COMPARATIVE GRAPHEMIC ANALYSIS

OF OLD BABYLONIAN AND WESTERN AKKADIAN

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This article represents the first publication of substantive results obtained from a major research project which has been in progress for a number of years. The tools developed as part of the project are meant to magnify our power of analysis, and as such to increase our ability to understand the documentation. It is in this light that I am especially pleased to present these pages as a tribute to Claude Schaeffer, a scholar who through his discoveries has dramatically increased the documentary range pertaining to the ancient Near East. The effort at a systematic and comprehensive retrieval of interconnections within the data may in some ways be compared with the initial retrieval of the data themselves: they both contribute to the ultimate goal which is to obtain a higher level integration of data and pertinent correlations. Schaeffer's research has been of great importance on both counts, whether he was dealing with the presentation of his findings or providing a broader analytical picture of the "comparative stratigraphic" data.

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This is not the place to register the names of all who have contributed to the substantive and technical progress of this project – a forthcoming volume in the series *Cybernetica Mesopotamica*, which will give the full results of our work, will includ such acknowledgements. But a special place must be given to John Hayes and Matthew Jaffe for the Assyriological, and to David Holzgang for the data processing aspects of the project. The specific responsibility for the individual corpora was divided as follows:

Old Babylonian Royal letters: J. Hayes
Old Babylonian non-Royal letters: J. Hayes, M. Jaffe, Y. Kobayashi
Mari: P. Gaebelein
Amarna: J. Hayes
Ugarit: T. Finley

Computer programming for the portion of the project presented here was provided by John Settles, while the technical implementation of the system is due to David Holzgang, with the assistance of M. Jaffe and J. Paul.

1. Nature of present investigation

The level of analysis pursued here is relatively simple, and the results correspondingly preliminary in nature. They are indicative, however, of the direction in which the project is going, and provide some substantive answers to meaningful problems. Some of these problems could not even have been formulated if only manual data processing had been available. Yet the results which *are* obtained through electronic data processing are of a type which is immediately relevant to current research, and will become even more so in the measure in which the data are increased and the pertinent parameters refined.

Basically, we are dealing here with frequency computations of graphemic data between partly homogeneous and partly heterogeneous data. Let me explain beginning with the latter, i.e. the nature of the corpus. There are five corpora included in the research. Their overall degree of homogeneity derives from the fact that all the texts are letters. Within this broad category there are gradations pertaining to period and provenience, hence to linguistic classification. Three corpora form a broadly coherent group in that all the texts are Old Babylonian from Mesopotamia; yet they are internally differentiated as follows. (1) One corpus comes from the royal chancery of Babylon (it includes only letters having a king's name as the sender). (2) Another comes from various cities in central and southern Mesopotamia, of either a private or an official nature, but not from the Babylon kings themselves. (3) The third includes most of the letters found at Mari, which all come from northern Mesopotamia, the middle and the western Euphrates (except for four letters from Babylon which are included in the first corpus). While these three corpora all reflect, albeit in different ways, the classical stage of the language, the other two corpora consist of texts which, at the opposite end of the spectrum, represent perhaps the most divergent type of Akkadian. They are (4) the letters from Amarna and (5) the letters from Ugarit.

Corpus	*Texts*	*Total Sign Occurrences*
1. OB royal letters from Babylon – originating in Babylon only:	200	30,711
2. OB letters, non royal – *ABB* 1-5, all texts except those in (1)	730	96,618
3. OB letters from Mari – *ARM* 1-6, 10, 13	820	153,308
4. El Amarna letters – all in *VAB* 2, except a few badly damaged	330	57,502
5. Ugarit letters – all letters from Ugarit and neighboring areas	115	12,952
	2.195	351,091

Table 1. Corpora Analyzed

The varying degrees of homogeneity within each corpus and from one corpus to the other are ideal in showing the value of the approach. Admittedly, the results are macroscopic because the underlying categories are very broad. They are also to some extent predictable because the differentiations are perhaps obvious. But as a test case this has the virtue to make easily understood a method which can then just as easily be applied on a microscopic scale, e.g. to the different periods and places of provenience of letters found at Mari (where known) extrapolating then to texts of unknown period or provenience.

2. Inventory Overlay

The core number of cuneiform signs, as registered in the standard handbooks, reaches a total of some 600 entries. But it is well known that not all signs occur in every period, area or genre. A comparison of the corpora analyzed in the present study yields the interesting result that all corpora share a similar total of signs in actual use, a total which hovers around 250:

Corpus	*Total number of signs in inventory*
1. OB royal	234
2. OB non royal	275
3. Mari	230
4. Amarna	221
5. Ugarit	223

Table 2. Total number of inventory items

Naturally, not all the same signs occur in each of the inventories. So a first interesting question presents itself: given the real possibility of an inventory overlay, what will be the degrees of proximity and divergence among the various corpora? The pertinent data are tabulated in Appendix I below where one can verify at a glance the total number of occurrences for any given sign in each of the five corpora. With this documentation available, we can ask the question as to how many inventory signs are shared by the various corpora. The answer is interesting because it shows a greater degree of uniformity than might be expected. As shown graphically in Table 3, the degree of coincidence among the five corpora is higher than the degree of variation; what is more, no significant discrepancy occurs in the total number of shared signs among the Old Babylonian corpora on the one hand and the Western Akkadian on the other. In other words, there is no particular clustering of Babylonian texts (with or without Mari) as over against the texts in Syrian Akkadian. The total number of inventory signs in all five corpora is 316. Of this total, almost exactly half (155) is shared by all corpora. One fifth (54) is found only in individual corpora – evenly distributed, except for the non-royal Old Babylonian corpus which exhibits the largest number (27) of non-shared signs. The remaining data are not particularly revealing of any distributional patterns among the corpora.

3. Frequency Computations

There are two major restrictions which must be introduced at this point in order to proceed with our analysis; not all signs appear with the same degree of frequency, nor do they exhibit the same degree of polyvalence. We will take up here only the question of frequency. It is surprising to see a very uniform picture emerge once the inventories are sorted for frequency. The fact that all the texts in our sample are letters reduces somewhat the effect of statistical bias which might otherwise derive from the type of genre involved: if signs such as *qí-bí-ma* are expectedly more frequent in letters, then the higher frequency will be equally distributed through all the corpora, since they all consist of letters with the same formulas. This enhances the value of the contrast (or lack of it) among the corpora, since it will be more specifically indicative of period and area characteristics. Now, as already indicated, the frequency curve is remarkably the same in all five corpora. Basically, the results may be summarized as follows: very few signs occur frequently, and as much as half of the signs in the inventory occur very rarely. The values assignable to "frequently" and "rarely" are generally low: "frequent" means that a sign occurs between 1% and 6% of the total sign occurrences in a given inventory; "rare" means that a sign occurs less than 0.1% of the same total (often only once or twice in absolute figures).

This information is summarized graphically in Table 4. Only about 12% of signs as inventory items occur "frequently", i.e. between 1% and 6.60% of the total of all sign occurrences. This means that a small percentage of given signs (taken as inventory items, e.g. NA) occurs frequently – NA, for instance, ranges between 826 occurrences in Ugarit (which is 6.17% of the Ugarit corpus) and 7,407 occurrences in Mari (which is 4.83% of the Mari corpus). The most frequent sign is A, which ranges between 917 occurrences in Ugarit (6.85% of the Ugarit corpus) and 9,214 occurrences in Mari (6.01% of the Mari corpus).

Conversely, at least half of the signs occur rarely. There are quite a few signs which occur only *once*, even in the larger corpora: 22 signs in OB-royal, 33 signs in OB non-royal, 15 signs in Mari, 15 signs in El-Amarna, 23 signs in Ugarit. Similar ratios obtain for all frequency ranges among all corpora.

A slightly different elaboration is provided in Table 5. Here the frequency percentage ranges are broken down more finely, absolute values are added for the various frequency ranges, and the bar histograms are the graphic representation of the same ranges. Again the curve is generally uniform, except that, compared to the rest, the Ugarit corpus exhibits a lesser amount, and the OB-non royal corpus a higher amount, of very rare signs.

A cultural and linguistic explanation can only be adumbrated here. The small incidence of variation is indicative, I would suggest, of a basic intrinsic trait of the cuneiform system, which keeps the system working within a certain balance of frequency ranges. There is a certain dynamism, as it were, which is operative within the system as such; it may be characterized as having a centrifugal force, which favors, up to a point, the utilization of uncommon signs, but this trend is at the same time mitigated by a centripetal force which precludes an excessive diversification. The variations noted for the OB-non royal corpus on the one hand and the Ugarit corpus on the other may be a reflection of the different degree of homogeneity between the two corpora – Ugarit being the second most homogenous corpus (after the OB-royal corpus), and the OB-non royal being the most heterogeneous with Mari, since they both include texts from a variety of points of origin.

Several other results have already been obtained from our analysis of the inventories – e.g. at the level of phonological and logographic polyvalence; however, they cannot be presented here given the preliminary nature of the article. I will, instead, describe briefly another concept which may be added to that of inventory analysis.

4. Graphemic profiles

If we move from the concept of inventory as a whole to that of specific inventory items, i.e. the individual signs, we may chart curves of occurrence for the signs of each corpus, and obtain thereby a "profile" of the graphemic configuration of a specific cultural writing system. This approach lends itself to a variety of very useful considerations which define the characteristics of the corpus; charted to a higher degree of definition, this would identify scribal preferences and thus provide a powerful tool for the identification of scribes or scribal schools. To explain the concept and the method, we will limit ourselves here to a macroscopic level of analysis, by comparing the first segment of the graphemic profile of our five corpora. This is presented graphically in Table 6.

The table lists the 25 most frequent signs in the five corpora, in decreasing order of frequency, measured on the basis of the highest values within the combined total of the five corpora. The frequency value is given in terms of percentiles, rather than absolute numbers of occurrences. Thus the sign A is the most frequent in all corpora, being consistently above 6%; the signs NA and MA are next, but the frequency range is higher, in that it spans two or more percentile points for both signs: MA in particular, is considerably less frequent in Western Ak-

kadian than in Babylonian proper. The widest range occurs with IA, which is rare in Babylonian proper, moderately frequent in Mari, and very frequent in Western Akkadian. The narrowest range occurs with I, which has about the same frequency in all corpora.

It is immediately apparent that these variations in frequency ranges correspond to linguistic distributional patterns. Where a discrepancy occurs, it is normally occasioned by recognizable factors: MA is less frequent in Western Akkadian because that dialect does not use the subjunctive particle *-ma*; conversely, Ù is more frequent in Western Akkadian precisely because the syntatical use of the conjunction *u* is much more frequent there than in Babylonian proper. Similar considerations apply, for instance, to IA, which is common in West Semitic verbal forms, hence its much higher frequency in Ugarit and El-Amarna; Mari occupies here a middle position because of the Amorite names present in that corpus. Interesting is also the distribution of UM, AM, IM: these signs are less frequent in Western Akkadian because of a linguistic reason – the loss of case endings and of mimation. The high value for IM in Mari, on the other hand, results from non-linguistic reasons, i.e. the higher incidence of lexical items such as the god Adad (written logographically as ^{d}IM) and of such components of personal names as *Zi-im-ri-* and *Li-im*. A cultural factor is behind the high frequency of LUGAL in El-Amarna, where the title is used regularly for the local Syrian kings as well as for the foreign suzerains, whereas it was avoided by the Mesopotamian kings.

Once the boundaries of the corpora are defined more narrowly, the graphemic profile of the type described here will serve as a sensitive tool for the identification of similarities and differences; conversely, such similarities and differences can serve as a clue for the definition of boundaries where these are not already given from another source, whether archaeological (findspot), linguistic (dialect constraints or graphemic choice) or historical (known scribal traditions).

5. Conclusions

It goes without saying that interpretations such as the ones proposed here will be safer once the documentary base is increased. Such a task has been in progress for several years, and is now carried out within the framework of CAM, the *Center for Computer Aided Analysis of Mesopotamian Materials.* A unit of IIMAS, the *International Institute for Mesopotamian Area Studies*, CAM is devoted to a comprehensive program of research and publications, which has already developed a considerable data base and a complex system of programs for electronic data processing. A major collection of volumes, entitled *Cybernetica Mesopotamica*, has begun to appear in Fall 1979 with two volumes by C. Saporetti on Middle Assyrian texts. Several other volumes, which include the full documentation for the materials presented here, are in advanced state of preparation and will appear in the near future.

Table 3. INVENTORY OVERLAY: Tabulation of Coincidence Factor

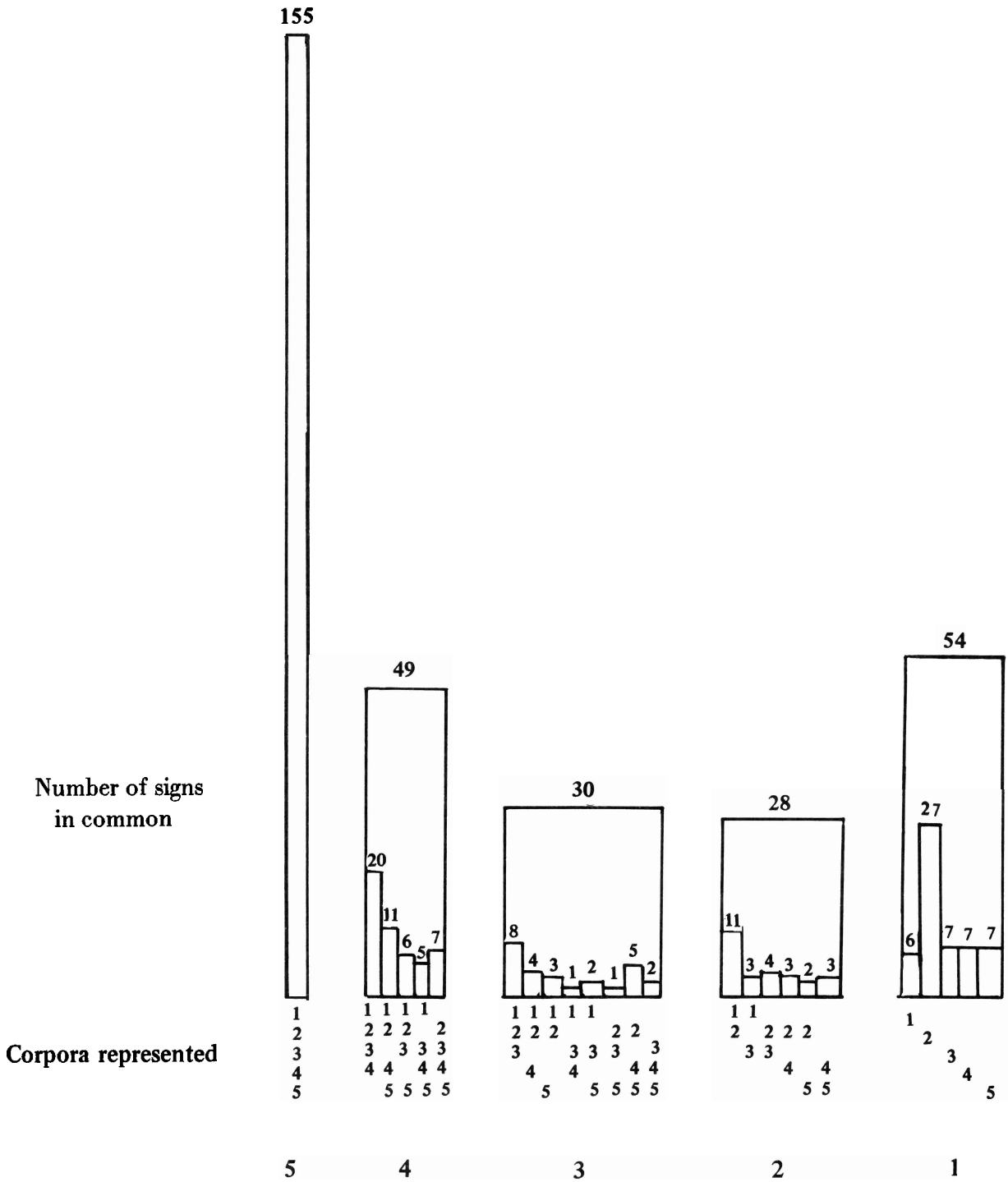


Table 4. FREQUENCY DISTRIBUTION
Major Percentile Categories

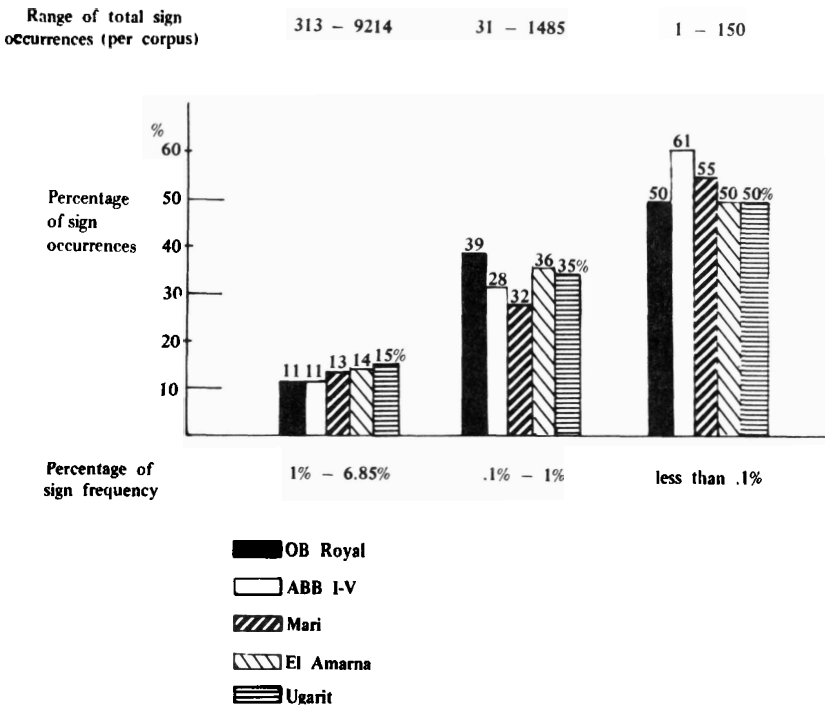


Table 5. FREQUENCY DISTRIBUTION: Absolute Values & Percentile Categories

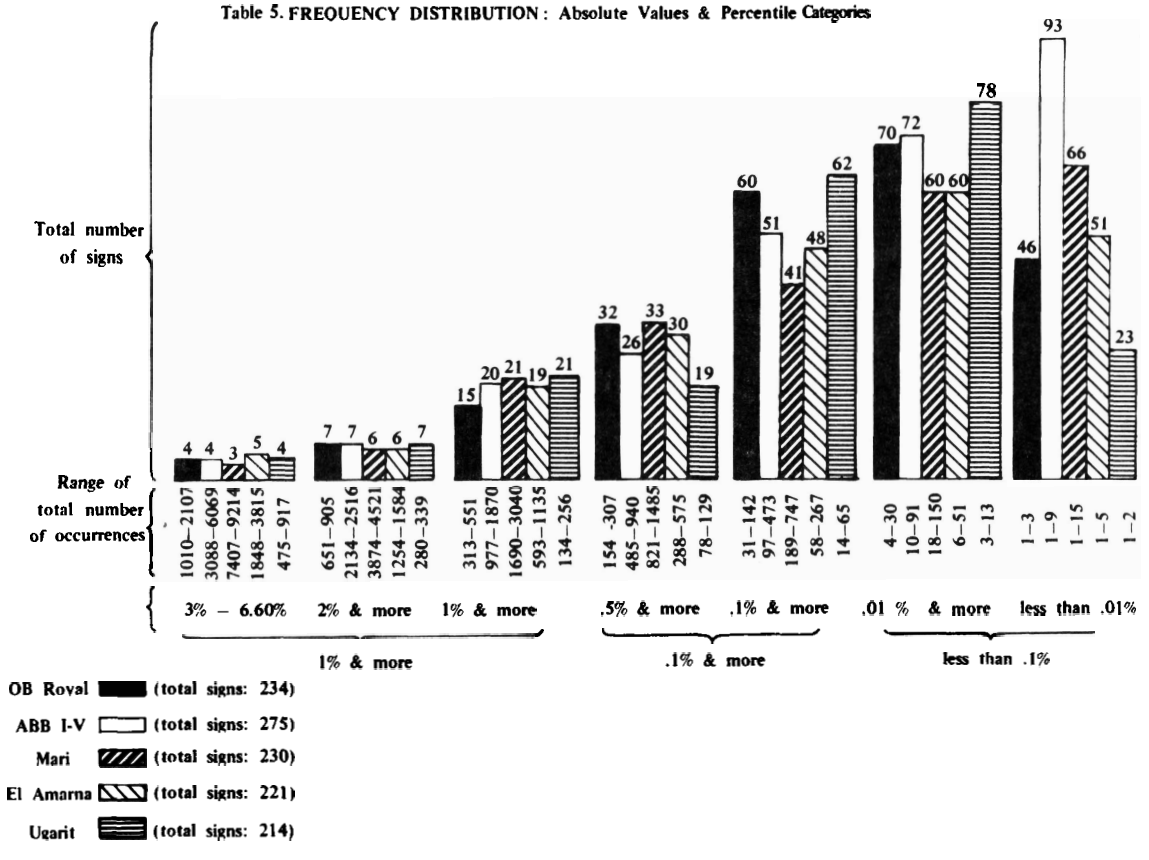
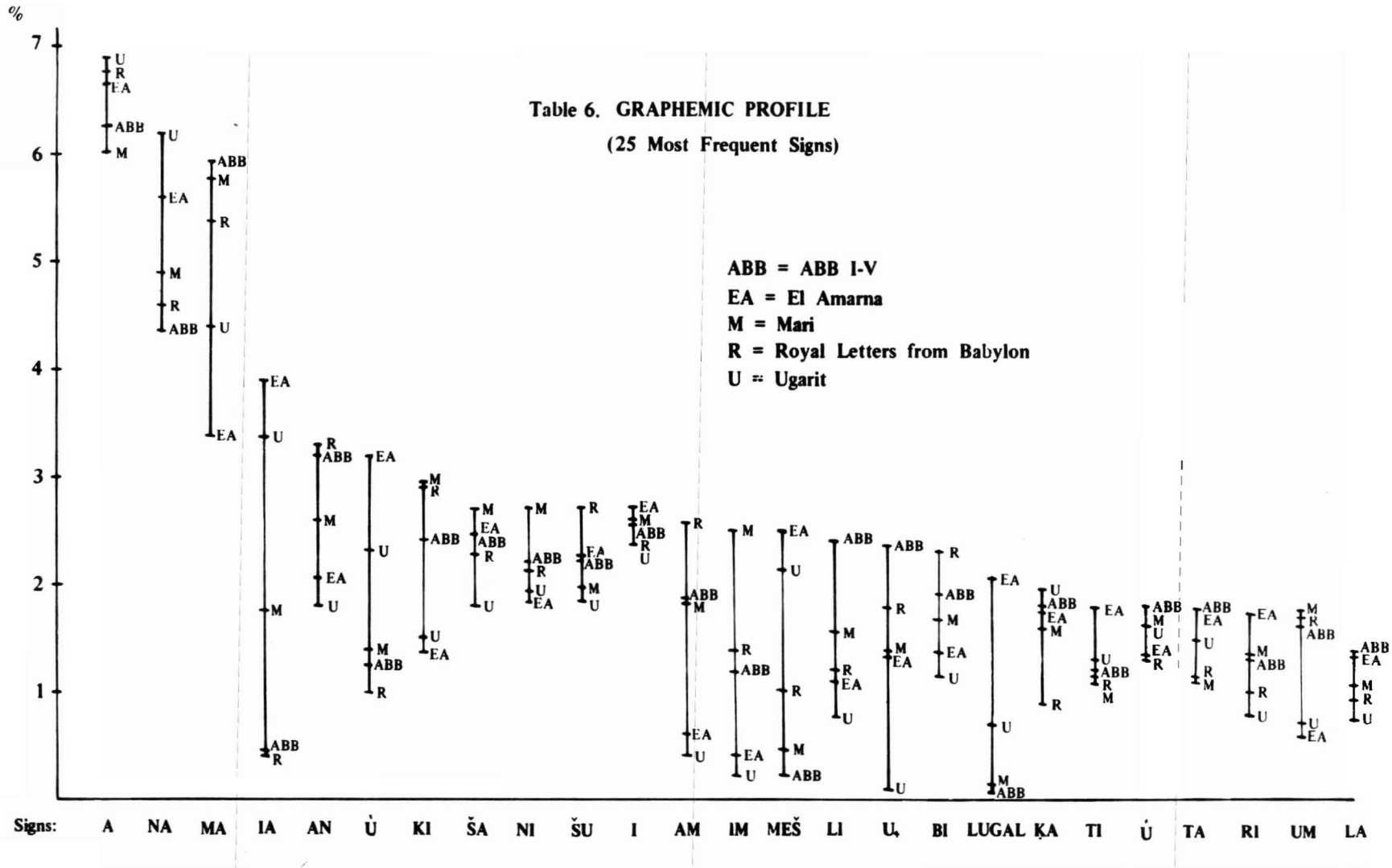


Table 6. GRAPHEMIC PROFILE

(25 Most Frequent Signs)



APPENDIX 1: INVENTORY OVERLAY

Complete List of Sign Occurrences

Sign	Value	OB royal 1	OB non-royal 2	Mari 3	Amarna 4	Ugarit 5
1	AŠ	239	1338	1783	314	104
2	ḪAL		36	15	18	9
2A	2	2	8	2		
5	BA	172	1357	1485	376	56
6	ZU	307	672	747	103	15
7	SU	71	91	269	9	5
8	ŠUN		3			
9	BAL	4	9	5	43	8
10	GÍR	3	5	4		1
12	TAR	70	71	50	68	37
13	AN	1010	3088	3893	1256	256
15	KA	269	1761	2391	1004	280
19	$BUZUR_5$		2			
26	BUM		3			
29	ZABAR				3	
30	BUN		1			
38	URU	33	91	25	494	65
40	UKKIN	2				
41	BANŠUR		1			
43	URÚ		1			
44	ŠILIG	2	2			
50	ARAD	7	25	568	335	61
52	ITU	25	59	142	10	2
53	ŠAḪ	7	34	2	1	
54	EBUR				2	
55	LA	301	1390	1808	759	165
56	APIN	8	31	53		
57	MAḪ	11	18	10	20	1
58	TU	202	1018	1369	414	94
59	LI	368	2300	2416	657	134
60	KÚR	13	5	29	23	54
61	MU	357	458	855	512	138
62	QA	7	69	885	267	33
63	KÁD	2	1			
67	GIL					2
68	RU	186	469	921	472	100
69	BAD	71	392	2108	334	39
70	NA	1411	4206	7407	3236	826
71	ŠIR		3		6	
72	NUMUN	1	13	5	7	2
73	TI	349	1196	1723	1046	231
74	BAR	24	80	42	23	50
74X	DALLA	4	1			
75	NU	537	1124	1920	1135	339
76	MÁŠ	14	6	15		1
77	KUN	2	1			
78	ḪU	49	248	455	114	14
78X	U_5		1			
79	NAM	130	168	121	16	8
79X	BUR_5			1		
80	IG	142	485	836	153	30
81	MUD				6	2
83	RAD				9	
84	ZI	170	404	746	197	38
85	GI	38	158	211	143	24
86	RI	313	1271	2096	1021	161
87	NUN	95	55	105	2	5
88	KAB	1	11	24	2	8
90	GAD	3		9	13	3
93	ŠINIG				18	
94	DIM	158	527	1256		2
95	MUN		1			
97	AG	109	514	725	190	43
98	MÈ		1			
99	EN	278	357	189	808	
100	DÀR			1		
101	SUR	2	6	6	4	3
102	SUḪ		5	4		
104	SA	51	98	313	102	3
105	GÁN	120	128	20	4	27
106	GÚ	9	42	48	8	12
108X	GUN	25	14	15	11	
108	DUR		4		1	
109	LÀL	1	1			1
111	GUR	29	152	8	3	2
112	SI	74	144	257	21	7
113	SU_4		25	2		1
114	DAR	2	1		4	
115	SAG	13	106	45	16	9
122	MÁ	33	63	127	15	12
122B	ÙZ	7	4			
123	DIR	4	2	4	2	
124	TAB	46	66	38	42	30
124A	LÍM		12	2		
126	TAG	133	771	827	186	56
128	AB	154	455	1008	181	15

Sign	Value	OB royal	OB non-royal	Mari	Amarna	Ugarit
		1	2	3	4	5
129A	MUL		1	1	2	4
130	UG	31	116	150	34	8
131	AZ	41	124	420	51	8
132	URUDU	8	5	12	13	6
133	KA	69	75	104	7	
134	UM	508	1527	2173	341	127
138	DUB	130	220	490	38	7
139	TA	350	1793	1737	1060	222
142	I	781	2516	3979	1584	328
142A	IA	137	921	2720	2264	475
143	GAN	14	24	459	43	13
144	TUR	139	200	443	289	83
145	AD	211	896	1481	429	83
147	ṢI	102	324	657	44	17
148	IN	113	372	388	68	20
149	RAB					4
150	DÌM		1			
151	LUGAL	5	22	231	1254	112
152	ŠÌR	36	180	118	62	1
152	ŠAR	22		30	2	12
152/4	UBARA					1
152/8	BÀD		13			
164	SUM	15	60	1		14
165	NAGA		2			
166	KASKAL	8	13	65	13	13
167	GABA	29	38	3	131	20
168	EDIN	10	3			
169	DAḪ	11	1			5
170	AM	790	1769	2801	356	78
171	UZU	1	1	1	21	1
172	NE	276	663	927	125	14
173	BÍL	23	7		2	11
176	NINDÁ		1			
183	RAM		2			
185	UŠBAR					1
187	ŠÁM		3		2	12
191	KUM	59	334	300	28	14
192	GAZ	2	1		74	
195	UNUG	44	19	4		
200	NINA	3	2			
202	KAS_4	5				
203	ÚR	18	43	31		3
205	IL	101	372	425	106	61
206	DU	138	317	577	310	24
206A	$LAḪ_4$			5		
207	TUM	98	345	331	152	3
208	ANŠE	1	17	59	85	26
209	EGIR		2	5	3	2

Sign	Value	OB royal	OB non-royal	Mari	Amarna	Ugarit
		1	2	3	4	5
210	GEŠTIN	1		42		2
211	UŠ	94	353	329	233	32
212	IŠ	224	852	1690	486	87
214	BI	704	1870	2577	794	228
215	ŠIM	3	1			
228	KIB	89	45	28	14	
229	NA_4		13	20	38	17
230	DÙ	9	6	18		3
231	NI	651	2134	4109	1055	290
232	IR	289		1094	195	40
233	GA	8	68	24	2	
237	DAGAL	1		1	8	4
249	KISAL		1			
252	$SILA_4$		5	4		
255	ÙR		13	22		
271	ARḪUŠ				1	
280	DAG		2	11	3	1
295	PA	246	523	1066	451	93
295D	MAŠKIM		1		53	4
295F	ŠABRA	1	4			
295K	ŠAB	1			13	7
295M	SIPA	31	3	7	1	1
296	GIŠ	167	403	693	293	55
297	GU_4	21	118	37	8	7
298	AL	91	940	998	167	50
306	UB	45	249	401	88	19
307	MAR	52	83	55	17	15
308	E	250	707	1144	346	141
309	DUG			37	1	2
312	UN	39	83	218	28	24
313	KID	24	38	70	2	1
314	ŠID	12	13	9	11	20
317	ALAL					3
318	Ú	398	1794	2674	756	247
319	GA	170	473	249	176	95
320	ÍL	14	4		58	
321	LUḪ	5	2	14	1	1
322	KAL	3	8	67	114	36
324	É	97	243	437	108	29
325	NIR		2			1
326	GI_4	1	10	2	1	
328	RA	483	1189	2202	607	172
329	DÙL	1	1	4		
330	LU	121	194	1114	629	157
331	ŠEŠ	44	45	5	296	93
332	ZAG		1		3	7
333	GÀR	56	64	52	16	5
334	ID	265	835	1127	397	153

Sign	Value	OB royal 1	OB non-royal 2	Mari 3	Amarna 4	Ugarit 5
335	DA	135	804	1267	332	27
336	LIL			3	2	4
337	MURUB$_4$				3	
338	DÉ		4			
339	ÁŠ	8	56	510	7	9
339A			9			
339B			5			
342	MA	1679	5740	8904	1983	589
343	GAL	48	112	292	224	22
344	BARÁ		3			1
346	GIR	25	22	4	2	
347	MIR	38		13		
349	BUR	36	55		22	6
350	BUR-U		11			16
350A	GAŠAN		3			
353	ŠA	722	2339	4149	1415	239
354	ŠU	829	2154	3040	1311	269
355	NAR	5	2	12		
356	SA$_6$	3	5	12		1
358	ALAM	1		2	15	
359	URI		1			
366	KUR	5	8	69	575	157
367	ŠE	130	550	563	209	44
371	BU	298	1097	2184	500	116
372	UZ	12	71	95	18	12
373	ŠUD		1	1		1
374	MUŠ	1	24	59	2	2
375	TIR	8	13	141	5	
376	TE	167	490	821	429	161
376*	KAR	24	8	14	1	7
377	LIŠ	1	4			
381	UD	551	2260	2112	772	108
383	PI	175	684	1067	530	18
384	ŠÀ	358	486	191	103	26
392	UḪ	24	33			
393	ERÍN	2	72	7	1	11
394C	USUN	1	2		1	
395	ZIB		1			
396	DÙG	251	674	1355	360	204
397	A’		1		94	24
398	AḪ	142	385	1145	148	11
399	IM	440	1182	3874	228	46
401	ḪAR	7	88	29	137	30
405	MÙL			430		
406	KAM	60	331		4	6
411	U	30	130	93	117	40
412	UGU				131	129
416	GAKKUL			1		

Sign	Value	OB royal 1	OB non-royal 2	Mari 3	Amarna 4	Ugarit 5
418	IŠTAR	27	54	28	8	
420	ÁB	16	18	12	1	
425	KIŠ	1	8			9
427	MI	170	814	1140	792	123
429	GUL	1	1	7	1	2
431	NA			1	2	
433	NIM	197	193	631	50	8
435	LAM	84	351	357	7	1
437	AMAR	72	463	48	29	3
438	ŠIZKUR					1
439	BAN	4				
440	DÍM	17	7	15		1
441	UL	80	648	984	297	60
444	GÌR	10	16	27	212	
445	DUGUD				1	1
446	GIG					1
449	IGI	273	1008	1729	823	98
451	AR	102	386		177	16
452	AGRIG	4	2			
454	SIG$_5$		2	21	17	17
455	Ù	388	1315	2188	1848	313
457	DI	258	977	1118	294	61
459	DU$_6$	4	2		2	
460	SU$_7$		1			
461	KI	905	2307	4521	792	226
465	TIN	114	87	82	56	31
467	ŠUL	7	5		99	145
468	KÙ	41	316	219	118	31
469	PAD	13	71	6	1	2
470	UIA		12	10		
471	NIŠ	5	81	75	13	3
472	EŠ	27	97	227	93	8
473	NIMIN	1	16	10	5	3
475	NINNU	1	6	28	8	
476			7			
477			2			
480	DIŠ	331	844	865	837	41
480B						1
481	LAL	14	12	11	5	5
483	LAGAB	2	4	2	1	
486	GIGIR	1		7		7
487	ESÍR			1		
491	ZAR		1		8	
493	GANÀM		2			
494	U$_8$	28	27	1		
511	TÙL	21	2	1	83	2
522	SUG	2				
529	NIGIN				2	

Sign	Value	OB royal 1	OB non-royal 2	Mari 3	Amarna 4	Ugarit 5
532	ME	72	204	649	318	109
533	MEŠ	302	175	891	1445	330
534			7			
535	IB	176	518	1064	354	40
536	KU	233	996	1322	593	142
537	LU	119	707	839	434	159
538	KIN	5	17	7	99	27
539	SÍG	6	31	11		10
541	ERIN		1	1	3	
545	ŠÚ		1		2	23
546	KÈŠ	1			6	
554	SAL	10	128	133	79	54
555	ZUM	3	18	25	64	2
556	NIN	14	141	31	44	4
557	DAM	85	124	322	61	8
558	GEMÉ	2	20	48	13	5
559	GU	12	47	91	29	3
560	NAGAR	14	12	17		
562	ÙḪ		1			
563	NIG	2				
564	EL	24	173	112	57	3
565	LUM	43	203	223	13	2
567	SIG_4	2	12	9	2	
570	MIN	17	137	232	85	12
574	TUG	1		1		
575	UR	85	275	625	121	14
579	A	2107	5740	9214	3815	917
585					336	
586	ZA	157	356	1317		86
589	ḪA	366	556	1219	386	45
592	SIG		4	1	2	
593	$EŠ_5$	21	61	108	15	5
595	ṬU	3	143	57	9	
596	PÉŠ		7			
597	NÍG	73	86	97	65	20
598A	IÁ	8	88	94	19	6
598B	ÀŠ	2	25	57	3	2
598C	IMIN	2		22	255	9
598D	USSU	4	6	19	3	2
598E	ILIMMU		2	5	2	

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