A SCIENTIFIC RESEARCH AND ACTION PROGRAMME FOR THE PROTECTION OF THE HYDROTHERMAL CAVES AND SPRINGS OF THE BUDAPEST (RÓZSADOMB) KARST

JÁNOS TARDY

Ministry for Environment and Regional Policy, Budapest

Abstract
The last few decades have seen the rapid, and ever increasing, development of Budapest. As a result the balance and stability of the natural and man-made environment have broken down. Some processes on the surface have seriously damaged the subterranean natural heritage, the stability of the caves and the quality of the thermal water. This paper describes a several-year-long series of complex research activities aimed at the protection of Budapests hydrothermal caves and thermal springs.

Introduction

Budapest, situated on the two sides of the River Danube, in a scenic setting of hills and lowlands, boasts one of the most beautiful natural environments of all capitals. Because of its geological and hydrogeological conditions, it is justly called a spa, with thermal baths and caves. Hot and tepid springs that discharge along a tectonic fault by the Danube have been known and utilised since the Roman times. The large and internationally well-known thermal caves, more than half of which were discovered in the last 15 years, are made up of passages created by the ancestors of these springs. The last few decades have seen rapid, and ever increasing, development of Budapest. As a result the balance and stability of the natural and man-made environment have broken down. Some processes on the surface have seriously damaged the subterranean natural heritage, the stability of the caves and the quality of the thermal water. Some other processes and phenomena are considered to be a potential threat. For this reason, the area and the Phare-supported large-scale scientific research and action programme have become a focus of public interest.

Scientific and action programme for the protection of hydrothermal karst areas of Budapest

The programme includes the following topics:

1. The preferably full-scale provision of public utilities in the urban area over the most endangered, most valuable, strictly protected hydrothermal caves which are also the richest in formations and the most sensitive to pollution. To this end, trunk sewers with a diameter of 50 and 60 cm have been laid to support the efforts of the municipalities of the capital and the district, with the precondition that the municipalities in turn oblige the local population to connect their sewers to the trunks.

2. Complex geological research and drilling activities in the Rózsadomb area:

1. Deepening of deep drills and the establishment of groundwater observation wells.
2. Geological, petrophysical, tectonic and paleokarst analyses and evaluations.
3. Measuring of superficial water absorption capacity.
4. Analysis of water infiltration and concomitant phenomena.
5. Analysis of migrations (the movement of dissolved materials from the surface to the karst system).
6. Measuring of the water absorption of caves.
7. Hydrochemical, microbiological and isotope analyses.
8. Temperature profiling in order to detect any water seepage from the thermal springs towards the Danube.
9. Cave mapping.
10. Examination of cave stability and security.
11. Examination of cave minerals and their contamination

3. Special microclimatological research both in the caves and on the surface in order to prepare medicinal utilisation as well as to monitor the compliance with the requirements and the interactions.

1. A comprehensive survey of the characteristics of cave airspace and the situation of Hungarian cave therapy.
2. Pollen analyses.
3. Ion analyses.
4. Radon analyses.
5. A complex chemical and bacteriological examination and analysis of dripping water and air in caves.
4. The establishment of a complex monitoring system on the surface of the Rózsadomb thermal karst, in the Pál-völgyi Cave and in the area of the foothill József-hegyi springs (set up at springs and in deep drills).
5. The reconstruction of the Szent Iván Cave (Cave Chapel) in Gellért Hill.

During the special microclimatological research, answers were sought to numerous questions that, according to our knowledge and the literature, had never been treated before, neither in Hungary, nor any other country. For example:

- Is it possible to plan and use the same cave (and the same passages of that cave) at the same time or consecutively for both touristic and medicinal purposes?
- Is it possible to carry out medicinal activities in caves under urban areas, where the chemical and bacteriological parameters of the dripping and infiltrating water is not always perfect?
- How do the consequences of superficial contamination affect the quality of the cave's air?

- Is there any correlation between the health conditions of the patients and the parameters of the special microclimatological research?
- How does the air quality of a given part of a cave limit the number of patients and the duration of the treatments?
- In order to purify the air and aerosol matter in the caves, how long regeneration periods must intervene between the touristic and the medicinal uses?
- What factors other than the so-called 'cave healing factors' may cause the efficiency of cave therapy?
- Is there any of the natural parameters in the given cave that might damage the health of the patients treated there or the staff working there?
- What is the current potential of the medicinal use of caves in Hungary for the population suffering from chronic respiratory diseases due to environmental pollution?
- As a parameter never examined before in Hungary or in any other country, what are the relations between the air plankton composition of the cave and of the surface above, with special regard to pollens and fungus spores?

All of the above questions have been positively answered by those serial measurements whose results have been recently published in various forums. These results will not be treated here in detail but a number of the above questions will be answered by the more recent studies published here.

The research programme covered primarily the Rózsadomb thermal karst area, including its surface and caves. How have these caves that are justly nominated to the UNESCO Natural and Cultural World Heritage list evolved? How far can we consider this geologically complex, 'multi-storey' system as the standard example of researching environment pollution and protection, nature conservation and water quality protection? How can we further exploit the potential of this now irrefutably efficient medicinal cave system that has cured thousands of children infected by the pollution of a metropolis right under the increasingly developed greenbelt surface zone of the same metropolis?

The research site extends on the surface to about 10 km^2. The number of known caves underneath now exceeds seventy, and the total length of known passages is over 30 km. József-hegyi springs, with the greatest discharge among all thermal spring groups in Budapest, discharge at the foothills, yielding medicinal waters of 20-50 °C.

Problems

The thermal springs and caves situated under Budapest city centre offer unique opportunities for touristic and medicinal use, but at the same time cause problems that are not known to occur anywhere else and have therefore never been researched. These problems include:

- static (engineering geologic) and stability (environmental geologic) questions: what damages may any defects in public utilities cause in this particular

geological environment? (breaking or leaking of water pipes, defects of gas pipes or sewers)

- special conditions to lay down public utilities
- the introduction of a zonation system restricting and/or prohibiting new constructions in the research site
- the effects of seepage of chemicals used to defreeze winter roads on the water quality of thermal springs (with special regard to the sodium and chloride ion concentrations)
- continuous chemical and bacteriological analysis of dripping water in caves: the infiltration of pollutants from the surface to the interior of the karst (the direction and intensity of contaminations)
- the correlation of chemical and bacteriological pollution (significance analysis)