



Biological ageing and wear-down of rocks

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Concern with rock decay started early in the history of the mankind. The last two centuries yielded a large wealth of information on the many aspects of rock decay and rock protection related to the physical cultural heritage.

Increasing awareness of biodeterioration and air pollution related biological infections has grown over the years. In this overview the evolution of trends and techniques in the study of rock biology is described. Ageing is a term that is not only used for living organisms but also for inorganic and organic materials when used in the production of objects of art and the physical cultural heritage. This natural decay process is ruled by physical and chemical interactions with the environment and can be considerably accelerated and in some special cases slowed down by the interaction with organisms and especially micro-organisms. Many different micro-organisms are involved. Adhesion to surfaces and resistance to stressed conditions are of importance as well as special biochemical pathways to furnish energy, electrons, water, and mineral matter to the microbes living in such environments. Lichens and other symbiotic communities, chemolithotroph and chemoorganotroph bacteria, fungi and actinomycetes have been reported to be active in material transformations as well as phototroph micro-organisms. Quantitative data on mere physical and chemical attack in comparison to biologically induced changes have been collected. Studies on the speed of physical/chemical deterioration as compared to biodeterioration were undertaken. In conclusion it is stated that all materials exposed to the natural living environment are more rapidly transferred and cycled biologically than under conditions of a sterile environment. Although water plays an eminent role in all biotransfer processes it is shown, that biologically induced accelerations of decay and ageing of materials takes place in practically all objects of the cultural heritage studied so far. The processes of rock ageing are very complex physical and chemical interactions with the immediate environ-

ment, which can be considerably accelerated or retarded through the influence of biota or biological phenomena in the field of life. Most of the acting agents in inorganic and organic material ageing are invisible microbiota. Interestingly, physicists and mathematicians have calculated the thermodynamical stabilities of many compounds and compound mixtures. It is said that granite is decomposed more rapidly than DNA and that DNA in turn decays faster than some important proteins. The recognition of time is much more complex than can be derived from the simple linearity past - present - future. The terms of physical, physiological, even psychological time are related to the ageing process of art works. For each object and living organism a certain life span or duration is characteristic. The potential age of DNA-regulated living organisms is programmed. If this were not the case, men could acquire offspring with a physiological status of an old woman instead of a baby. From this we can assume that ageing must be related rather to the ageing and alteration of proteins and other compounds. The same is true for ageing of art works. Excellent "young" stone will age slower than defect, "old" stone. Financial support by grant EVK4-CT-2002-00098 is acknowledged.