyssey* cluster, a feature related to higher significance levels. Thus Wilamowitz' analysis as a whole does not find much support from our classifications.

The article should be concluded with a note of caution. While most of the distinctions obtained at high significance levels[20] are obviously due to differences of authorship, at least one distinction of medium significance is due to other differences: the distinction of two main branches in the *Argonautica* at scale-value 39. In general, differences not related with authorship may refer to the period in the life of a poet, to the way of representation (different amounts of direct discourse, similes etc.), and even to the literary genre: within hexametric poetry, we may distinguish didactic poems, hymns and catalogues from heroic epics in the proper sense. With regard to authorship, all this may cause side-effects. Thus, while the distinction of two main branches in the *Odyssey*-cluster (at level 37) could be explained mainly by random variation in the letter-distributions, in the *Argonautica* (split at level 39) and in the *Iliad* (split at level 42) a somewhat higher amount of side-effects should be assumed. As to literary genre, *Op.* 2, a piece of instructional poetry, and the

[20] *I.e.* at scale-values greater than 44 in Fig. 4.

Theogony are certainly of a different type; but can this sufficiently account for the distance of these poems in the dendrogram? The relative similarity of *Op.* 2 and the *Hymn to Hermes* does not support this view. The Hesiodic *Catalogue*, too, is closer to *Op.* 2, although it would fit much better to the *Theogony* with regard to literary genre. The *Homeric Hymns*, finally, although of the same type of hexametric poetry, appear rather scattered in the dendrogram. Only in the *Achaean catalogue* (*Il.* 2c) should a heavy influence of literary genre be assumed, since it is, as has often been stated, "markedly different in many respects from the rest of the *Iliad*"[21]; its extreme isolation is probably best explained by a combined influence of both authorship and side-effects, but this is far from being an established result. In general, there remains a certain need for a better discrimination between authorship and side-effects, a task which must be left for future investigations. It can be hoped that such investigations will also lead to a better understanding of the isolated position of some books of the *Odyssey*.

[21] KIRK (1962), p. 118.