

können. Das bedeutet, daß al-Qazwini, der oft an Mangel Kritizismus aufweist, ist kein naiver Mensch im gewöhnlichen Sinne des Wortes und sein Interesse für unbekannte und rare Phänomene, die nicht erklärt werden können, ist vollkommen gesund. Die Wissenschaft umfasst nur ein Teil der Phänomene und Tatsachen. Mittelalterliche arabische Kosmographen gestützt auf originalen Erbe ihrer Vorgänger bemühten sich Synthesen zu geben, die nicht immer gereift waren. Doch von diesem Interesse für das Ungewöhnliche und das Unerklärte geht auch die zeitgenössische Literatur der science fiction heraus. Die arabischen Kosmographen haben bei der Popularisierung des Wissens Verdienste, die von uns nicht unterschätzt werden können.

„Wer sich nicht wundern und begeistern kann, ist ein toter Mensch; seine Augen sind erloschen“ sagte A. Einstein und das kann vielleicht auch auf *ʿAḡāʾib al-mahlūqāt wa garāʾib al-mawjūdāt* angewendet werden.

STANISŁAWA KUBIAK

THE *PÓŁGROSZE* (*DEMI-GROSSI*) OF WŁADYSŁAW JAGIEŁŁO IN THE LIGHT OF STATISTICAL RESEARCHES

Thank to Prof. Z. Żabiński's¹ initiative, since several years we observe in Polish literature a growing interest for the application of the statistical method in the numismatic researches. These investigations included up till now the early-medieval coins, viz., the coins of Mieszko I, Bolesław Chrobry and the Palatine Sieciech.

Since we dispose of a relatively large metrological material concerning the coins from the late Middle Ages, among others the *półgrosze* (*demi-grossi*) of Władysław Jagiełło (1386—1434), we shall try to analyze from the statistical point of view some of the problems concerning their minting. The *półgrosze* belonged to one of the three kinds of crown-coins minted in the time of Władysław Jagiełło. The *półgrosze*, like also the remaining kinds of coins — *quartenses*, also called *trzeciaki* (*ternarii*) and *deniers* (*denarii*) —

¹ Z. Żabiński, *Statystyczna analiza wagi denarów Sieciecha* (Statistical Analysis of the Weight of the Denarii of Palatine Sieciech), „Wiadomości Numizmatyczne“ (WN), vol. VIII, 1964, p. 177—186; Id., *Statystyczna analiza wagi denarów Mieszka I i Bolesława Chrobrego* (Statistical Analysis of the Weight of the Denarii of Mieszko I and Bolesław the Valiant), WN, vol. IX, 1965, p. 105—116; Id., *Stosowanie teorii estymacji statystycznej w badaniach numizmatycznych* (Application of the Statistical Estimation Theory in Numismatic Research), WN, vol. XII, 1968, p. 1—17; s. also S. Suchodolski, *Le poids des monnaies de Charlemagne émises après la réforme*, „Dona Numismatica“, Hamburg 1965, p. 46—50.

were minted in silver with an admixture of copper varying in different periods of time. According to the general tendency occurring in the Middle Ages, both weight and silver content in coins varied, chiefly in minus. On the basis of the basic table of weights of the *półgrosze*² three average values for each particular type of *półgrosze* have been calculated: the arithmetical average (Ma), the medium value placed in the middle of the statistical range (Me), and the modal value, which shows the centre of the greatest density of the series (we insert below the list of the average values of the *półgrosze*)³.

Z. Żabiński⁴ presumes that when the arithmetical average is lower than the modal value (left-hand asymmetry — negative)⁵, it may be concluded that the coins of the given population were minted solidly enough with the maintenance of the appropriate weight of the unit, while, when there occurs the right-hand asymmetry — positive⁶, where the arithmetical average is higher than the modal value, it is to be supposed that those coins were lighter than it has been foreseen by the norm.

In our case, the diagrams of the following types of *półgrosze* show the left-hand asymmetry: I, II, III, V, XI, XII, while the types: IV/AS, IV/SA, VI, VII present the right-hand asymmetry. It is only in one instance, viz.: of the type X, that the symmetrical statistical range occurs in which the modal value is equal with the arithmetical average⁷.

Now, the question arises how does the real value of the coins of each particular type of *półgrosze* present itself in regard both

² S. tabl. The table does not include the specimens particularly damaged.

³ The column „a” presents the actual weight data, while the column „b” the presumable original weight data obtained by the addition of 5% to the actual weight, in order to compensate the loss of weight caused by the currency of coins, corrosion and conservation. The diagrams have been prepared on the basis of the column „a” data.

⁴ Z. Żabiński, *Stosowanie teorii estymacji...*, WN, vol. XII, 1968, p. 5.

⁵ S. diagram No 1, 2, 3, 6, 12, 13.

⁶ S. diagram No 4, 5, 7, 8.

⁷ S. diagram No 11.

Type	Marks under the crown as a distinctive feature of the type of „półgrosze”	number of pieces	Ma g		Me g		Mo g	
			a	b	a	b	a	b
I	letter P	183	1,66	1,74	1,68	1,76	1,72	1,80
II	letter N	240	1,64	1,72	1,65	1,73	1,68	1,76
III	letter S	35	1,56	1,63	1,57	1,64	1,57	1,64
IV/AS	letter AS	177	1,64	1,72	1,64	1,72	1,63	1,71
IV/SA	letter SA	101	1,59	1,67	1,59	1,67	1,58	1,66
V	letter A	61	1,65	1,73	1,64	1,72	1,66	1,74
VI	marks F ‡	312	1,59	1,67	1,57	1,65	1,56	1,64
VII	marks W ‡	51	1,51	1,59	1,50	1,58	1,47	1,54
VIII	mark ‡	13*	1,58	1,66	1,67	1,75	-	-
IX	mark ‡ / * /	19	1,48	1,55	1,45	1,52	-	-
X	mark ‡	51	1,58	1,66	1,55	1,63	1,58	1,66
XI	no mark	727	1,55	1,63	1,54	1,62	1,62	1,70
XII	mark ○	93	1,52	1,60	1,51	1,59	1,54	1,62
XIII	mark x / * /	7	1,50	1,58	1,48	1,55	-	-
		2070						

* Because of the small number of the specimens of *półgrosze* belonging to the types VIII, IX, XIII, their modal values have not been calculated.

to the weight of coins and to the silver title⁸. The only way to test the value of coins as well as to fix the degree of solidity of their minting will be the comparison between the nominal mint rate of each particular type of *pólgrosze* with the real one, as it has been illustrated by the below inserted table.

Type	Nominal Rate	Real Rate	The proportional relation between the real and nominal rates
I	96	235—337	245%—351%
II	96	240—339	250%—353%
III	96	257—321	268%—334%
IV/AS	96	230—273	240%—284%
IV/SA	96	250—298	260%—310%
V	96	270—291	281%—303%
VI	96	301—477	314%—497%
VII	96	335—415	349%—432%
VIII	96	341, 346 ⁹	355%, 360%
IX	96	293—384	305%—400%
X	96	293—390	305%—406%
XI	96	279—478	290%—498%
XII	96	317—382	330%—398%
XIII	96	373, 384 ⁹	388%, 400%

As it appears from the data of the table, the best coins were undoubtedly the *pólgrosze* of the type IV/AS minted in the time when Andrzej Czarnysza and Szymon de Talentis were in charge of the mint. The types I—V of the *pólgrosze* are also to be counted to the good coins. Considerably worse were the *pólgrosze* of the types VI—XIII, and especially of the types VI and XI. Comparing the results of the volumetric analysis of the coins with those of the qualitative one, i.e. of the analysis in regard both to the weight and title of the coins we can see that in many cases they

⁸ S. the list of the real mint rate of the *pólgrosze* in the work of S. Kubiak, *Monety pierwszych Jagiellonów* (in print), as well as the list on the page where the extreme values of the real mint rate for each particular type of *pólgrosze* have been given.

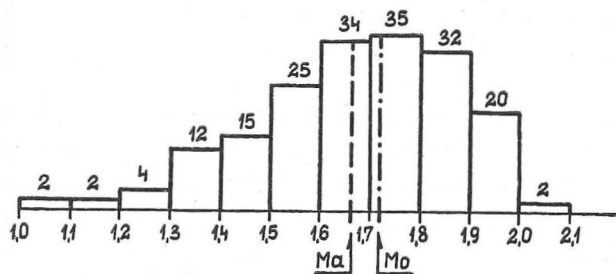
⁹ Because of the small quantity of chemical analyses of silver done for this type of *pólgrosze*, only the real mint rate calculated on the basis of two tests of silver has been given.

The Basic Table of Weights of the *pólgrosze* (*demi-grossi*) from the Time of Władysław Jagiełło

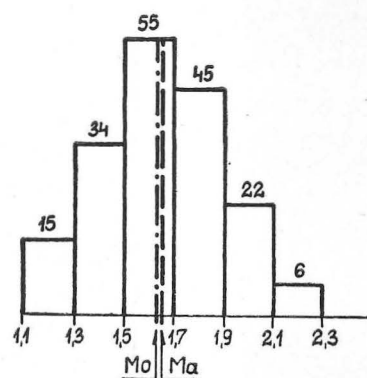
Weigt	Type I		II		III		IV/AS		IV/SA		V		VI		VII		VIII		IX		X		XI		XII		XIII		Sum	
	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g	quan- tity	g
0-82																								1	0-82			1	0-82	
0-83																														
0-84																														
0-85													1	0,85														1	0-85	
0-86																														
0-87																														
0-88																														
0-89																														
0-90																														
0-91																														
0-92																														
0-93																														
0-94																							1	0-94				1	0-94	
0-95																							1	0-95				1	0-95	
0-96																														
0-97																														
0-98																														
0-99																														
1-00													1	1-00										1	1-00			2	2-00	
1-01													2	2-02														2	2-02	
1-02			1	1-02									1	1-02									2	2-04				4	4-08	
1-03													1	1-03														1	1-03	
1-04																								1	1-04			1	1-04	
1-05																							2	2-10				2	2-10	
1-06			1	1-06									1	1-06									1	1-06				3	3-18	
1-07			1	1-07									1	1-07	1	1-07							2	2-14				5	5-35	
1-08	2	2-16											1	1-08									1	1-08				4	4-32	
1-09			2	2-18											1	1-09							1	1-09				4	4-36	
1-10					1	1-10				1	1-10		1	1-10									4	4-40				7	7-70	
1-11																					1	1-11	2	2-22	1	1-11		4	4-44	
1-12																					1	1-12	1	1-12	1	1-12		3	3-36	
1-13										2	2-26												2	2-26				4	4-52	
1-14			1	1-14			2	2-28							1	1-14							1	1-14				5	5-70	
1-15	1	1-15					1	1-15	1	1-15			1	1-15	1	1-15							4	4-60	1	1-15		10	11-50	
1-16			1	1-16			1	1-16					1	1-16									2	2-32	1	1-16		6	6-96	
1-17													1	1-17									5	5-85				6	7-02	
1-18	1	1-18	1	1-18									1	1-18					1	1-18			2	2-36	2	2-36		8	9-44	
1-19							1	1-19	1	1-19													5	5-95	1	1-19		8	9-52	
1-20									1	1-20			1	1-20			2	2-40					4	4-80				8	9-60	
1-21													1	1-21			1	1-21					4	4-84				6	7-26	
1-22													1	1-22									4	4-88				5	6-10	
1-23							1	4-92					2	2-46					1	1-23			7	8-61	1	1-23		15	18-45	
1-24											1	1-24	3	3-72	1	1-24					1	1-24	8	9-92	1	1-24		15	18-60	
1-25					1	1-25							4	5-00					1	1-25			9	11-25	1	1-25	2	2-50	18	22-50
1-26	2	2-52			1	1-26	1	1-26					1	1-26	1	1-26					1	1-26	4	5-04	1	1-26		12	15-12	
1-27	1	1-27	1	2-54			1	1-27	1	1-27					2	2-54	1	1-27	1	1-27	1	1-27	9	11-43				19	24-13	
1-28			3	3-84			3	3-84					2	2-56					1	1-28			3	3-84	1	1-28		13	16-64	
1-29	1	1-29	1	1-29			1	1-29	3	3-87	1	1-29	2	2-58	1	1-29							4	5-16	2	2-58		16	20-64	

1-30								2	2-60			1	1-30	2	2-60						8	10-40	1	1-30			14	18-20		
1-31	2	2-62			1	1-31		1	1-31	1	1-31	4	5-24						1	1-31	10	13-10	1	1-31			21	27-51		
1-32	2	2-64	2	2-64			1	1-32	1	1-32		3	3-96							6	7-92					15	19-80			
1-33	1	1-33	2	2-66			2	2-66		1	1-33	3	3-99				1	1-33			7	9-31	1	1-33			18	23-94		
1-34	3	4-02	1	1-34				1	1-34			1	1-34	3	4-02						13	17-42					22	29-48		
1-35	1	1-35	5	6-75			2	2-70				1	1-35	1	1-35	1	1-35	1	1-35		13	17-55					24	32-40		
1-36	2	2-72	1	1-36	1	1-36	2	2-72	2	2-72		1	1-36						1	1-36	8	10-88	2	2-72			20	27-20		
1-37			5	6-85			2	2-74		1	1-37	4	5-48	1	1-37				2	2-74	8	10-96	1	1-37			24	32-88		
1-38			1	1-38	1	1-38	2	2-76	1	1-38		7	9-66						1	1-38	10	13-80	1	1-38			24	33-12		
1-39	1	1-39	3	4-17			2	2-78		2	2-78	2	2-78	1	1-39						7	9-73	3	4-17			21	29-19		
1-40	1	1-40	3	4-20	2	2-80	7	9-80	1	1-40	1	1-40	4	5-60	1	1-40				1	1-40	13	18-20	3	4-20			37	51-80	
1-41			2	2-82	1	1-41			4	5-64		6	8-46	1	1-41			1	1-41	1	1-41	10	14-10				26	36-66		
1-42	2	2-84	4	5-68			4	5-68	2	2-84	1	1-42	4	5-68				1	1-42		13	18-46	3	4-26			34	48-28		
1-43	1	1-43	3	4-29			2	2-86	1	1-43	1	1-43	6	8-58	1	1-43					12	17-16					27	38-61		
1-44	1	1-44	4	5-76					1	1-44	2	2-88	2	2-88					1	1-44	2	2-88	10	14-40	3	4-32			26	37-44
1-45	3	4-35	5	7-25	1	1-45	2	2-90	3	4-35		7	10-15	1	1-45			1	1-45		11	15-95	2	2-90	1	1-45	37	53-65		
1-46	1	1-46	2	2-92			3	4-38	1	1-46		2	2-92	1	1-46				1	1-46	9	13-14					20	29-20		
1-47	3	4-41	1	1-47	2	2-94	1	1-47	1	1-47	3	4-41	7	10-29	1	1-47					14	20-58	1	1-47			34	49-98		
1-48	1	1-48	6	8-88			1	1-48			1	1-48	7	10-36					1	1-48	11	16-28	3	4-44	1	1-48	32	47-36		
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1-51	3	4-53	2	3-02	1	1-51	1	1-51	1	1-51	1	1-51	2	3-02	2	3-02			1	1-51		8	12-08	3	4-53			25	37-75	
1-52	1	1-52	1	1-52	1	1-52	4	6-08			1	1-52	6	9-12	2	3-04					15	22-80	3	4-56			34	51-68		
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1-54	1	1-54	3	4-62			3	4-62	4	6-16		8	12-32						1	1-54	11	16-94					31	47-74		
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1-60	6	9-60	4	6-40	1	1-60	1	1-60	3	4-80	1	1-60	7	11-20	1	1-60				2	3-20	17	27-20	2	3-20			45	72-00	
1-61	3	4-83	7	11-27				2	3-22			1	1-61								12	19-32	1	1-61			26	41-86		
1-62	4	6-48	2	3-24			2	3-24	3	4-86		9	14-58					2	3-24	1	1-62	17	27-54	2	3-24			42	68-04	
1-63	2	3-26	5	8-15			4	6-52	3	4-89	2	3-26	2	3-26	2	3-26					10	16-30					30	48-90		
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1-65	2	3-30	8	13-20			4	6-60				3	4-95							1	1-65	18	29-70	1	1-65			37	61-05	
1-66	1	1-66	5	8-30	1	1-66	4	6-64	1	1-66		8	13-28	1	1-66						9	14-94	1	1-66			31	51-46		
1-67	7	11-69	5	8-35	1	1-67	5	8-35	3	5-01	2	3-34	8	13-36			1	1-67	1	1-67		6	10-02	2	3-34			41	68-47	
1-68	7	11-76	5	8-40	1	1-68			1	1-68	1	1-68	6	10-08				1	1-68	1	1-68	18	30-24	2	3-36			43	72-24	
1-69	1	1-69	5	8-45	3	5-07	1	1-69	2	3-38	1	1-69	6	10-14	1	1-69					14	23-66	3	5-07			37	62-53		
1-70	6	10-20	7	11-90	1	1-70	4	6-80	1	1-70	4	6-80	6	10-20	2	3-40				1	1-70	12	20-40	2	3-40			46	78-20	
1-71	2	3-42	1	1-71			2	3-42			1	1-71	7	11-97	1	1-71					8	13-68	3	5-13			25	42-75		
1-72	3	5-16	9	15-48	1	1-72	3	5-16				4	6-88				1	1-72				5	8-60				26	44-72		
1-73	5	8-65	4	6-92	1	1-73	3	5-19	1	1-73		6	10-38	1	1-73						6	10-38					27	46-71		
1-74	1	1-74	3	5-22			1	1-74	1	1-74		2	3-48	1	1-74					1	1-74	6	10-44				16	27-84		
1-75	5	8-75	3	5-25	2	3-50	1	1-75	3	5-25	1	1-75	2	3-50					1	1-75	2	3-50	6	10-50	1	1-75			27	47-25
1-76	3	5-28	2	3-52			2	3-52	1	1-76		2	3-52							1	1-76	6	10-56	2	3-52			19	33-44	
1-77	5	8-85	5	8-85			2	3-54			1	1-77	3	5-31			2	3-54			1	1-77	8	14-16	1	1-77			28	49-56
1-78	3	5-34																												

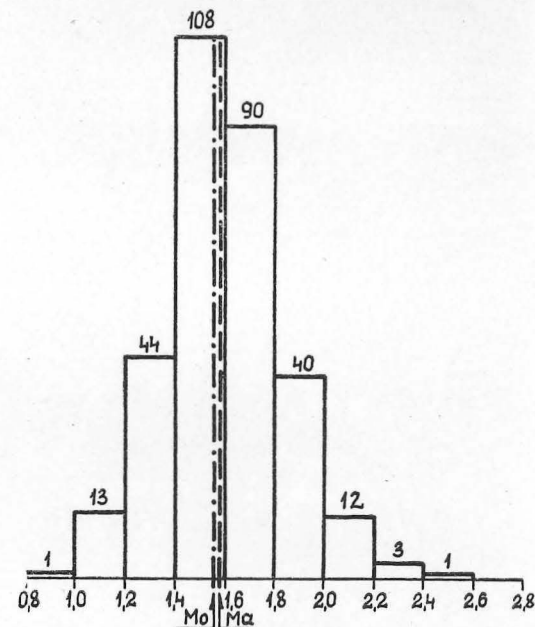
1-80	9	16-20	6	10-80	1	1-80	1	1-80		3	5-40	4	7-20									2	3-60	1	1-80			27	48-60	
1-81			3	5-43			1	1-81	1	1-81	1	1-81	2	3-62	1	1-81						4	7-24	1	1-81			14	25-34	
1-82	5	9-10	4	7-28			4	7-28	1	1-82	2	3-64	2	3-64	1	1-82					1	1-82	11	20-02			31	56-42		
1-83	2	3-66	1	1-83			4	7-32	1	1-83	1	1-83	1	1-83								3	5-49	3	5-49			16	29-28	
1-84	1	1-84	3	5-52			3	5-52					3	5-52	1	1-84					1	1-84	4	7-36	1	1-84			17	31-28
1-85	1	1-85	1	1-85			1	1-85	1	1-85	1	1-85	1	1-85	1	1-85	1	1-85			1	1-85	5	9-25			14	25-90		
1-86	5	9-30	2	3-72			3	5-58	1	1-86			3	5-58	1	1-86							3	5-58			18	33-48		
1-87	5	9-35	8	14-96			1	1-87			1	1-87	1	1-87			1	1-87					8	14-96	1	1-87			26	48-62
1-88	3	5-64	4	7-52			1	1-88					4	7-52									4	7-52			16	30-08		
1-89	1	1-89	1	1-89			2	3-78					2	3-78									1	1-89			7	13-23		
1-90	7	13-30	2	3-80			5	9-50	3	5-70	3	5-70	4	7-60									2	3-80			26	49-40		
1-91	3	5-73	4	7-64			2	3-82			1	1-91	2	3-82							1	1-91	4	7-64			17	32-47		
1-92	2	3-84	3	5-76							1	1-92									2	3-84	7	13-44			15	28-80		
1-93	1	1-93	1	1-93			1	1-93			1	1-93	2	3-86									3	5-79			9	17-37		
1-94	2	3-88	1	1-94					1	1-94			2	3-88									5	9-70			11	21-34		
1-95	1	1-95	1	1-95			3	5-85					1	1-95									1	1-95	1	1-95	1	1-95	9	17-55
1-96	3	5-88	2	3-92					2	3-92			1	1-96							1	1-96	2	3-92	1	1-96			12	23-52
1-97			1	1-97			1	1-97			3	5-91	1	1-97									1	1-97			7	13-79		
1-98	1	1-98	2	3-96			1	1-98					1	1-98									2	3-96	1	1-98			8	15-84
1-99			1	3-98			1	1-99	2	3-98			3	5-97	1	1-99			1	1-99	1	1-99	4	7-96			15	29-85		
2-00	1	2-00	5	10-00			1	2-00					4	8-00									2	4-00			13	26-00		
2-01									1	2-01													3	6-03			4	8-04		
2-02	1	2-02			1	2-02	2	4-04	1	2-02			1	2-02			1	2-02					5	10-10			12	24-24		
2-03			1	2-03			2	4-06															1	2-03			4	8-12		
2-04													1	2-04													1	2-04		
2-05			1	2-05			3	6-15	1	2-05													3	6-15			8	16-40		
2-06													2	4-12									1	2-06			3	6-18		
2-07			1	2-07																							1	2-07		
2-08													1	2-08									1	2-08			2	4-16		
2-09													1	2-09									1	2-09	1	2-09	3	6-27		
2-10							1	2-10			1	2-10	1	2-10													3	6-30		
2-11																														
2-12							1	2-12					1	2-12	1	2-12							1	2-12			4	8-48		
2-13							1	2-13																	1	2-13	2	4-26		
2-14																														
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2-28													1	2-28													1	2-28		
2-29							1	2-29					1	2-29									1	2-29			3	6-87		
2-30							1	2-30																			1	2-30		
2-31																														
2-32																														
2-33													1	2-33													1	2-33		
2-34																														
2-35																														
2-40																														
2-46													1	2-46													1	2-46		
	183	304-14	240	392-74	35	54-56	177	290-17	101	160-82	61	100-51	312	495-98	51	76-91	13	20-49	19	28-15	51	80-73	727	1124-20	93	141-20	7	10-53	2070	3281-13



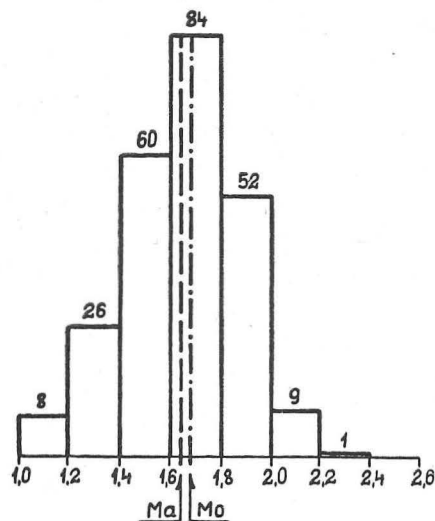
1. Histogram of weight of półgrosze (demi-grossi) — Type I



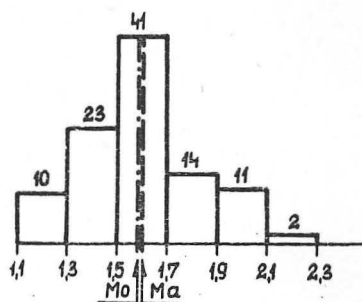
4. Histogram of weight of półgrosze (demi-grossi) — Type IV/AS



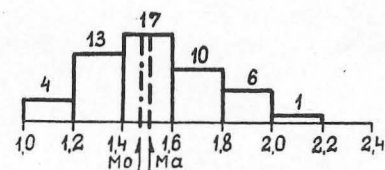
7. Histogram of weight of półgrosze (demi-grossi) — Type VI



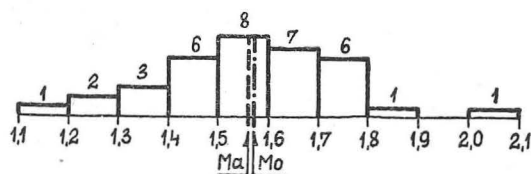
2. Histogram of weight of półgrosze (demi-grossi) — Type II



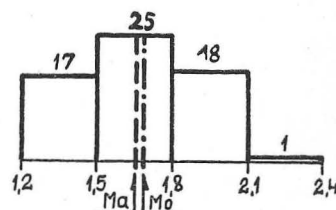
5. Histogram of weight of półgrosze (demi-grossi) — Type IV/SA



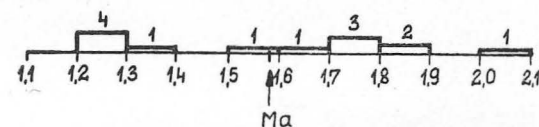
8. Histogram of weight of półgrosze (demi-grossi) — Type VII



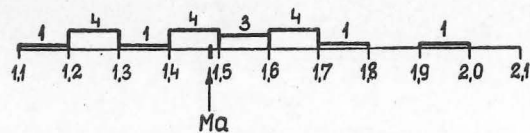
3. Histogram of weight of półgrosze (demi-grossi) — Type III



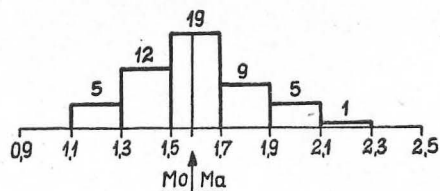
6. Histogram of weight of półgrosze (demi-grossi) — Type V



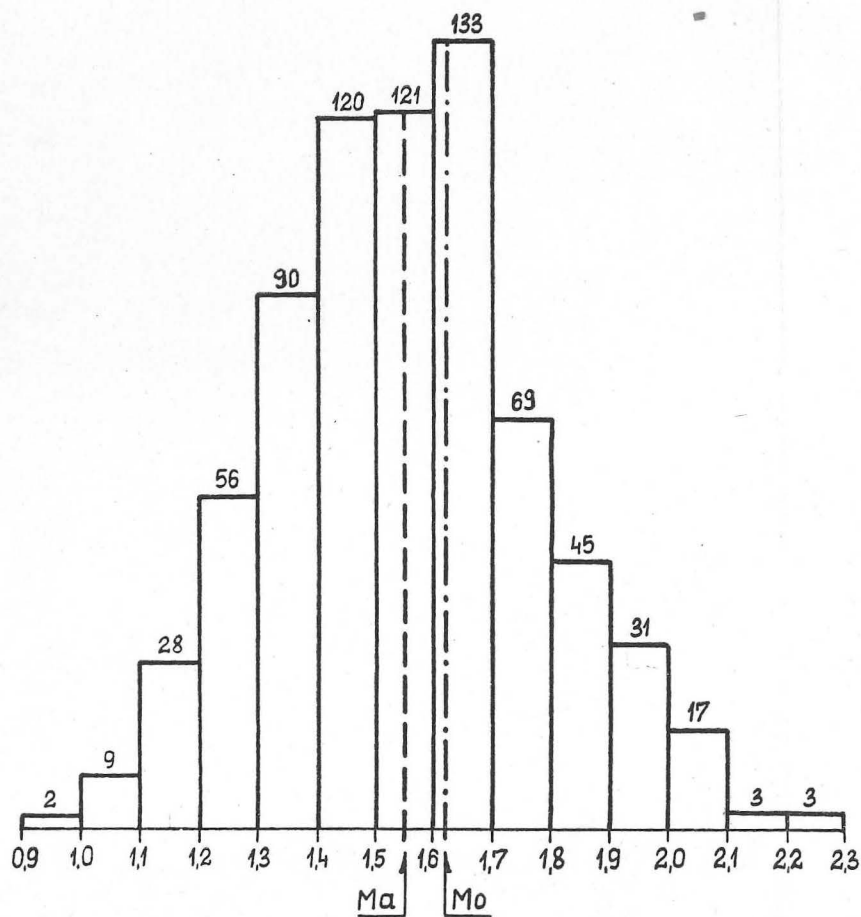
9. Histogram of weight of półgrosze (demi-grossi) — Type VIII



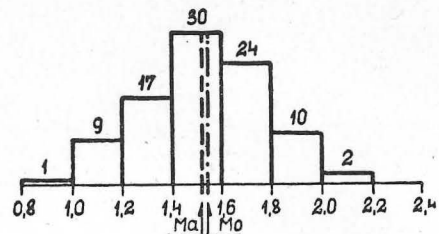
10. Histogram of weight of półgrosze (demi-grossi) — Type IX



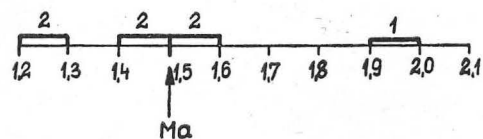
11. Histogram of weight of półgrosze (demi-grossi) — Type X



12. Histogram of weight of półgrosze (demi-grossi) — Type XI



13. Histogram of weight of półgrosze (demi-grossi) — Type XII



14. Histogram of weight of półgrosze (demi-grossi) — Type XIII

are discordant with each other. And thus e.g. the diagram of weights of the IV/AS type of *półgrosze*, the best in regard to the quality, shows the right-hand asymetry which means that these coins were being minted generally below the norm, where as the type XI which includes chiefly the worst perhaps specimens from among the coins minted in the time of Władysław Jagiełło show in the diagram of their weights the left-hand asymetry and thus should have been minted properly.

Naturally, these discordances have been evoked, apart from the weight, by the second factor, viz., the quality of metal which influenced the quality of coins. This problem does not exist for the coins from the X—XI cc., since their title was so high that in those circumstances the metal in which they were being minted could have occurred as a pure silver¹⁰. Therefore, while comparing the particular groups of coins with each other, the weight could have served as a criterion of their value. In later period however, when the value of coins was being lowered not only by the lowering of weight but also by worsening of the quality of silver, the investigations like these presented above find no application, because they can lead to such absurd conclusions like we have come to in our considerations, viz., that the better coins were being minted less solidly and vice versa.

¹⁰ S. S. Suchodolski, *Moneta polska w X/XI wieku* (Polish Coinage at the Close of the 10-th and the Beginning of the 11th Century), WN, vol. XI, 1967, p. 148.