

Preface

Natural stone is a topic of interest to geologists and natural stone producers, as well as for architects, building specialists, conservators, monument curators, and of course, building owners. It is one of the oldest and more durable construction materials. However, its importance for the construction industry has changed over time and so has its perception by society. In the last three decades, a significantly increased demand has been noticed that can be attributed to its use as cladding material. Predictions suggest an even greater growth rate in the demand.

Natural stone is a construction material with a favorable ecological rating compared to manufactured materials such as Portland cement or bricks. In architecture, this material is particularly valued for its design possibilities, especially with regards to color, shape, and surface processing. This gives the building a unique value.

In past centuries, master builders and sculptors used locally available stones, since transport from distant sources was difficult and very expensive. Therefore, whole towns were built with a single type of stone. This resulted in the development of cultural landscapes that are characterized solely by the type of stone used. With globalization, this local type of landscape construction is being valued again, especially since natural stones are in essence a part of the landscape. They reflect tradition and identity and are fundamental to both the local community and tourism.

Although there may be a general belief that natural building stones are durable materials, all rocks undergo weathering and will literally turn to dust. The use of natural stone in buildings requires that the stone type have the required suitability for the intended purpose. Otherwise, their deterioration will occur even after short periods of time. The weathering and deterioration of historical buildings, as well as that of many monuments or sculptures using natural stones is a problem that has been known since antiquity. Although much of the observed world-wide destruction of these monuments can be ascribed to war and vandalism, many other factors contribute significantly to their deterioration, such as neglect and poor maintenance. There has been a significant increase in deteriorating structures during the past two centuries. This prompted Erhard M. Winkler in his book "Stone: Properties, Durability in Man's Environment" (1973. Springer Verlag) to make a pessimistic prediction, that at the end of the last millennium these structures would largely be destroyed because of predominantly anthropogenic environmental influences.

Erhard M. Winkler's book "Stone: Properties, Durability in Man's Environment" first published in 1973 marks a milestone in the series of publications on the conservation of our cultural heritage. In the year the book was published, science was not yet concerned with conservation and was still at the level of knowledge that had been accumulated by scientists at the turn of the nineteenth and twentieth century and the two decades between the two world wars. Conservation interventions were not widespread at that time and treatment with chemicals was barely in its infancy. Clever restorers used promising chemical products and applied them to stone conservation, but kept their formulas a trade secret.

Winkler was among the first who embraced the ideas of prewar scientists, such as Hirschwald, Schaffer, and Kieslinger. They advanced the idea that stone conservation should be placed into the context of understanding the processes of weathering and deriving remedies against deterioration. Therefore, he stressed the geologists' role in leading conservation interventions that start with the anamnesis of the building, followed by a correct diagnosis of the problem, and then the development of an appropriate therapy. Simultaneously, other relevant disciplines, such as chemistry, biology, and material science took interest in the conservation of architectural and archeological heritage sites. In 1972, the first international meeting on this topic was held in LaRochelle under the name of "International Symposium on the Deterioration and Conservation of Building Stone." Since then, ten more meetings were convened regularly, and the name simplified to Deterioration and Conservation of Stone. Other international conferences were also organized, such as the Conservation of Monuments in the Mediterranean Basin Meeting.

In the 1980s, the forest decline resulting from increased pollution raised the awareness that "acid rain" could accelerate the deterioration of exterior works of art. This induced politicians—mainly in Europe and in North America—to support research into the effects of air pollution on materials. As a result, the volume of knowledge grew exponentially. In conjunction, the advances in instrumental analysis as well as in technology in general, allowed the development of various chemical compounds that could be adapted for the consolidation or the protection of stone. In the last issue of his book published in 1994, E. M. Winkler added a comprehensive chapter on conservation, a topic which had only been slightly touched upon in the previous editions.

The offer from Springer Publishing Company to prepare a new book to address more thoroughly all the acquired knowledge over the past 20 years will serve to follow the trail that Winkler blazed. The book will cover a wider spectrum with significantly more detail in all topics addressed. Therefore, an attempt was made to develop a natural stone nomenclature from a geoscientific point of view. The suitability of a given stone to the considered function it will have in a building or object is extremely important, therefore different structural engineering and relevant petrophysical and rock technical parameters were compiled for the different rock groups. Since negative material properties of a stone may become evident after a long or very long exposure, suitable testing methods are required for a meaningful stone evaluation. The resistance to weathering is extremely important

because every stone at the outcrop or in a building is subjected to the destructive physical, chemical, and biological influences of weathering. Next to these geogenic factors, anthropogenic influences on the material properties and weathering processes are also decisive. These can be deduced from laboratory experiments and also from experience on historical buildings.

Rocks will react to changing environmental conditions; especially when high “multi-pollutant” situations dominate that are caused by various chemical pollutants, suspended particles, and dust. The pollution during the last two centuries has deteriorated many of our cultural assets that may be considered as “contaminated sites.” Moreover, through climatic changes such as more precipitation, higher temperatures, freeze–thaw impacts, etc., the pollutants may react following different paths and new deterioration scenarios will develop.

Changes on the rock surface produced by weathering processes can be described with the aid of a specific terminology to avoid misunderstandings. To overcome this problem and to harmonize all the existing classification approaches, an updated version was produced by the ICOMOS-ISCS. These will help in the mapping of the various deterioration patterns and their intensity.

The objective of the new edition is to address practitioners like architects, civil engineers, stone producers, restorers, etc., as well as students who are interested in qualifying themselves for a career. All these professions require a basic understanding and experience in many disciplines such as geology, chemistry, material science, and biology. In the course of the past 20 years, knowledge has grown to such an extent that a single person can hardly acquire an overview of the field or even write a textbook on the subject. Therefore, the editors decided to elicit the aid of further specialists to create an up-to-date book containing the most recent progress in this field of science: A. Elena Charola for deterioration processes and salt decay, Michael Steiger for salt and weathering processes, Katja Sterflinger for biological deterioration and conservation issues. Peter Brimblecombe contributed to air pollution and climate change, Helmut Dürrast for the rock technical properties, Heiner Siedel for the characterization of stone deterioration on buildings, and Akos Török for the petrographical characterization of building stones. The editors are indebted to these colleagues for their essential and valuable help. Likewise, the editors want to express immense thanks to the following persons: J. Ruedrich, T. Weiss, W.-D. Grimm, B. Fitzner, K. Heinrichs, C. Schneider, G. Hundertmark, M. Reich, B. Siegesmund, M. Siegesmund, and A. Elena Charola and Christian J. Gross, who made great efforts in correcting the linguistic deficiencies of the German speaking authors.

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