PROVENANCE AND PETROGRAPHICAL PROBLEMS OF THE BUILDING AND ORNAMENTAL STONE MATERIALS OF HUNGARIAN RENAISSANCE ARCHITECTURE

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Abstract

The paper summarizes the probable motivations in choosing building stones of art monuments and surveys the history of stone utilization. It deals with the characteristics of stone utilization of the Renaissance period by surveying geologically the most important building stones used in this period (compact red limestone, marls of the Buda region, marble, coarse limestone, fresh water limestone, sandstone). It analyses in detail the petrographic and geological data of the recently recognized stone material, the marl of Buda.

Through human history, a diverse utilization of stone materials may be followed. This use can be observed in almost every society living in a region with available stone materials where the nature of dwelling necessitated durable buildings. The spread of stone utilization was also favoured in regions where no building material was available fully conforming with the demands of society. At the same time, people living in forests (e.g. the Finns till the beginning of this century) had their houses built mainly of wood, in spite of the presence of stone.

Among building materials, stone became important mainly due to its strength and durability. A third motif, the specific esthetic beauty of stone, as a consequence of which several types of stones became valuable decorative elements, associated only later to the two former aspects.

It was only in particular cases that in the utilization of individual stones also some ideological motives appeared (e.g. ancient purple porphyry to indicate dignity; Augusztynowicz-Kertész—Kertész, 1982).

An important characteristic of stone materials is their very high density which manifests itself in the large weight of stone blocks or stone elements. Owing to this, the transportation of stone materials was always a very expensive and technically difficult task. Thus, in the course of stone utilization, it was required that the suitable stone material should be used most economically, i.e. stone should be transported from the least possible distance.

Thus in case of each construction only a certain geographic area can be allotted, from which the transportation of stone material was technically possible, economically expedient (Kertész, 1982). The dimensions of this range were

restricted in an early society only to the immediate neighbourhood of the settlement, and increased later on significantly with the development of society and mainly with that of transportation, according to the momentary political, economic and possession relations of the given period.

In the present area of Hungary, stone utilization began in the Roman epoch. The geographic range allowed for underwent numerous changes since then. In Roman times, this range did not exceed the area of the province in respect of stones utilizable in larger amounts, but inside the province, the way of transport for fresh water limestone can be followed e.g. from the occurrence in the Buda-Gerecse mountains to the vicinity of Székesfehérvár.

However, at the same time this range was significantly widened in respect of marble, a valuable building material. The area of origin for marble found in Hungary from the Roman period is partly Greece, but for late Roman constructions eventually also Italian marble has been used.

With the foundation of the Hungarian state, the area which can be considered for stone was narrowed to the area of the country, to the Carpathian basin, for some time, and even within this, only the transportation of certain stone materials (e.g. Jurassic limestone from the Gerecse mountain) can be traced to longer distances (e.g. far as Pusztaszer). The utilization of marble in the Arpadian age (e.g. Ják) meant a renewed cutting of Roman marble, thus it cannot be considered a widening of the geographical region to be allowed for.

Thus due to the variation in this geographical region and/or to the non-uniform geological construction of Hungary, not only stone material from the immediate neighbourhood of buildings is to be found, like in other places in Europe, and the determination of the mining site of stone materials provides useful data also from the standpoint of history. Therefore, at the suggestion of M. Horler, the National Authority for Historical Buildings initiated joint research with the Department of Mineralogy and Geology at the Budapest Technical University in 1975. The objective of this work is to determine the petrographic character and origin, as well as the quarrying site or at least the quarrying district of stone elements, stone ornaments on buildings or in museums of stonework remnants with the nature of art relics or monuments. During this work, questions requiring the petrographic studies of stone materials also arose, thus detailed, analytical petrographic investigations were carried out for different purposes on numerous stone materials of artistic value.

The aim of this paper is to give the results achieved in the study of Hungarian Renaissance stone materials, the problems that had been solved and the ones that are still to be solved. In the frame of this paper we cannot survey all the occurrences of art relics; instead we try to summarize the experience from the viewpoint of rock types.

2. Hungarian Renaissance related to stone utilization

The utilization of rock cannot be treated separately from the whole of social-artistic development. The frequent Italian (e.g. Venetian) connection at the period of state foundation was replaced later on by French influence, thus after the unknown Italian stone cutters, known French architects (e.g. Villard de Honnecourt) also participated in Hungarian building activities. However, there is no information from this period about the transportation of foreign stone material together with the arrival of stone cutters into the Carpathian basin. In the 14th century, the Italian connections of the Anjou dinasty revived again the Italian orientation and to a certain extent, this period prepared the field for the Italian influence in the Renaissance period.

In the 15th century, the Italian Renaissance, as a very important artistic and intellectual trend, affected Europe significantly; nevertheless this effect spread unevenly in the region northward of the Alps. The dynastic connections of King Mátyás (1458—1490) and his intellect opened up first his country to the Renaissance influence. This lead, among others, to a significant immigration of stone cutters and sculptors. From among these artists, numerous with names known created also identifiable works.

From the aspect of stone utilization, the Renaissance period means an organic continuation of the Hungarian middle ages: part of the rocks are used in the same way, however, the importance of another part decreases or increases, even new stone types appear in some places not used so far, or which have been imported earlier. This shift in the way of stone usage can probably be ascribed to the taste of the Italian masters and their traditions.

Stone material in our buildings appear in three characteristic forms: as simple masonry stones, as fashioned structural stone material and as cut ornamental stone of artistic character. The usage of masonry stones in this period is not specific: the geographically closest and most easily workable materials are always built into the buildings. Thus their analysis does not provide more information for the Renaissance period, as it does for others. The choice of structural stone elements (e.g. door and window frames, ledges) is, however, more specific: in addition to good cuttability, esthetic requirements are also set. Concerning this, the geographic region utilized may include far-away quarry sites. The material of decorative elements is chosen mainly from the esthetic point of view, in certain cases it may require also long distance transportation.

The large number of stone cutters and sculptors resulted in an appreciable development of decoration on an industrial scale, which — unfortunately not sufficiently known from documents — resulted also in a significant development of quarrying in Hungary. Stone cutters prefer the stone material they are used to. It can be assumed that Romans used in their building activities almost exclusively fresh water limestone, because it was identical with their home

"Lapis triburtinus" originating from the neighbourhood of Tivoli. Thus in the Renaissance period, besides the already known and used ones, a new stone material, marble was also imported and used which could not be obtained in a satisfactory quality from any part of historical Hungary.

A very great difficulty of art history and history of architecture in Hungary is that only a very few of our buildings withstood the storm of ages. The ruins of buildings destroyed in wars and wars of independence served later as stone pits, whereas the ones of limestone were used for lime kilning. Thus we have much less historical monuments than necessary to prove the standard of art and the diversity of stone utilization in Hungary. To this contributes also the fact that very few written proofs remained from the period before the Turkish occupation in Hungary, and the documents available were not evaluated with respect to stone utilization and stone quarrying.

Correspondingly, we have no data concerning the source and way of transportation of stone materials, which is well documented for the major part of buildings in Germany or France. Thus our historical conclusions — with some exceptions — are based mainly on petrographic and geological analyses. As a consequence, they may be more important from the viewpoint of Hungarian art history than they are in other countries.

3. Some important rocks of the Renaissance period

The variety of rocks in Hungary differs significantly from that usually found in Europe due to geological reasons: sandstone used frequently in Europe is rarely found in Hungary and its quality is not satisfactory; the quality and durability of coarse limestone are more unfavourable than those of the coarse limestone serving as a standard, from which cathedrals and castles are built in France; usable marble occurs only in Transsylvania. Hence, due to the difference in the quality of stone materials, the now practically not reconstructible character of the Renaissance buildings in Hungary also differs from that of the examples. Moreover, so far unknown types of rocks have been introduced in architecture in Hungary, probably to diminish this difference.

The importance of certain stone materials, e.g. fresh water limestone, significantly decreased in this period, while the utilization of other rocks, e.g. of Jurassic compact red limestone, reached its peak.

Numerous petrographic-geological problems have risen in connection with the various types of rocks which will be dealt with from the aspect of the main rock types (Fig. 1).

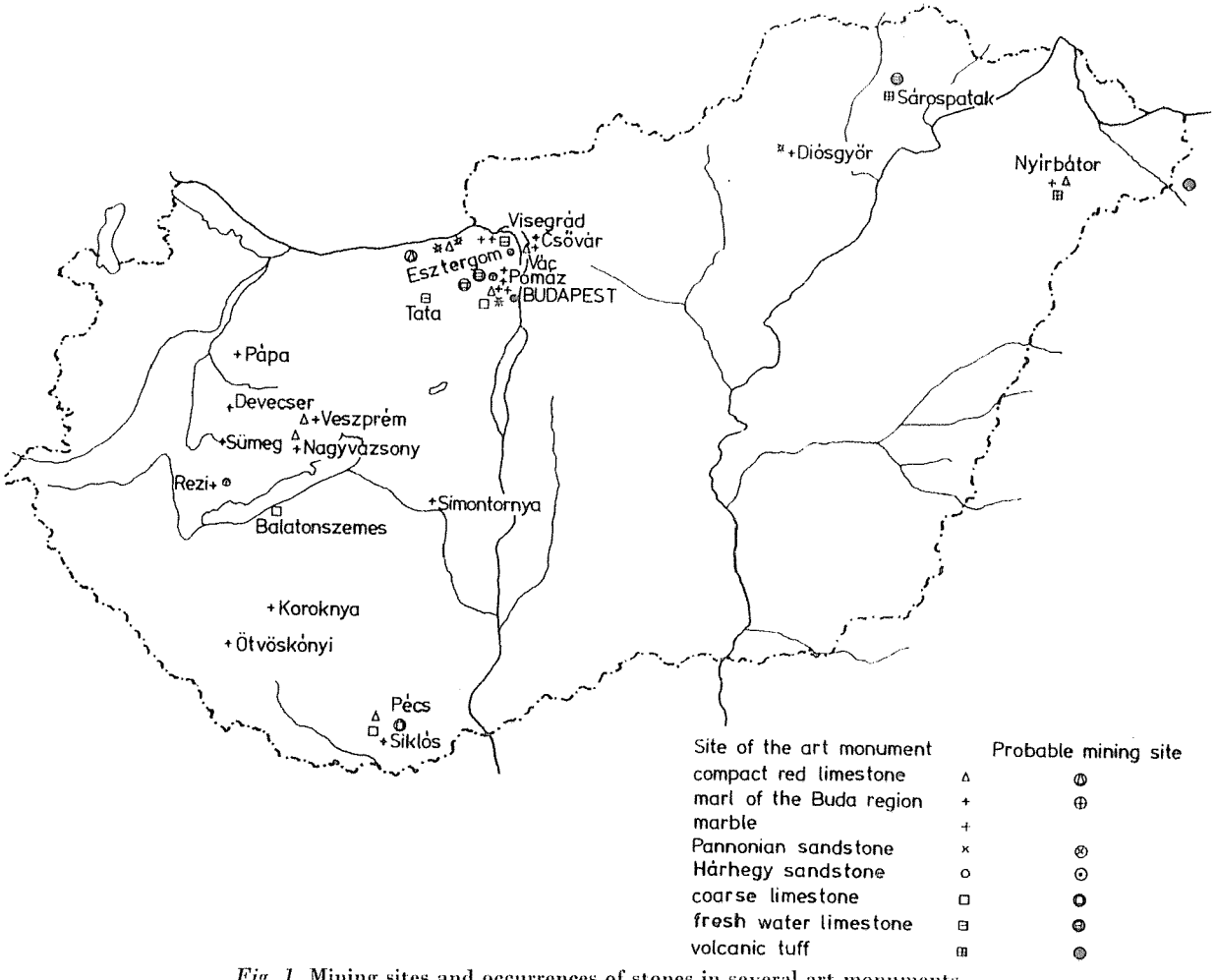

Fig. 1. Mining sites and occurrences of stones in several art monuments

3.1 *The compact red limestone of Piszke (so-called red marble)*

This rock can be identified first as the material of mosaics in the Roman age, it was applied in significant amounts in the buildings of the Arpadian period (e.g. in Esztergom), the well-known "Kings Head" of Kalocsa is also from this material. It is the raw material of a very highly developed stone cutting work in the Anjou-wells, and it is a very important and generally used stone material of Hungarian Renaissance. The significant and very decorative cuttings in the Buda castle are also made of this rock, as well as tombal flatstones and ledges which were also exported. The only well-preserved architectural unit from the Renaissance period in Hungary, the Bakócz Chapel in Esztergom is also built of this rock.

Petrographic and art history literature do not use the same name for this rock. The latter call it "Hungarian red marble", and this name was accepted also by international literature, thus it is often used in this form, despite its petrographic inaccuracy. Architectural literature mentions it as "red marble of Piszke" or "red compact limestone of Tardos". Its genesis may be placed to the Lias-Dogger age of the Jurassic period of the Mesozoic, hence names as "Lias limestone" or "Dogger limestone" can also be found frequently. The deposits of the Jurassic Thetys Ocean have accumulated to a significant thickness and as a result of the spreading of the Ocean and later tectonic activities, such compact limestones have been deposited in numerous regions of Europe in an identical or similar way. Later on it was used as a building material in e.g. Salzburg-Adnet in Austria, Svinica in Yugoslavia and in the neighbourhood of Verona.

The Jurassic compact red limestone in Hungary is usually considered to be originating from the Gerecse Mountain, though from the beginning of our century, literature (e.g. Jakabffy, 1908) mentions also a significant import from Austria. In recent years, however, doubt has arisen also concerning the Hungarian origin of the stone material of the most important remnant, the Bakócz chapel (Figs 1, 2). Namely, the altar of the chapel is made entirely of marble (see 3.3). Since this marble cannot originate from Hungary, the question has arisen whether the Jurassic limestone has not also come from Italy, probably from quarries near Verona.

Based on detailed investigation of the material of the Bakócz chapel and on the analysis of some rock types from Verona, as well as on the results of Konda (AFT, 1982) the conclusion has been drawn that the building material of the Bakócz chapel has more similarities with rocks from the Gerecse Mountain than with those from Verona, therefore the material of the Bakócz chapel is still regarded as originating from the Gerecse Moutain. It is, however, to be noted that a more ancient find (the burial case of Béla the III) also differs to a certain extent from the material of the Gerecse Mountain and its imported origin cannot be excluded (Konda, 1987).

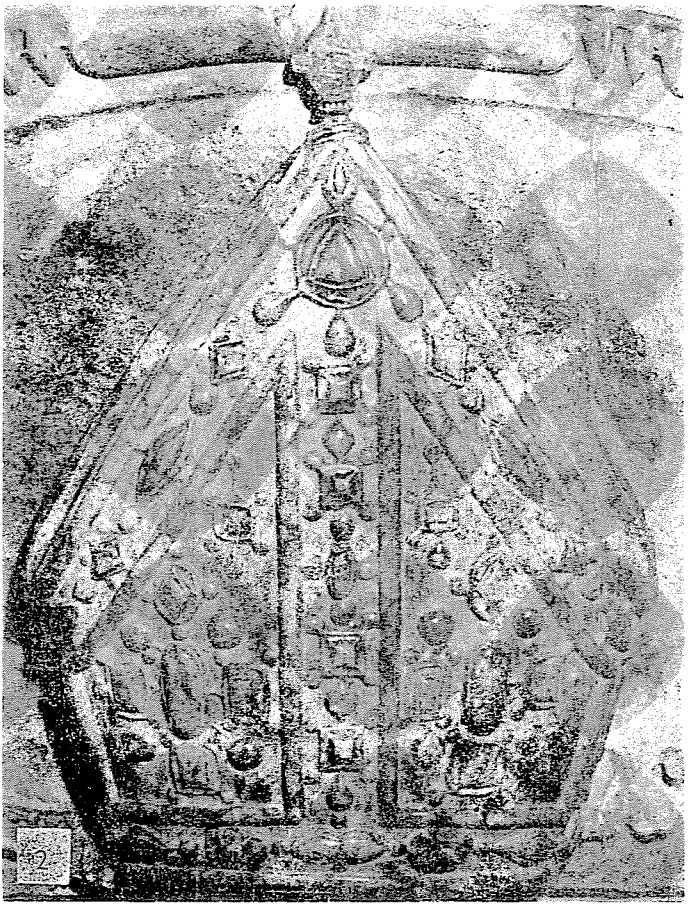

Fig. 2. Bishops-cap from the Bakócz chapel at Esztergom, compact red limestone

Nevertheless, the Gerecse origin of the Bakócz chapel is made probable also by the fact that the Polish king, Old Sigismund (1506—48), staying for a longer time at the Hungarian court chose the well-proven "Hungarian marble" as the building material of his chapel in Cracow.

As the Italian stone cutters went to Cracow from Buda, and the stone materials of the two chapels are practically identical, this may be considered as a proof for the Gerecse origin of the stones of the Bakócz chapel.

Consequently, the red limestone cuttings appearing in the Renaissance period can also be regarded as of Gerecse origin (e.g. the coats of arms from Nyírbátor and Pécs, Fig. 3), certain cuttings in Vác, the material of the Vetési pile-caps in Veszprém and the tombal flatstones very widesprend since the Gothic period). It seems that the main decorating stone material of the Buda castle in the period of King Mátyás consists also of this rock whose com-

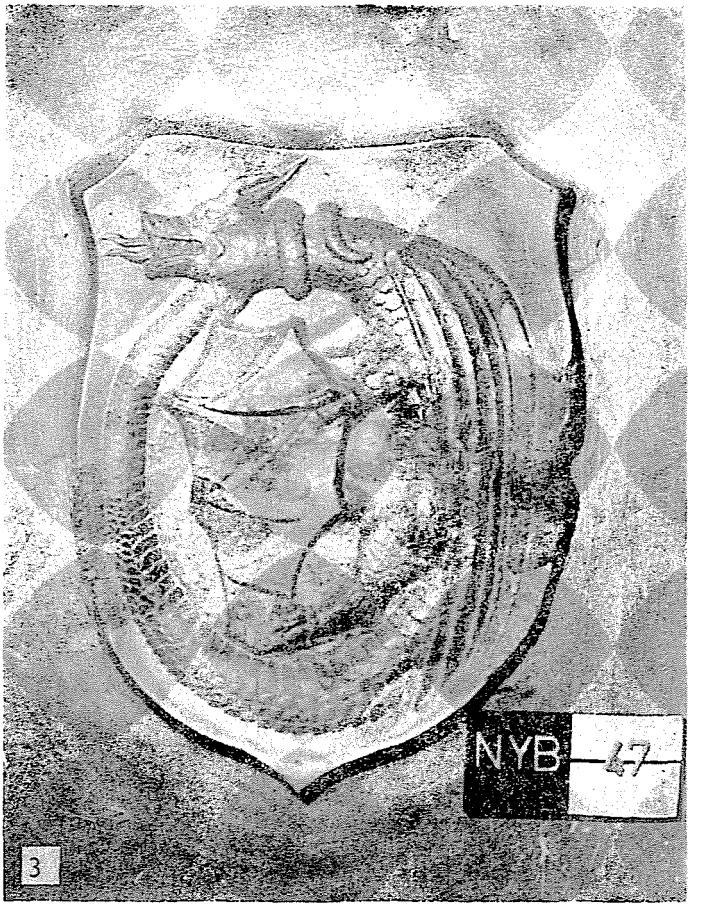

Fig. 3. Báthory coat of arms from Nyírbátor, compact red limestone

pact, carbonatic texture ensured good cuttability and brightness at the same time. This primary stone material was exchanged for marl from the Buda region in the second part of the Renaissance.

Numerous stone quarries were opened and closed during the centuries in the Gerecse area. Our present knowledge does not allow to correlate the stone elements identified at various places with the appropriate layers of different stone quarries.

3.2 *The problems of marl from the Buda region*

Hungarian art history is not very kind to people searching for petrographic data: petrographic names are only very rarely found in descriptions, and those present are often too general, e.g. numerous types of rocks, very different

from each other are cited under the same name: e.g. the name of limestone. This particular stone material of the Renaissance was also called by this name.

3.2.1 *The appearance of marl from the Buda region in art monuments*

In the course of our research activity we first met a stone material not identical with any known home building material when dealing with the castle at Simontornya. The petrographic name of this stone material, namely marl, was first accepted with doubt, but further studies at other places lead to similar results. Analyses have shown that this stone material originates from the more calcic beds of the series of Eocene Bryozoa and Buda marls and that it is well cuttable. So far it has been known only from the excavation report of Budanyék by Garády (mentioned by Horler, 1986). This same stone material could be identified later also at other places in the country, e.g. at Nagyvázsony, Devecser, Koroknya (Fig. 4), at Bács, (Yugoslavia) Nyirbátor (Fig .5), Esztergom (Fig. 6), Vác (Fig. 7). These places mark the limits of spreading for this type of stone, besides the very important utilization in Buda and its vicinity.

According to petrographic and geological data, the quarry site for this material might be in the immediate neighbourhood of Buda. To our present knowledge, this stone material was not used before the Renaissance period, and there is no report either from later times about its use in art monuments. It appears in the Renaissance period also relatively late: in the age of King Mátyás, the decoration of buildings was made from "Hungarian red marble" (e.g. in Buda). Ballustrades were also made of fresh water limestone (e.g. in Visegrád), whereas in the time of Mátyás, this stone material was first used for the building of the king's villa at Budanyék, perhaps because of the closeness of occurrence (Fig. 8).

Later on, in the age of the Jagellonian Renaissance, this stone become a generally applied material. The reason for this might be that the red or white stone material was not familiar to Italian stone cutters accustomed to the compact grey limestone of the Renaissance called "pietra serena", and this material was closer to that in its appearance and properties. It is also possible that the opinion of Horler is correct, according to which the mines of Gerecse could not provide the stone material for the building activity of Ulászló (1490—1516) thereby to the spreading of this material, as after the death of Mátyás the mines were owned by Queen Beatrix. Utilization of the stone material corresponding to its form and properties can also be found in the buildings of the aristocracy (e.g. Horler mentions the loggia at Simontornya being built after the royal villa at Nyék). Since the quarry was in the vicinity of the royal residence it may be assumed that the formal and material identity of the buildings in the country prove the survival of the royal workshop up to the Turkish occupation.

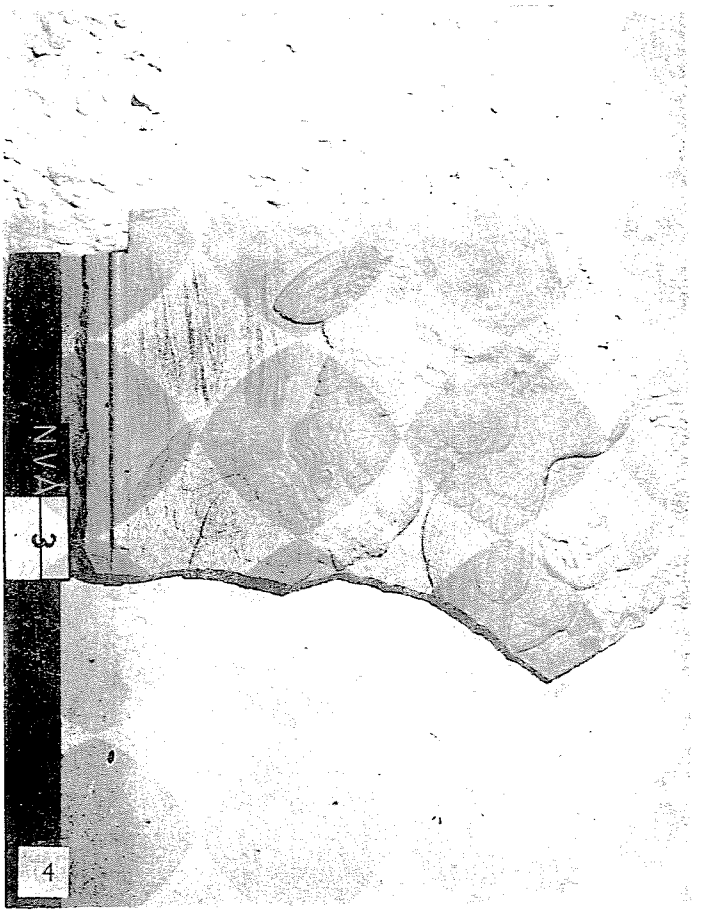

Fig. 4. Master of marble Madonnas: Giovanni Ricci, part of the relief with cherub heads from the Nagyvázsony castle

3.2.2 *Geological and petrographic analysis of the marl from the Buda region*

This stone material may have two kinds of geological origin: the so-called Bryozoa and the somewhat younger but also Eocene Buda marl occur together, but frequently there are also transition members between them.

These rock types are called in art historical usage comprehensively *marl from the Buda region.*

At the end of the Mesozoic, the major part of the country became firm ground due to the closure of the Tethys basin. The great amounts of limestone and dolomite emerging in the course of this process began to weather away, to become karstic.

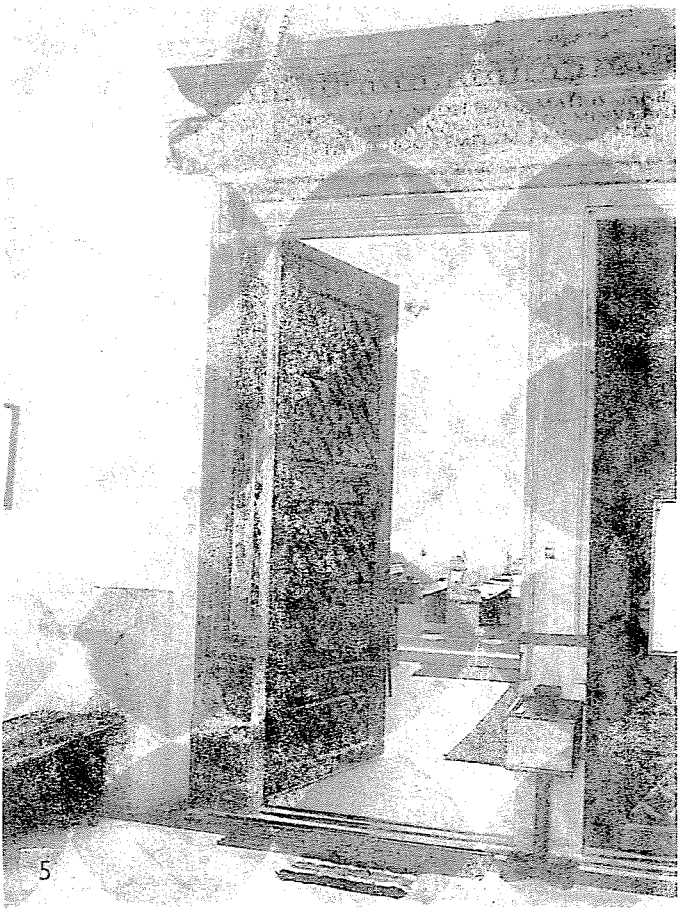

Fig. 5. Church door from the St. George, today protestant church from Nyírbátor, marl of the Buda region

At the beginning of the cainozoic era, these weathered areas started to sink due to structural motions in the Transdanubian direction, and the clayey limestone, the marl in the Buda region was among the sedimentary rocks of the sea thus formed.

Marl was present over large areas, but it has broken to the surface only in the Buda region. Good outcrops of it can be found in the area of the Gellért Hill, Csiki Mountains, Budaörs Hills, Mátyás Hill, Zugliget, János Hill, Budakeszi, Hárs Hill, Martinovics Hill, Gugger Hill, Hármashatárhegy, Solymár, Nagykovácsi and the Kevély Hills.

It has always been problematic to separate the connecting two members of the marl series in the Buda region, i.e. Buda marl and Bryozoa marl.

Fig. 6. Balustrade part from Esztergom castle, marl of the Buda region

Recent research shows that the two formations are of the same origin transforming continuously into each other (heteropic facies) with the difference that the Bryozoa marl is a formation of shallow waters, whereas the Buda marl forms in deeper waters, though both forms originate from localities close to each other (Kázmér, 1982).

3.2.2.1 *Buda marl from the series of marls in the Buda region*

The colour of the rock is most often light brownish-grey or yellowish-brown, but a red-brown colouration originating from iron is also often found. In art monuments, this latter colour is more frequent, due to subsequent oxidation.

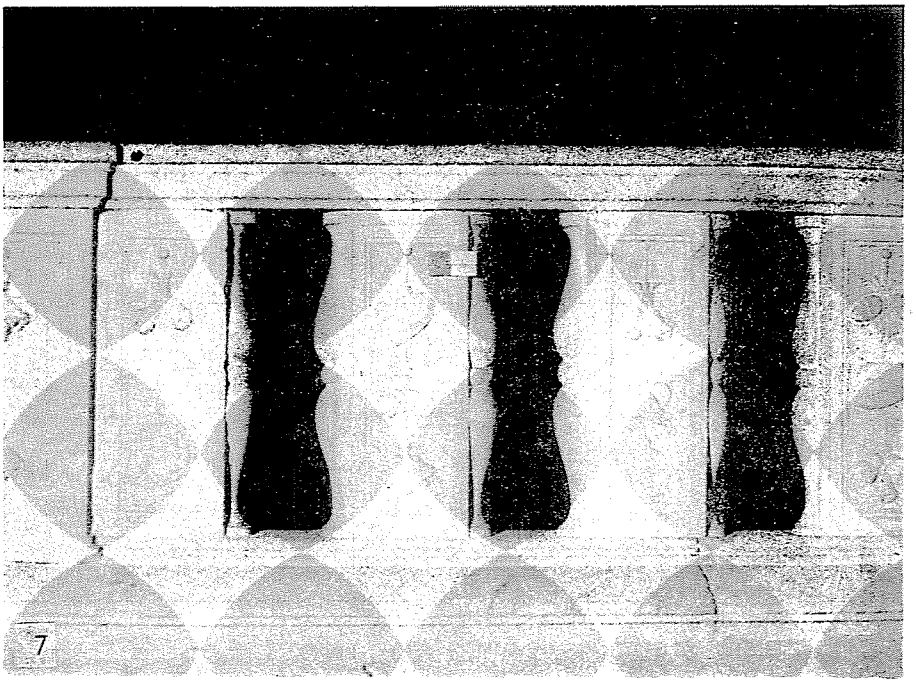

Fig. 7. Balustrade from the cathedral at Vác, marl of the Buda region

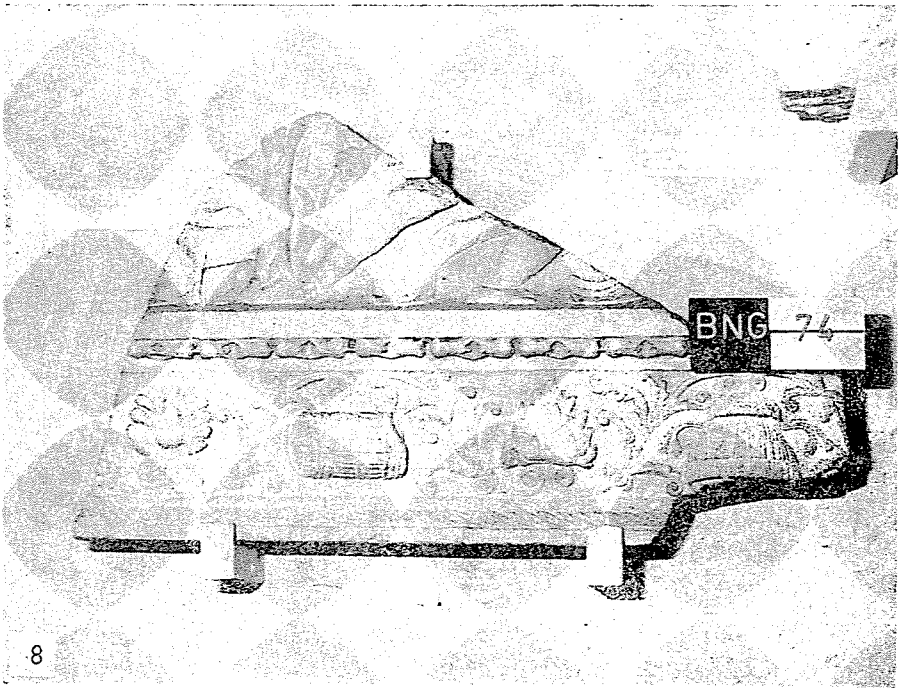

Fig. 8. Part of a frieze with the emblems of Mátyás and with bucolic scenes, from Nyék, marl of the Buda region

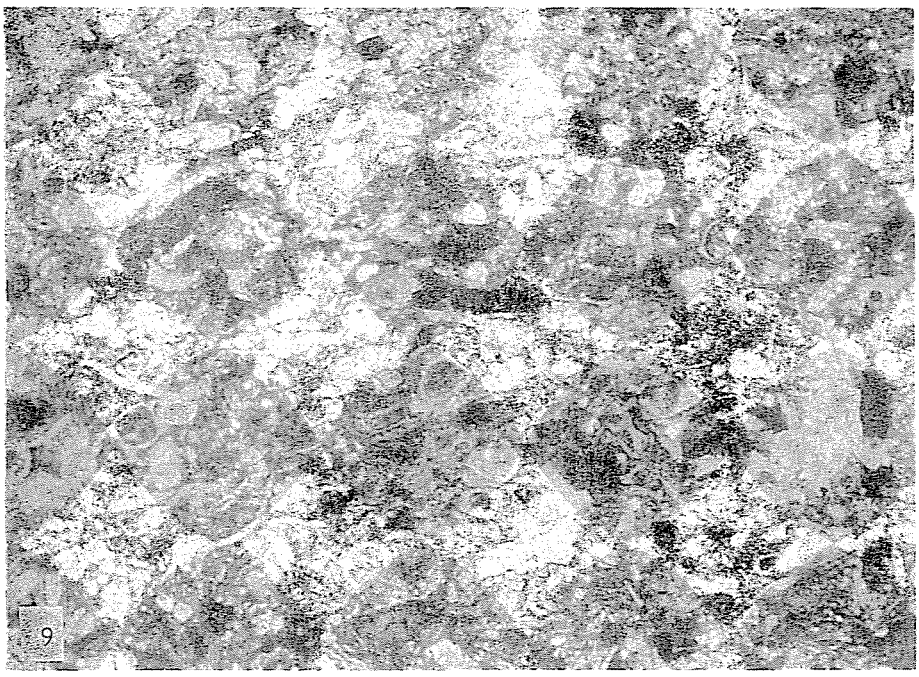

Fig. 9. Texture of the Buda marl

The rock is generally lightly layered a phenomenon that later becomes more pronounced due to weathering.

The surface of the samples is slightly rough, clayey at touch. The rock is mostly compact and hard, not friable by hand. The average particle diameter is 0.08—0.2 mm. The amount of biogenic constituents is significant. Terrigenic components also occur, mainly quartz, and a few particles of feldspar (Fig. 9).

The rock evolves CO_2 under the effect of hydrochloric acid, the residue of acid dissolution is in the average 28—39%. In the weathered, clayey variants this may be even as high as 53%. The clay minerals in the Buda marl are kaolinite and illite. The biogenic components can be identified only microscopically, their amount is 55—60%. Foraminiferae are characteristic, and among them, especially Globigerinae which indicate an open water surrounding (Fig. 10).

Bryozoae and Echinoida members are also characteristic for Buda marl but their amount is negligible.

3.2.2.2 *The Bryozoa marl from the series of marls in the Buda region*

The rock is usually a light yellowish brown, light grey, sometimes with limonite streaks or spots. The fossils in the Bryozoa marl are sometimes oriented, causing a slight stratification in the rock.

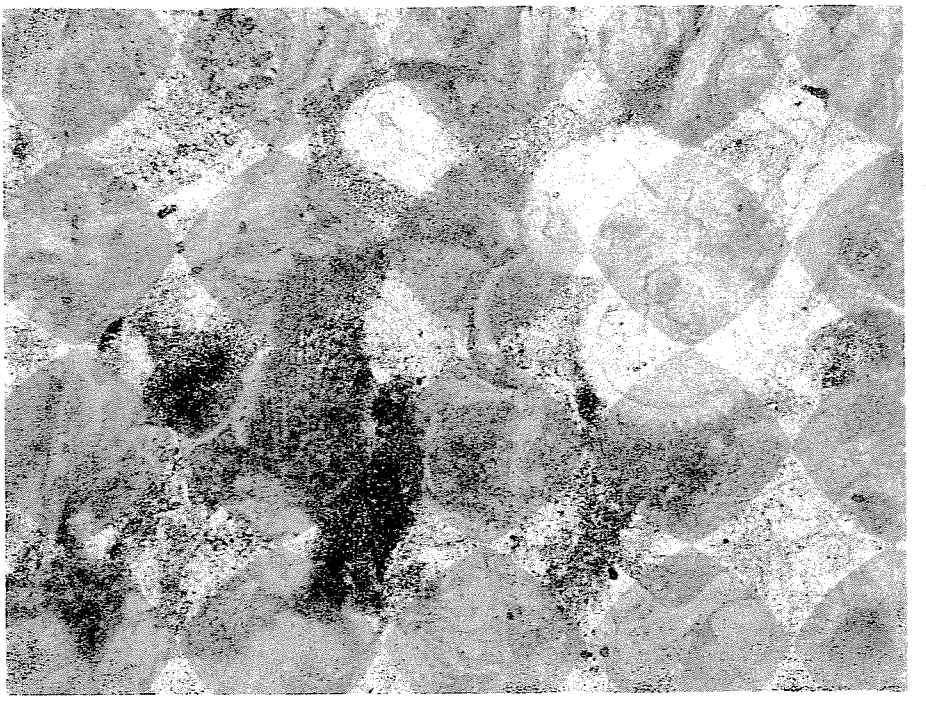

Fig. 10. Globigerina fossil in Buda marl from the series of marls of the Buda region

The surface of the rock is rough, sandy, its average particle size is 0.3—1.0 mm. It is hard and resistant, not friable by hand.

The Bryozoa marl is sometimes porous, the dimension of pores is identical with the average particle size, their distribution is non-uniform, their amount does not exceed 1 vol.%.

Homogeneous constituents make up at least 75—85%. Terrigenic particles also occur, but in negligible amounts (quartz, feldspar). The marl is sometimes fissured, the fissures are subsequently filled up by calcite.

The material strongly develops CO_2 with hydrochloric acid, its dissolution residue varies between 9 and 22%. Clay minerals in the rock are illite and kaolinite.

Biogenic components can be identified by light microscopy (Fig. 11).

Very characteristic for the rock is the fossil Bryozoa, after which the marl is named (Fig. 12). Frequent fossils are also red algae and Echinoidea skeletons (Fig. 13). Foraminiferae occurring in shallow waters are also to be found in the rock.

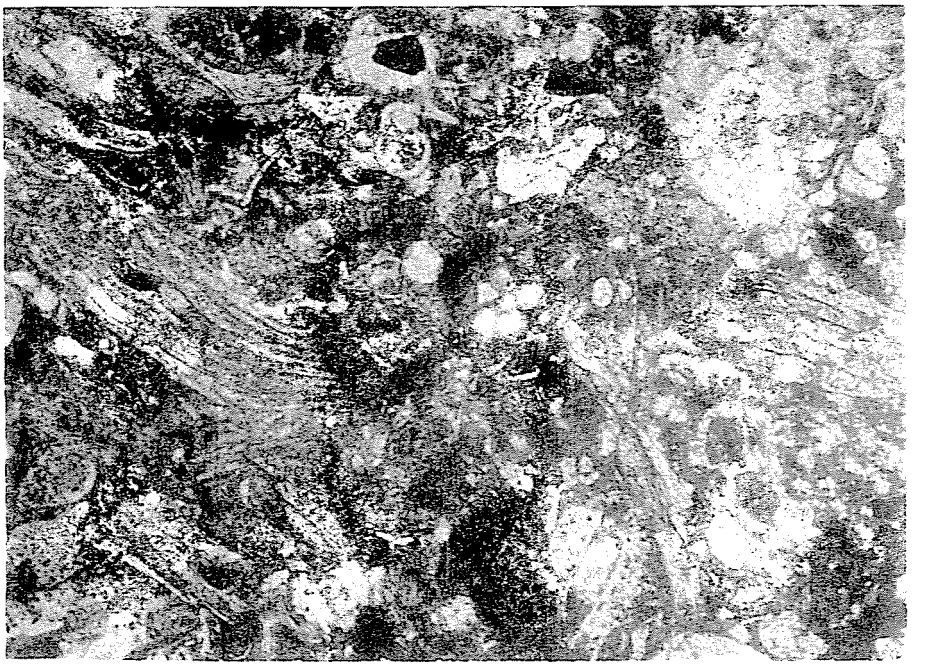

Fig. 11. Texture of Bryozoa marl from the series of marls of the Buda region

Fig. 12. Bryozoa fossil in the Bryozoa marl from the series of marls of the Buda region

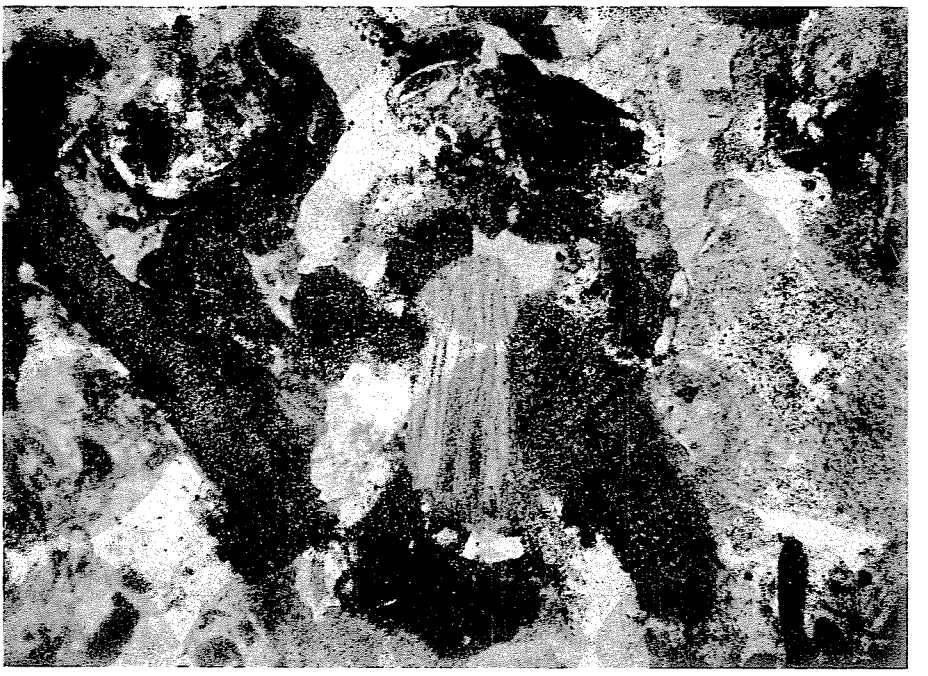

Fig. 13. Fossil of red algae in bryozoa marl from the series of marls of the Buda region

3.2.2.3 *Transition members in the series of marl from the Buda region*

This rock type is a real transition in its every property between the Buda and the Bryozoa marl.

3.3 *Marble in Hungarian Renaissance*

Marble in thought to be the noblest stone material; as such quality, it could only be imported to Hungary. In Roman times, the geographical surrounding might have included Greece and Italy, thus both areas could be considered when searching for its origin, whereas the period of Turkish occupation excluded the utilization of so-called antique marbles. Thus art history brings the Renaissance marble into connection with the world-wide known occurrence at Carrara. In the quarries of Carrara numerous variants occur, therefore every type of marble can be connected with Carrara. So far no possibility has arisen for their identification based on structural investigations and trace element analysis.

From the Renaissance period, a larger known unit made of marble is the altar of the Bakócz chapel. There are problems concerning the fitting together

of the so-called Madonna of Diósgyőr and the spottedness of a well-known Beatrix relief.

The marble of the Bakócz chapel did not cause any petrographic confusion, but it called attention to the possibility of Italian origin of the whole stone material of the chapel. The torso of the Madonna at Diósgyőr attributed to Giovanni Dalmata and sculptured between 1488 and 1490 was found at two different places and the pieces could be fitted only on the basis of style critical studies. As the two pieces have no fitting surfaces, petrographic investigations were able to show that the material and orientation of the two pieces is fully identical, thus their relatedness is probable for petrographic reasons (Fig. 14).

The couple of reliefs representing Mátyás and Beatrix which is assumed to have been made by a Lombardian-Milanese master between 1485 and 1490 was cleaned several years ago. After the cleaning, the appearance of yellowish spots was observed. Since this relief is one of the most important artistic remnants of this period, the museum has asked for a detailed investigation to know if not a rapid weathering process has taken place in the rock. This study was made difficult by the fact that only tiny samples could be taken from the backside of the relief.

From petrographic aspects it could also be established that the spots follow geological formations (folds), especially on the relief of Mátyás, and

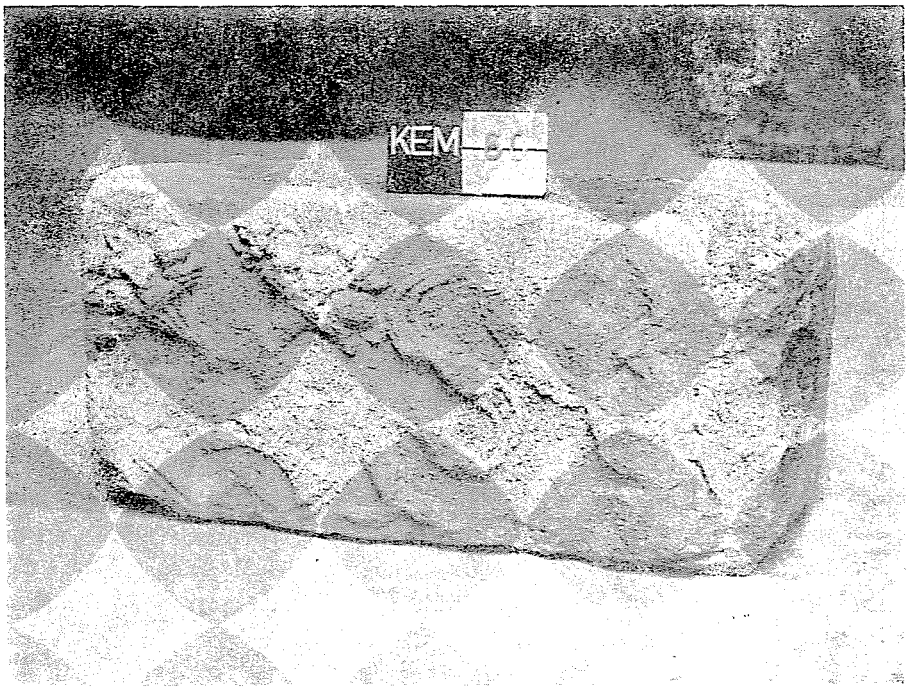

Fig. 14. Renaissance ornament from Castle Rezi, Pannonian sandstone

also that the spots seem to start from individual black mineral particles. In the thin section only calcite could be found, by a stereomicroscope the presence of pyrite and biotite could be made probable. Scanning electron microscopy did not detect minerals on a morphological basis, but by microanalysis, in addition to the elements of calcite, sulfur, iron and magnesium could be identified. Thus the spottedness could be explained by the colouring effect of iron oxide liberating, as a consequence of weathering of pyrite and eventually biotite. These spots do not endanger the relief significantly, even at a distance.

3.4 *The Pannonian sandstone*

Among sandstones, architectural literature so far has not dealt with the Pannonian sandstone occurring in the Western part of Transdanubia which appeared already in earlier buildings (e.g. the main building material of the monastery at Somogyvár or as some cuttings in the church at Ják). After the Turkish era it was utilized only locally, thus it did appear in descriptions about quarrying. According to studies carried out so far, it was used mainly for structural elements (doorframe in the Rezi castle, sacristy door in the church at Zalaszántó). It is also known that in the Rezi castle a Renaissance loggia and other cuttings are made from this material (Fig. 15).

The geological origin of Pannonian sandstone is not always clear: utilizable beds may have formed between the sand layers of Pannonian sand not leaving any traces of quarrying. It may be assumed that the Renaissance (and earlier) cuttings of sandstone in the Rezi castle have been made of the sandstone taken from the large quarry in the neighbourhood of Rezi which could the ancestor of today's quarrying in the Keszthely Hills.

Two basic types of Pannonian sandstone have been identified on the basis of the difference in the binding material. Hard, resistant sandstone bound by siliceous material may alternate with a variant with carbonatic binding material which is often friable by hand.

Clastic constituents are represented mainly by quartz in both types, other components are muscovite, small amounts of amphybole and zircon.

3.5 *Coarse limestone*

The most general stone material in the early Hungarian Middle Ages, the so-called coarse limestone of the Sóskút type originating from the Sarmatian and the Lajta limestone from the Baden age disappear from among the decorations of Renaissance buildings, to become predominant again in the Baroque. The fineness of cutting of coarse limestone did not satisfy the requirements of the Renaissance, therefore the continuity of limestone quarrying is indicated almost exclusively by a tabernacle at Balatonszemes (Fig. 16) or the coat

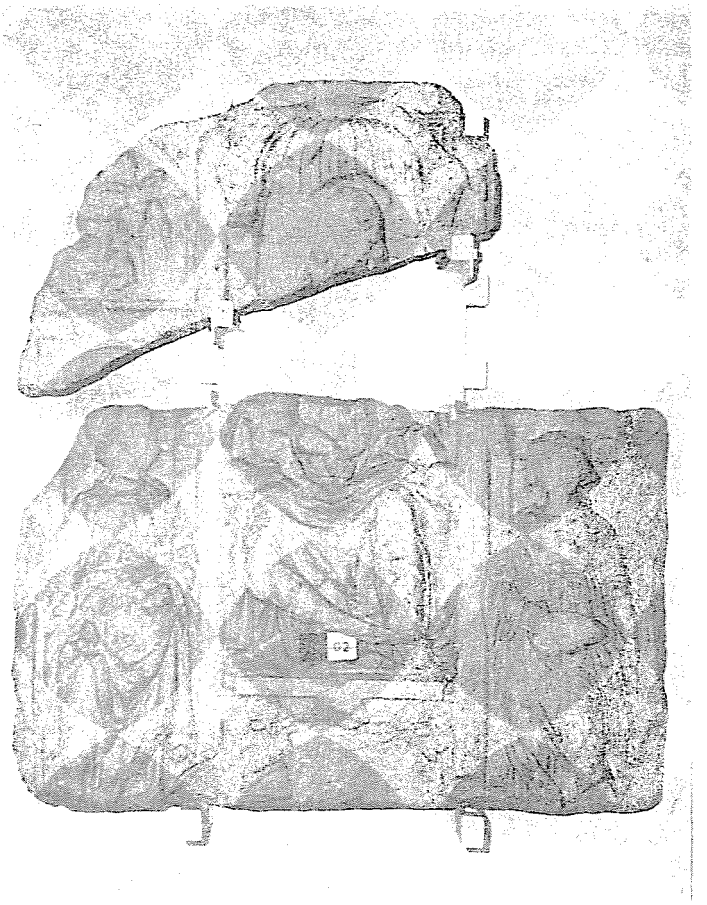

Fig. 15. Giovanni Dalmata: the Madonna of Diósgyőr, marble

of arms stone of Bishop Ernuszt at Pécs. The tabernacle from Balatonszemes was held so far originating from the Buda region, whereas the requisite of Pécs was identified as originating from the surrounding of Pécs-Vasas. The coarse limestone from Bánta applied earlier is found in this age only as the material of the Renaissance doorframe at Szentkirályszabadja.

3.6 *Fresh water limestone*

The utilization of fresh water limestone predominant in the Roman age and frequently used in the early Middle Ages decreased significantly in this period. It was practically never cut any more, its place was taken by more noble stone materials. It appears as a locally used material e.g. at Tata (as pile caps), the series of balustrades in the Visegrád castle from the age of King

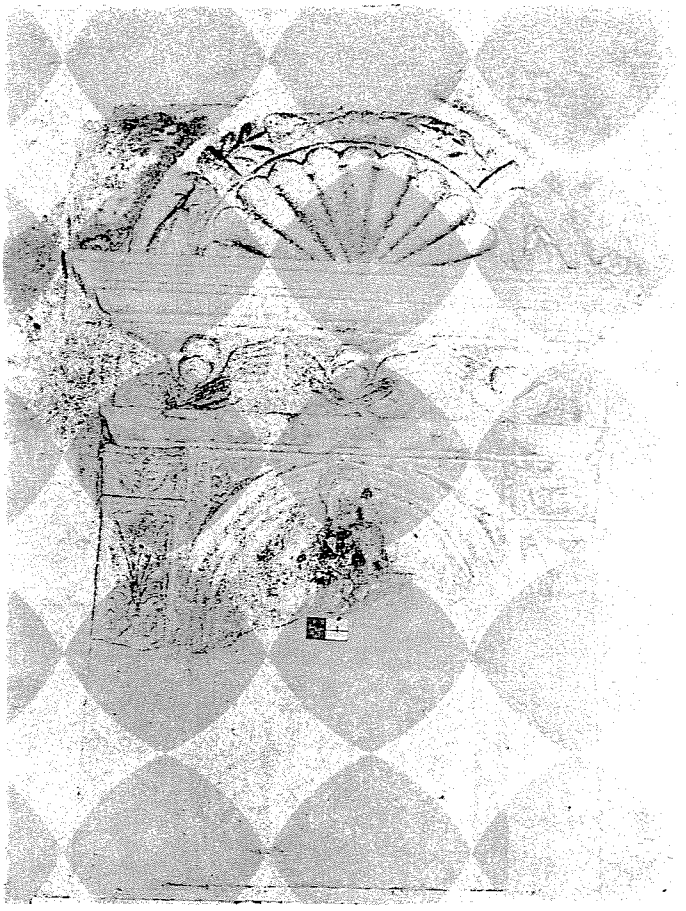

Fig. 16. Tabernacle from the Catholic church at Balatonszemes, coarse limestone of Sóskút character

Mátyás (Fig. 17) originates from the quarries in the Buda region or from the Gerecse Mountain.

3.7 *Sandstone from Hárs Hill*

The durable but hardly cuttable sandstone from Hárs Hill was only rarely used also in this period. The stone pits are well known from geological literature, the stone elements have usually been identified unambiguously. Thus e.g. the columns of the Visegrád castle originate from the stone pit in Ezüsthegy (Fig. 18).

Fig. 17. Part of a balustrade from Visegrád Castle, fresh water limestone

3.8 *Volcanic tuffs*

Volcanic tuffs are usually less well cuttable, thus they are known mostly as masonry materials (e.g. as the andesite agglomerates in the Visegrád castle). Variants cuttable better appear also as structural stone materials (e.g. in the Visegrád castle, Nyírbátor or Sárospatak). Since volcanic tuffs can be easily, but not finely cut, and owing to their petrographic character, they tend to weather and are not durable, therefore there are only few cut stones known in the works of this period. They are the ornaments in Nyírbátor and Sárospatak.

Among the stone elements in Nyírbátor, both rhyolitic and dacitic tuffs are present (e.g. as the material of balustrades), whereas the rhyolitic tuff of Sárospatak is the material of the most durable cuttings due to its siliceous impregnation (e.g. coat of arms, cut doors, ledge lions).

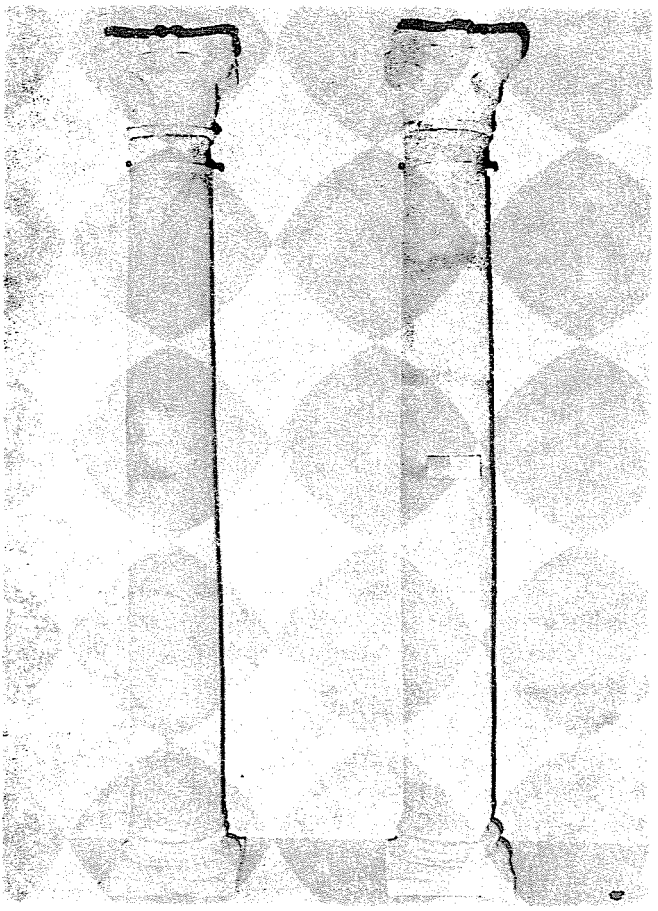

Fig. 18. Columns from the fourth terrace of the Visegrád palace, sandstone from Hárs hill

The occurrence of volcanic tuffs is in Visegrád in the immediate neighbourhood, whereas in Sárospatak the stone pits are situated within a circle of several kilometers in diameter from the castle. The stone material in Nyírbátor is to be looked for probably outside the present Hungarian borders. These stone materials, especially the easily identifiable dacitic tuff should be studied in Transsylvania.

4. Summary

On the basis of the stone materials listed in this survey it is not possible to prepare comprehensive statistics about the frequency distribution of individual stone types, as the remnants do not characterize satisfactorily the ori-

ginal building assemblies, neither do the studies carry out data collecting. However, an exhibition in 1983 (King Mátyás and the Hungarian Renaissance) in the National Galery provided some support for evaluation. This exhibition showed, of course, only the most important artistic objects, therefore it did not characterize the ratio of structural or less significant cut stones. The petrographic distribution of the items of this exhibition is the following (ÁFT, 1985):

	item %
marble	10
Jurassic compact red limestone	49
other (foreign) compact limestone	1.3
marl of the Buda region	35
coarse limestone	1.3
fresh water limestone	2
sandstone from Hárs hill	0.7
rhyolitic tuff	0.7

Based on this study it can be established that the majority of the items is represented by three stone types (marble, compact red limestone and marl of the Buda region) from among the eight types, they make up 94%. The use of compact red limestone and marl of the Buda region is the most generally applied. Both types of stones were brought to the exhibition from several occurrences of art monuments (e.g. compact red limestone from 26, marl from 16 places). they can also be found in the parts of the country far away from the royal residence and the quarry site.

In the number of items, the frequency of compact red limestone exceeds that of marl from the Buda region, but they have to be considered nearly equal in respect to their artistic value.

The remnants of marble are shown at this exhibition only from royal residences: Buda, Diósgyőr and Visegrád. Esztergom is represented in this series by the marble of the Bakócz chapel.

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