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K. KARCZMARZ

MOSS REMAINS FROM DEPOSITS OF EARLY AND LATE MEDIEVAL AGE FOUND ON THE WAWEL HILL AND THE MAIN MARKET SQUARE IN CRACOW

Szczątki mchów z warstw wczesnego i późnego średniowiecza odkryte na Wawelu i Rynku Głównym w Krakowie

ABSTRACT. A large quantity of moss remains was discovered in culture layers in two localities, on the Wawel Hill (32 species) and in the Main Market Square (16 species) in old Cracow. The layers containing mosses were dated by pottery, in the first locality to the period from the IXth or Xth to the XIIth century A. D., and in the second, from the XIIth or XIIIth to the XVth century. All the remains of mosses examined from the Wawel Hill were isolated from 25 samples in six profiles used for carpological analysis (Wasylikowa 1978), and from 40 large packets of mosses which were discovered in archaeological investigations (Table 6). On the Main Market Square all the remains were collected in 13 seed samples (Wieserowa 1979) from two excavations (Table 7). Detailed data of the remains of vascular plants are given in the references.

In both localities large epilithic and epiphytic mosses of the families *Neckeraceae, Thuidiaceae* and *Brachytheciaceae* were found. They were probably brought from Cracow's environs to be used for packing walls of wooden houses or as wrapping material.

INTRODUCTION

Only a few Polish bryologists have been concerned with subfossil mosses from archaeological excavations. Several moss species from excavations in Gniezno were identified by Jaroń (1939). A relatively complete analysis of the bryological material from excavations at Ostrów Tumski in Wrocław was presented by Berdowski and Wilczyńska (1973). Wasylikowa's paper (1978) includes 12 bryophyte species (*Bryales, Sphagnum* sp., *Anthoceros* sp.) identified by Szafran, which were found during the first investigations on the

Wawel Hill. Among them there are *Antitrichia curtipendula*, *Polytrichum attenuatum* and *Ulota ulophylla*, which have not been recorded before. Other papers in this field contain few species (Savič-Lyubickaja & Abramova 1950; Dohnal 1955; Behre 1976).

The moss remains obtained from medieval Cracow, which were quite well preserved, come from archaeological examinations carried out on the Wawel Hill and the Main Market Square in Cracow by the Archaeological Laboratory on the Wawel Hill and Archaeological Museum in Cracow. I received the whole material and its dating by favour of Doc. dr. Krystyna Wasylikowa from the Institute of Botany, Polish Academy of Sciences, Cracow.

Detailed data about the flora of vascular plants, giving a more complete picture of the total botanical studies carried out, can be found in the papers of Klichowska (1964), Pawlikowa (1965), Trzcińska-Tacik and Wieserowa (1976), Wasylikowa (1965, 1978) and Wieserowa (1979). In their latest papers these authors have attempted to interpret this flora from the phytosociological point of view. Archaeological information is available in Radwański's book (1975).

The material studied is kept in the Museum of the Palaeobotanical Department, Polish Academy of Sciences, Cracow. Some of the duplicates are in the palaeobotanical collections of the Department of Systematics and Geography of Plants, Institute of Biology, Maria Curie-Skłodowska University, Lublin.

MATERIAL AND METHODS

Preservation of samples

Mosses of the families *Amblystegiaceae* and *Thuidiaceae* having strongly built brown costas are exceptionally well preserved in peats and boulder loams and alluvial deposits.

In the material examined almost all the mosses, except small specimens or parts, have been preserved in good condition. Stems and leaves are brown or yellow-brown; however, hepatics are absent. Among the mosses specimens of the genera *Anomodon*, *Neckera*, *Thuidium* and of the species *Thamnobryum alopecurum* are best preserved. The greatest abundance in the material of all layers has been reached by *Anomodon viticulosus*, *Neckera crispa* and *Thamnobryum alopecurum*. All plants are preserved only as gametophytes.

Preparation

In this paper the preparation techniques used in Polish studies have been applied (Karczmarz 1968; Wasylikowa 1973). The isolated remains were washed 5–10 times with 50% alcohol for conservation. Before making prepara-

tions, cleaned moss remains were dehydrated in methyl alcohol and then in xylene alcohol 15%, 20%, 30%, 50%, 75%, 80%, absolute alcohol, then absolute alcohol with xylene at the ratio: 1:3, 1:1, 3:1. Permanent preparations were made on glass slides varying with the size and thickness of the object. The most delicate leaves and stem tops as well as thicker stems were mounted in Canadian balsam. The preparations were dried in an incubator for 15 days (Karczmarz 1968, p. 99–100).

Identification

The isolated remains were provisionally assigned to a family or genus, and after being sorted the species were determined, using the works of Szafran (1957, 1961) and Dombrovskaja *et al.* (1959). From these material permanent preparations in Canadian balsam were made. The permanent preparations as well as unfixed remains were used for direct comparative examinations during determination. The determination of some damaged specimens was possible only after carrying out detailed comparative examinations allowing the author better understanding of the complete variability of the plants analysed.

EXCAVATIONS ON THE WAWEL HILL

Stratigraphy and age

The Wawel Hill constitutes a distinctly isolated morphological area, being one of the so-called horsts of the Cracow Gate. It is built of Upper Jurassic limestone, overlain in some places by a thin layer of Cretaceous deposits. The original surface, which was formed of limestone, was considerably deformed by accumulations several metres thick due to systematic, long lasting human action. The suitable location of the Wawel Hill as well as its defensive advantages have made it a place of human habitation for ages, which was greatly intensified in the early Middle Ages. Over the period from the IXth to the XIth century wooden buildings became distinctly denser, and excavations have revealed palisade fortifications and a bulwark of earth, wood and stone (Radwański 1975).

Between the IXth and XIth century, after the incorporation of Cracow into the Polish state ruled by the Piasts, a great development of settlements occurred. In the west part of the Hill a complex of manor buildings was established. In the XIth, XIIth, and XIIIth centuries the Romanesque Wawel Hill was extended and rebuilt, mainly in its north-east part, where a Romanesque castle was erected at that time. In the west part of the Hill a settlement of wooden buildings, both domestic and commercial, was erected.

Table 1
Tabela 1

Wawel Hill-region X. Samples of mosses isolated from samples of seeds and fruits (sample numbers acc. to K. Wasylikowa 1978)
Wawel-region X. Próby mchów izolowane z prób owoców i nasion (numery prób wg K. Wasylikowej 1978)

No. of sample	Stand	Depth in cm.	Layer	Wall	Century A. D.
54a	I	580–590	pit 1	C	XI–XII
54c	I	600–610	1	C	XI–XII
54d	I	610–620	1	C	XI–XII
54e	I	620–635	1	C	XI–XII
54f	I	635–645	1	C	XI–XII
54g	I	650–660	1	C	XI–XII
54h	I	660–670	1	C	XI–XII
52a	IV	530–540	VIe$_4$ (VIe$_3$)	C	X –XI
51a	III	533–543	VIe$_4$ (VIe$_3$)	C	X –XI
51h	III	600–610	VIg	C	IX–X
50d	VI	510–520	VIe	A	XI–XII
50i	VI	560–570	VIf	A	IX–X
50k	VI	580–590	VIf	A	IX–X
45n	II	630–640	VIg	C	IX–X
22b	II	540–550	VIe$_4$ (VIe$_7$)	C	X –XI
21a	I	530–540	pit 1	C	XI–XII
21b	I	540–548	1	C	XI–XII
21c	I	550–558	1	C	XI–XII
21d	I	560–568	1	C	XI–XII
21e	I	570–578	1	C	XI–XII
9x	VII	515–523	VIe	A	XI–XII
9y	VII	505–515	VIc–d	A	XI–XII
3e	I	520–530	VIe	C	XI–XII
House 3	are L	sec. 708	VIe$_1$	A	XI–XII

Stands: I — are K, sector 10, II — are K, sector 11/12, III — are L, sector 13, IV — are L, sector 14, VI — are L, sector 5, VII — are K, sector 4

In the late phase of the Early Middle Ages, squares and lanes were built on the Wawel Hill, rather poorly paved with limestone pebbles.

The whole material from the Wawel Hill was collected during field examinations in the years 1955–1956, and is dated to the Early Medieval period, from the IXth to the XIIth century. The layers from which the plant material comes have detailed dating given in Tables 1 and 2. Two kinds of sample were examined:

1. 25 vials containing mosses coming from washed material which was carpologically analysed by Wasylikowa (1978) (Table 1). The mosses contained in the vials came from the large-area excavation, from six profiles denoted as points I–VII. They were randomly collected from the walls (A–C) of the excava-

Table 2
Tabela 2

Wawel Hill-region X (Samples of mosses)
Wawel-region X (próbki mchów)

No. of sample	No. of inventory	Date of collection	Localization Are	sector	Depth in cm.	Layer	No. of archaeological complex	Century A. D.
1	570B	14. IX. 55	K	12	520–530	VIe		XI–XII
2	571B	1. XII. 55	K	2	520–530	VIe		XI–XII
3	572B	2. XII. 55	K	2	520–530	VIe		XI–XII
4	573B	5. XII. 55	K	2	527–540	VIe	3210	XI–XII
5	586B	2. XII. 55	K	3	520–530	VIe	3237/55	XI–XII
6	589B	10–12. XI. 55	K	3	530–540	VIe	3242/55	XI–XII
7	591B	15. XI. 55	K	3	540–550	VIe	3247/55	XI–XII
8	592B	16. XI. 55	K	3	550–560	VIe	3256/55	XI–XII
9	593B	15. XI. 55	K	3	516–530	VIe	3261/55	XI–XII
10	599B	12. X. 55	L	5	510–520	VIe?	3306/55	XI–XII?
11	608B	20. XII. 55	L	6	550–560	VIe	3352/55	XI–XII
12	612B	30. XI. 55	K	10	530–540	VIe	3374/55	XI–XII
13	621B	1. XII. 55	K	10	560–580	VIe		XI–XII
14	626B	16. XI. 55	K	11	550–560	VIe		XI–XII
15	643B	10. XI. 55	L	13	530–540	VIe	3496/55	XI–XII
16	647B	11. XI. 55	L	13	530–540	VIe		XI–XII
17	650B	12. XI. 55	L	13	530–540	VIe		XI–XII
18	653B	15. XII. 55	L	13	540–550	VIe	3502/55	XI–XII
19	654B	7. XII. 55	L	13	535–600	VIe VIf	3505/55	IX–XII
20	663B	22. XII. 55	L	5	580–590	VIf_2	3610/55	IX–X
21	666B	21. XII. 55	L	6	570–580	VIf	3628/55	IX–X
22	667B	21. XII. 55	L	6	570–580	VIf		IX–X
23	668B	22. XII. 55	L	6	590–600	VIf_2		IX–X
24	669B	15. XI. 55	K	11	550–560	VIf	3639/55	IX–X
25	675B	10. XII. 55	K	11	620–630	VIf_2	3662	IX–X
26	761B	21. IX. 55	K	3	520–530	VIe		XI–XII
27	765B	23. XI. 55	L	13	530–550	VIe		XI–XII
28	766B	29. VIII. 55	K	11	500–510	VIe		XI–XII
29	772B	29. XI. 55	K	2	520–530	VIe		XI–XII
30	784B	5. XI. 55	K	2	510–520	VIe		XI–XII
31	845B	6. X. 55	K	4	520–530	VIe		XI–XII
32	875B	26. XI. 55	K	2	520–530	VIe		XI–XII
33	899B	28. XI. 55	L	5	570–580	VIf_1		IX–X
34	920B	11. VIII. 55	L	14	547–565	VIe_2 VIf_1		IX–XII
35	972B	10. VIII. 55	L	16	520	VIe		XI–XII
36	989B	10. VIII. 55	L	16	525–540	VIe		XI–XII
37	1040B	10. VIII. 55	L	16	510–530	VIe_2	4046	XI–XII
38	1108B	17. XII. 55	L	14	590–600	VIf_1		IX–X
39	1119B	16. IX. 55	K	11	520–530	VIe		XI–XII
40	33	14. IX. 55	K	12	520–530	VIe		XI–XII

tion, without reference to concrete archaeological objects, except for profile I, taken from a pit.

2. Material in 40 bags and in boxes, collected by archaeologists during excavations on the Wawel Hill (Table 2). Some of this consists of large accumulations of moss remains which could be macroscopically recognized. These mosses are most likely to have been collected for utilitarian purposes by the inhabitants of those times.

Both sample series are interesting, but from the bryological point of view the material contained in the bags is of the greater value.

Main features of the moss flora

In the samples examined 32 mosses were found (Table 6), representing species of the following habitats (Table 4):

a) Springs and swamps (4 species): *Cratoneuron filicinum*, *Drepanocladus aduncus*, *D. exannulatus*, *D. revolvens*.

Table 3
Tabela 3

Main Market Square-samples of mosses (sample numbers acc. to A. Wieserowa 1980)
Rynek Główny — próby mchów (numery prób wg A. Wieserowej 1979)

No. of sample	Layer	Depth in cm.	Excavation section	Wall	Century A. D.
4d	Ve	473–478	NE/I	N	from XII/XIII to the middle of XIII
4f	Ve	450–460	NE/I	N	,,
4i	Va	420–430	NE/I	N	Gothic layer middle of XIII
4l	IVc	390–400	NE/I	N	from the middle of XIII to the end of XIV
4m	IVc	380–390	NE/I	N	,,
4o	IVc	360–370	NE/I	N	,,
4p	IVc	350–360	NE/I	N	,,
4s	IVc	±338–340	NE/I	N	,,
11e	IIc	270–280	SE/II	N	from the middle of XIII to the end of XIV
11f	IIc	260–270	SE/II	N	,,
11g	IIc	250–260	SE/II	N	,,
11i	—	200–205	SE/II	N	XV
11j	If	192–200	SE/II	N	XV

Table 4
Tabela 4

Ecological characteristics of mosses found on the Wawel Hill
Ekologiczne właściwości mchów stwierdzonych na Wawelu

Species	Substratum	Frequency
Mniaceae		
Rhizomnium punctatum	ws, w, r	1
Leucodontaceae		
Leucodon sciuroides	e, r	8
Neckeraceae		
Neckera crispa	e, r	43
Neckera pennata	e, r	7
Neckera complanata	e, r	12
Neckera besseri	e, r	2
Homalia trichomanoides	e, r	1
Thamnobryum alopecurum	r	10
Lembophyllaceae		
Isothecium myurum	e, r, sr	19
Leskeaceae		
Leskeella nervosa	w, r	2
Pseudoleskeella catenulata	r	2
Thuidiaceae		
Anomodon attenuatus	e, r	17
Anomodon longifolius	e, r	2
Anomodon viticulosus	e, r	17
Thuidium tamariscinum	s, w	2
Thuidium recognitum	s, r	1
Thuidium delicatulum	s, r, w	7
Amblystegiaceae		
Cratoneuron filicinum	sp	2
Drepanocladus exannulatus	sp, p	3
Drepanocladus revolvens	sp, p	2
Drepanocladus aduncus	p	1
Hygrohypnum luridum	wr, sp	2
Calliergon giganteum	w, p	1
Brachytheciaceae		
Homalothecium sericeum	w, r	1
Homalothecium philippeanum	r	1
Homalothecium lutescens	s, r	1
Brachythecium albicans	s, r	1
Brachythecium velutinum	s, r, w	1
Cirriphyllum tenuinerve	r	2
Eurhynchium zetterstedtii	r, s, w	7
Oxyrrhynchium swartzii	r, s	3
Rhytidiaceae		
Rhytidiadelphus triquetrus	s, w	3

Explanations: e — epiphytes; p — peat, r — rocks, s — soils, sp — springs, sr — soil on rocks, w — wood, wr — wet rocks, ws — wet soils

b) Rocks (7 species): *Cirriphyllum tenuinerve, Homalothecium phillippeanum, Leucodon sciuroides, Neckera besseri, N. crispa, Pseudoleskeella catenulata, Thamnobryum alopecurum.*

c) Bark of trees (7 species): *Anomodon attenuatus, A. longifolius, A. viticulosus, Isothecium myurum, Neckera complanata, N. crispa, N. pennata*; some *Neckera* species forming also large patches on calcareous rocks.

d) Soil (5 species): *Eurhynchium zetterstedtii, Rhizomnium punctatum, Thuidium delicatulum, Th. recognitum, Th. tamariscinum.*

e) Various habitats — rocks, wood, soil (6 species): *Eurhynchium zetterstedtii, Isothecium myurum, Rhizomnium punctatum*, and both species of *Thuidium*.

Table 5
Tabela 5

Ecological characteristics of mosses found on the Main Market Square
Ekologiczne właściwości mchów znalezionych na Rynku Głównym

Species	Substratum	Frequency
Mniaceae		
Plagiomnium cuspidatum	s, r, w	1
Neckeraceae		
Neckera crispa	e, r	4
Lembophyllaceae		
Isothecium myurum	e, r, sr	4
Leskeaceae		
Leskea polycarpa	w	1
Pseudoleskeella catenulata	r	1
Thuidiaceae		
Anomodon attenuatus	e, r	2
Amblystegiaceae		
Drepanocladus revolvens	sp, m, p, mp	1
Calliergon cuspidatum	sp, m, p, mp	1
Cratoneuron decipiens	sp	1
Brachytheciaceae		
Brachythecium geheebii	r	2
Brachythecium salebrosum	s, w	1
Brachythecium plumosum	s, r	1
Brachythecium albicans	s, r	1
Cirriphyllum tenuinerve	r	1
Oxyrrhynchium swartzii	r, s	1
Hylocomiaceae		
Hylocomium splendens	r, s, w	4

Explanations: e — epiphytes, m — meadows, p — peat, r — rocks, s — soils, sp — springs, sr — soil on rocks, w — wood

EXCAVATION ON THE MAIN MARKET SQUARE

Stratigraphy and age

The samples from the Main Market Square in Cracow contained moss remains taken from samples washed for carpological examinations by Wieserowa (1979). They came from two excavations situated in the NE and SE quarters of the Square. As compared with the Wawel Hill materials, they are much younger and come from layers of Early Medieval age, from beginning of the XIIth century to the middle of the XIIIth, and of Late Medieval age.

Main features of the moss flora

In the samples from the Main Market Square 16 moss species (Table 7) were identified, gathered in the Medieval period most probably in the Bielańskie Skałki near Cracow and near Ojców regions. They represent the following habitat types (Table 5):

a) Springs and swamps (3 species): *Brachythecium plumosum*, *Cratoneuron decipiens*, *Drepanocladus revolvens*.

b) Rocks (5 species): *Brachythecium albicans*, *B. geheebi*, *Cirriphyllum tenuinerve*, *Oxyrrhynchium swartzii*, *Pseudoleskeella catenulata*.

c) Bark of trees (4 species): *Anomodon attenuatus*, *Isothecium myurum*, *Leskea polycarpa*, *Neckera crispa*.

d) Soil (3 species): *Calliergon cuspidatum*, *Hylocomium splendens*, *Plagiomnium cuspidatum*.

e) Various habitats — rocks, wood, soil (3 species): *Hylocomium splendens*, *Isothecium myurum*, *Plagiomnium cuspidatum*.

CONCLUSIONS

1. The mosses found on the Wawel Hill (32 species) come from culture layers dated to the time from the IX/Xth to XIIth century (Early Middle Ages).

2. The mosses found on the Main Market Square in Cracow (16 species) belong to culture layers dated to the time from the XIIth to the middle of the XIIIth century and to the time of the XVth century inclusive.

3. Determination of the subfossil remains of 38 leafy mosses from the two localities resulted in the following statement: all mosses from the Wawel Hill and from the Main Market Square belong to the pleurocarpous mosses, except for *Rhizomnium punctatum* and *Plagiomnium cuspidatum*, which belong to the acrocarpous mosses.

Table 6
Tabela 6

The occurrence of mosses in samples from the Wawel Hill
Występowanie mchów w próbach z Wawelu

Species \ Samples	1	2	3	3e	4	5	6	7	8	9	9*	9y	10	11	12	13	14	15	16	17	18	19	20	21	21a	21b	21c	21d	21e	22	22b	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	50d	50l	50k	51a	51b	52a	54a	54c	54d	54e	54f	54g	54h	Hutch 3xx	Frequency
Anomodon attenuatus (Hedw.) Hueb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	.	.	+	+	+	+	.	.	15
Anomodon longifolius (Brid.) Hartm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Anomodon viticulosus (Hedw.) Hook. et Tayl.	+	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	+	.	.	.	+	.	+	.	.	+	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	+	.	.	.	.	.	.	+	17
Brachythecium albicans (Hedw.) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Brachythecium lutescens (Hedw.) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Brachythecium velutinum (Hedw.) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
Calliergon giganteum (Schimp.) Kindb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cirriphyllum tenuinerve (Lindb.) Wijk. et Miarg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cratoneuron filicinum (Hedw.) Spruce	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Drepanocladus aduncus (Hedw.) Warnst.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Drepanocladus exannulatus (B. S. G.) Warnst.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Drepanocladus revolvens (Sw.) Warnst.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Eurhynchium zetterstedtii Stoerm.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	7
Homalia trichomanoides (Hedw.) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Homalothecium philippeanum (Spruce) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
Homalothecium sericeum (Hedw.) Kindb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
Hygrohypnum luridum (Hedw.) Jenn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Isothecium myurum Brid.	.	+	.	.	+	+	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	+	.	.	.	.	.	.	+	+	.	+	.	+	.	+	.	+	.	.	.	+	+	+	.	.	+	.	.	.	.	.	19
Leskeella nervosa (Brid.) Loeske	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Leucodon sciuroides (Hedw.) Schwaegr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	8
Neckera besseri (Lub.) Jur.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Neckera complanata (Hedw.) Hueb.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	12
Neckera crispa Hedw.	+	+	+	.	+	+	.	.	+	.	+	+	.	+	+	.	.	.	.	+	+	+	+	.	+	+	+	.	+	+	.	+	+	+	.	+	.	.	.	.	+	+	+	+	.	+	+	.	+	+	+	.	+	.	.	.	+	+	+	+	+	+	.	40
Neckera pennata Hedw.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	7
Oxyrrhynchium swartzii (Turn.) Warnst.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Pseudoleskeella catenulata (Schrad.) Kindb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Rhizomnium punctatum (Hedw.) Kop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	3
Rhytidiadelphus triquetrus (Hedw.) Warnst.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Thamnobryum alopecurum (Hedw.) Nieuwl.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	10
Thuidium delicatulum (Hedw.) Mitt.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	7
Thuidium rocognitum (Hedw.) Lindb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Thuidium tamariscinum (Hedw.) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Number of species	4	3	3	1	4	3	1	2	1	2	2	1	4	1	1	1	6	2	4	2	1	1	5	1	6	4	1	2	2	2	1	6	7	4	3	2	1	2	1	2	3	2	6	1	9	2	7	2	4	2	2	3	4	1	2	3	5	2	5	3	2	3	1	

* — Localization and dating of samples are given in table 2
** — Localization and dating of samples are given in table 1

4. Dominating families with species occurring in great numbers (Table 4, 5) are: *Neckeraceae* (*Neckera crispa* — 47, *N. complanata* — 12, *Thamnobryum alopecurum* — 10), *Lembophyllaceae* (*Isothecium myurum* — 23), *Thuidiaceae* (*Anomodon attenuatus* — 19, *A. viticulosus* — 17, *Thuidium delicatulum* — 7), *Brachytheciaceae* (*Eurhynchium zetterstedtii* — 7, *Oxyrrhinchium swartzii* — 3), and *Hylocomiaceae* (*Hylocomium splendens* — 4).

5. Most abundant mosses belong to large epilithic, epiphytic and epixylic pleurocarpous species. The species growing in moist forests, on meadows occur

Table 7
Tabela 7

The occurrence of mosses in archaeological samples from the Main Market Square
Występowanie mchów w próbach archeologicznych z Rynku Głównego

Species \ Samples	4d	4f	4i	4l	4m	4o	4p	4s	11e	11g	11f	11i	11j	Total
Anomodon attenuatus (Hedw.) Hueb.	.	+	.	+	.	.	.	.	.	.	.	.	.	2
Brachythecium albicans (Hedw.) B. S. G.	.	.	.	.	.	.	.	.	.	.	.	+	.	1
Brachythecium geheebii Milde	.	.	+	.	.	.	.	.	.	.	+	.	.	2
Brachythecium plumosum (Hedw.) B. S. G.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
Brachythecium salebrosum (Web. et Mohr) B.S.G	.	.	+	.	.	.	.	.	.	.	.	.	.	1
Calliergon cuspidatum (Hedw.) Kindb.	.	.	.	.	.	+	.	.	.	.	.	.	.	1
Cirriphyllum tenuinerve (Lindb.) Wijk et Marg.	.	.	.	.	+	.	.	.	.	.	.	.	.	1
Cratoneuron decipiens (De Not.) Loeske	.	.	.	.	.	.	.	.	.	.	.	.	+	1
Drepanocladus revolvens (Sw.) Warnst.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
Hylocomium splendens (Hedw.) B. S. G.	.	.	+	+	.	.	+	+	.	.	.	.	.	4
Isothecium myurum Brid.	+	.	.	.	+	.	.	.	+	+	.	.	.	4
Leskeea polycarpa Ehrh. ex Hedw.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
Neckera crispa Hedw.	+	+	.	.	.	.	.	.	+	+	.	.	.	4
Oxyrrhynchium swartzii (Turn.) Warnst.	.	.	.	.	.	.	.	.	.	.	.	+	.	1
Plagiomnium cuspidatum (Hedw.) Kop.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
Pseudoleskeella catenulata (Schrad.) Kindb.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
Total	2	5	3	4	2	1	1	1	2	2	1	2	1	

Localization and dating of samples are given in table 3

less numerously. Very numerous epilithic species grow at present on Jurassic rocks in the closest vicinity of Cracow.

6. Among the mosses examined only one aquatic species, *Calliergon giganteum*, was identified.

7. The mosses identified are typical for such habitats as rocks, soil, and living on dead substrata.

8. The mosses examined belong to the following subelements of the Holarctic element:

a) Eurosiberian sub-element comprising mainly common forest species, e. g. *Eurhynchium zetterstedtii*, *Homalia trichomanoides* and *Plagiomnium cuspidatum*.

b) Middle European sub-element, comprising species occurring on the bark of trees in deciduous forests, on rocks, e. g. *Neckera complanata*, *N. crispa*, *N. pennata* and *Anomodon attenuatus*.

c) Circumboreal-oceanic sub-element, e. g. *Thuidium tamariscinum*.

9. All mosses examined are generally classified in the Holocene element.

10. It can be concluded from numerous data that in the remote past moss cushions were used for packing walls of small wooden hutches and buildings (Dixon 1910; Doignon 1954; Ando 1957), and more rarely as wrapping of boats (Dickson 1973) or for hygienic purposes. However, the analysis of the

preserved moss materials does not enable us to estimate unambigously what they were used for in medieval Cracow. It is likely that the first and last of the uses mentioned above were common in those times.

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Institute of Biology, Department of Systematics and Geography of Plants, Maria Curie-Skłodowska University, ul. Akademicka 19, 20-033 Lublin
Instytut Biologii, Zakład Systematyki i Geografii Roślin, Uniwersytet Marii Curie-Skłodowskiej

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STRESZCZENIE

SZCZĄTKI MCHÓW Z WARSTW WCZESNEGO I PÓŹNEGO ŚREDNIOWIECZA ODKRYTE NA WAWELU I RYNKU GŁÓWNYM W KRAKOWIE

Opisane w pracy subfosylne szczątki 38 gatunków mchów zostały odkryte podczas badań archeologicznych i paleobotanicznych prowadzonych na Wzgórzu Wawelskim i Rynku Głównym w Krakowie. Materiały briologiczne z Wawelu były izolowane z prób karpologicznych przez Doc. Dr K. Wasylikową, dzięki uprzejmości której miałem sposobność opracowania całego zbioru mchów.

Materiał z Wawelu, w którym oznaczono 32 gatunki mchów (Tab. 6) reprezentujących 5 typów siedlisk (Tab. 4) został zebrany w latach 1955–1956 i jest datowany na wczesne średniowiecze (IX–XII w.). Obejmuje on dwa rodzaje prób. Pierwsze próby to 25 fiolek z materiału szlamowanego do analizy karpologicznej (Tab. 1) pochodzącego z jednego szerokoprzestrzennego wykopu, z 6 profili oznaczonych jako punkty I–VII. Przy czym profil nr I był pobrany z jamy. Drugie próby to materiał zawarty w 40 torebkach i pudełkach, zebrany przez archeologów (Tab. 2). Są to duże skupienia całych łodyżek lub nawet darni mchów łatwe do makroskopowego rozpoznania w terenie.

Materiał z Rynku Głównego zawiera 16 gatunków mchów (Tab. 7) rosnących na 5 typach siedlisk (Tab. 5). Pochodzi on z warstw kulturowych młodszych od wawelskich i jest datowany na okres od przełomu XII/XIII do XV w. Szczątki mchów izolowano z 13 prób szlamowanych do badań karpologicznych przez A. Wieserową, pobranych z dwóch wykopów położonych w NE i SE kwartale Rynku.

W analizie materiałów briologicznych podano charakterystykę ekologiczną i fitogeograficzną stwierdzonych mchów oraz określono przypuszczalną ich rolę w gospodarstwie domowym mieszkańców średniowiecznego Krakowa.