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단 보 (Note)

러시아 상트 페테르브르크 여름궁전 스웨덴 석조화병의 조사 결과

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Inspection Results of the Swedish Stone Vase in the St. Petersburg Summer Garden, Russia

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ABSTRACT The results of the inspection of the vase condition for April 29th, 2008 have stated the mineral-petrographic characteristic of the material, the character of the stone mechanical defects; its impurity and biological faults have been described; the results of ultrasonic sounding of the stone have been shown. Possible reasons and process of destruction of the stone vase have been analysed on January, 6 to 12th, 2008. Recommendations on restoration and preservation of the vase have been given.

Key Words: Ultrasonic sounding, Stone vase, Restoration and preservation

1. Introduction

The granite vase from Elfdahlen, Sweden in the famous Summer Garden of St.-Petersburg opposite from the Engineer's Castle at the Carp's Pond had stood more than 150 years. In the strongest frost at night of January 6 to 7th, 2008 the body of the vase cracked with a loud sharp sound. The rupture gradually expanded. A half of the vase body fell down at night of January, 12 to 13th, 2008. The second half of the vase body remained untouched and kept its position (Figure 1). There are no doubts that the direct reason of the vase rupture were the sharp frosts which had fallen upon the city. The state weather service observations showed that at that time the temperature had fallen down from +2 Centigrade (December 26th, 2007) to 14 Centigrade (on January 6th, 2008).

The fall downwards had made 16 degrees. Natural inspections showed that the split of the vase had continued unevenly. The older crack, in our opinion, had been in the part of the vase body facing the Carp's Pond. Here it is appropriate to recollect an episode of the preparation of the gift to the Russian emperor Nikolay I from the Swedish king, the fact is quoted by Bulakh (2006, 2007) by the materials of the Elfdahlen Museum of Porphyry. Two vases were made but one of them cracked when it was being carried out of the factory.

It means that the vase had a heterogeneity or even an inner invisible crack that opened because of mechanical

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Figure 1. Studied broken stone vase.

pressure still there in Elfdahlen. The vase was not sent to St. Petersburg. Obviously, the body of the vase that reached the place at the Carp's pond also had a developing invisible thin zone of weakening - the future crack. It had lived in the vase body. The crack gradually extended deep into the vase due to biological, physical and chemical factors. At the moment of the break in January, 2008 is did not reach its internal space only by 1.5 to 2 cm, thus the crack remained invisible from the outside, first, because of its insignificant thickness (about one or several tenths of a millimeter), and second, because of its dirty external surface.

2. Result and Discussion

In the place of the crack curve the surface of the split has greenish-grey color. The granite here changed and is covered by a very thin (0.2 mm) film of secondary finely dispersed substances. Probably, this part of the split passed through the old crack that had existed in the vase body already before January, 2008. The green surface does not reach 1.5 to 2 cm to the wall of the internal cavity of the vase. It means the old crack could not be result of a mechanical influence on the stone from within of the vase.

Actually the vase is composed of four parts - a neck, body and leg supported by a two-level plinth. All four parts are made of pink Swedish granite of so-called Garberg type. Garberg is the name of the mountain and small settlement where the granite was obtained. The Garberg type granite belongs to the ancient (Subjotnian) post-fold (postorogenic) geological complexes of Dalarna area. It is in the neighbouring Sweden. This granite composes big areas. There are its rocky exits, but they are split by mighty cracks. The find of an integral monolithic stone is always a success. For manufacturing of the famous Rosendahl vase in Stockholm a unique 140-ton and 50-cubic meter monolith was used (Hjelmqvist, 1966, p195). In the town of Elfdalen last large products from this granite are four columns supporting the galleries in the city cathedral.

They were erected in 1903. The granite varies in its structure a little, but is always characterized by massive general composition (texture) and medium-grained, homogeneous structure, equal light pink color. General average size of the grains is about 2-3-5 mm. In special transparent cuts of the stone (in petrographic sections) taken of splinters of the vase, the granite internal structure shows clearly under a microscope. The stone has dense structure without cavities and ruptures. Its structure is typical of granite with similar idiomorphism of its main minerals (feldspars and quartz), partially granularic, granophyric, poikilitic. The microcline (more exactly - microcline-perthite) forms most well outlined grains. They are partially pelitized. The albite-oligoclase is slightly twinned. Clorite spreads on the biotite. Accessory apatite finds itself in the form of long-prismatic grains.

Ultrasonic sounding with the purpose of revealing of inside cracks of the granite body of the vase was carried out with two methods: by means of separate ultrasonic converters and by means of separate ultrasonic converters. It allowed revealing a number of heterogeneities that led to the vase ruin. The average speed of ultrasound was kept within the limits of 4,600 to 5,000 m/s corresponding to solidity of usual granite. Graphic representation of the results is given in the form of isolines and in colour (Figure 2). More than 350 measurements were carried out and taken account of. Lowering of ultrasound speed below 3,500 m/s can testify about internal heterogeneities in the body of the vase. In the remaining part of the vase body one such section was discovered (Figure 3), in the fallen part - five were revealed.

The vase pollution and biological damages of the stone were investigated during studying. In the samples under

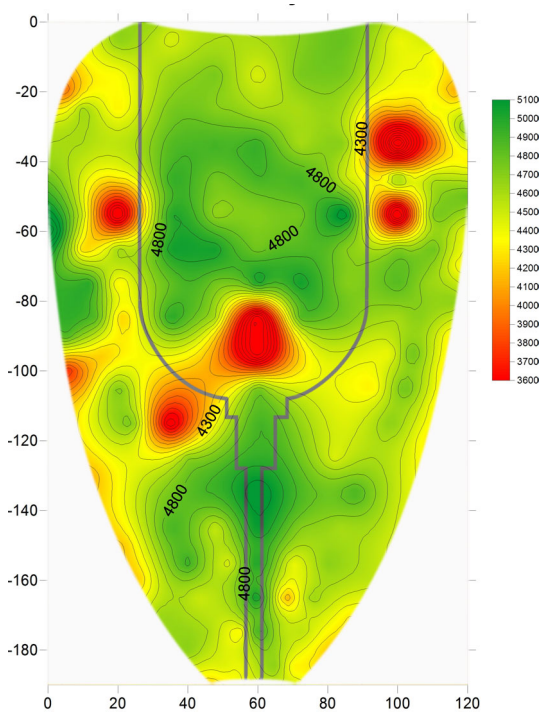

Figure 2. The fallen part of the vase body. The results of ultrasonic sounding of the stone

research a high variety of tiny fungi (from 8 up to 13 kinds in a sample) was registered. Dark-coloured microscopic fungi known as active stone biodestructors dominate. The number of fungi cells gets up to 4 thousands per 1 gram of the sample material. The obtained data testifies to a saturation of microbic community, in which, besides microscopic fungi, bacteria are revealed. It is interesting to note that the dominating kinds of fungi found on the surface of the vase were noted earlier by us on the granite of the monument "Sphinxes" in the zones of pollution.

Mycological analysis of the selected tests with a none-damaging method ("a method of prints") taken directly from the surface of the vase (only 12 tests) in many respects has confirmed the results of the analysis of the fragments of the vase, and also has shown presence in the prints of most often found kinds of mould fungi. In total, during mycological analysis of the stone surface with attributes of pollution 30 kinds of microscopic fungi have been discovered, the majority of which have a destructive activity regarding stone material.

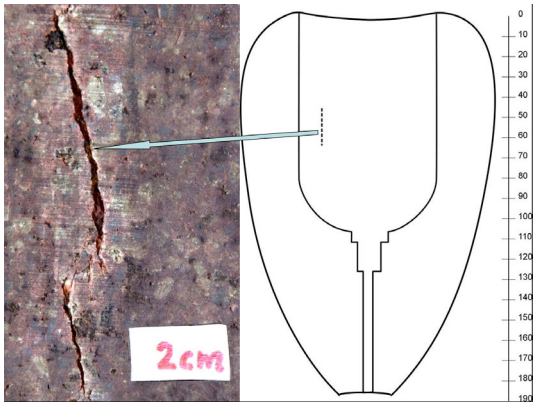

Figure 3. The remaining part of the vase body. A crack

3. Conclusion

The executed research has shown that the vase, most likely initially had had internal heterogeneities and faults in its integrity. In due course they had worked because of absence of regular inspection and care of the vase condition. Interconnected physical and chemical (first of all, atmospheric pollution and climatic conditions) and biological factors (aggressive microbic environment) encouraged the change of properties of the stone material (by cracks and in the superficial layer). The vase body broke up on an equal surface. It is absolutely fresh except for a small part which corresponds to the old crack. The stone surface microstructure is roughly granular, a favorable work for glue. For greater durability the two parts of the vase can be fastened by pins. It is desirable not to touch the leg, plinth, pedestal, socle and passing through them the old metal core covered by rust. To return to a pedestal vertical position is possible by means of lifting jack devices, then it is necessary to strengthen the base with elementary engineering-technical means.

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