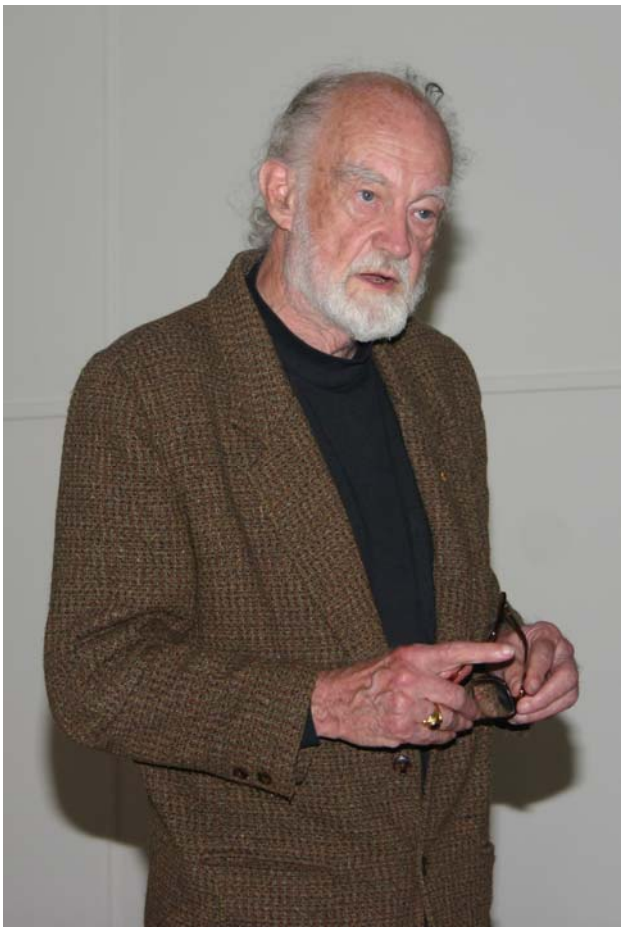
LOOKING BACKWARDS AND LOOKING FORWARDS *

– Professor Elery Hamilton-Smith



As I sat down to write this address, I realized that it is almost 50 years since I first wrote on cave fauna. Over those 50 years, there has been a remarkable evolution of both knowledge and the technology which so much enhances our capacity to manage information and knowledge.

Probably few of you actually experienced such wondrous innovations as the first electric typewriters and photocopying! My first work in this field was typed up on stencils with a manual typewriter and printed out one page at a time with a hand-operated duplicator.

And I well recall the first time I used a computer which had to be fed with numerical information on punch cards and which had far less power than any modern hand-held calculator.

Listing

Subterranean biology commenced with Valvasor's recognition of *Proteus* in the late 17th century.

This progressively but slowly advanced to the 19th century focus upon searching for fauna, trying to get specimens described or identified and compiling lists of species.

This led in turn to a more systematic approach to collection, initially in the classical karst of Slovenia and Croatia, and in turn an inevitable growth in taxonomic study and classification.

This new interest extended throughout other European countries and then in North and Central America.

Biology

The growing interest in biological function meant that the listing phase was supplemented by biological studies, often endeavoring to answer questions about specific species or species groups.

The underlying assumption was very much to do with the character of species and how that character had been shaped and the questions were about such issues geographic distribution, how environmental factors shaped physiological functions, nutrition and metabolism, behavior, vision and adaptation to darkness, and the speculative studies of evolution.

The most fundamental scientific base for this work was the developing sense of taxonomy as a systematic basis for study. The need to described new species and place them within their systematic context resulted in steadily increasing taxonomic competence.

However, this phase of subterranean biology was limited by the limited tools available for taxonomic work.

Descriptions were based on the overall anatomy of each species as was visible to the naked eye or to an optical microscope. This had served to lay a foundation but it also set a limit to intellectual growth in biology.

Although the United States saw a great deal of cave-based biological research in this mode, it was very much focused on caves (rather than the wider notion of karst) and had all too little relationship with international conceptual developments.

The ultimate development of this approach was ably summarised by Vandel (1965) in his *Biospeleology: The Biology of Cavernicolous Animals*. This provided for the first time a comprehensive overview of the state of knowledge about cave fauna throughout the world.

It pointed to the relationship with other subterranean fauna, particularly that of the soil(e.g., Coiffait 1959). It also recognised the potential importance of microbiota in karst.

It not only summarised knowledge to that time but the gaps in knowledge were perhaps made much

clearer that in the past. Certainly, it opened the door for progress.

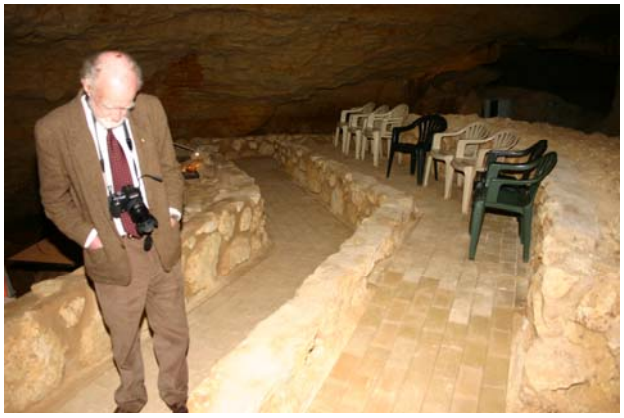
Ecology

The next major period saw two major developments. The first was the new technology which became available to enhance species description and taxonomy generally. The electron microscope and then the beginning tools for molecular biology both brought a much greater precision and definitional clarity.

It certainly excluded some of the long time amateur taxonomists many of whom had made an immense contribution particularly in the medium sized fauna, such as, beetles and crickets. At the same time, the ecological approach became a significant strategy in study and research.

It was not any longer simply a matter of looking at how the environment might impact on a species but rather looking at the systems of species which came together as part of the total biological environment.

This in turn provided a much better basis for relating the biota of a region to non-biological aspects of the ecology.



Elery considering new infrastructure
in the Fossil Chamber at Naracoorte

Although still far from a truly holistic approach to the natural world the possibility of holism at least entered into the awareness of an increasing number of scientists.

Again, it was the eastern European countries of the former Austro-Hungarian Empire which gave birth to and fostered the holistic view.

The increasing interest in the holism of an eco-systematic approach was clearly expressed in the remarkable *Encyclopædia Biospeleologica of Juberthie and Decu* (1994-1996) even though this also largely retained the organisational structure from the inventory approach.

More importantly, it was based upon the intellectual heritage of Racovitza and the movement of research to France and Romania.

The same leadership led to one of the earliest policy documents on karst protection – *Underground Habitats and Their Protection,* edited by Juberthie 1995 for the Council of Europe.

This gave an entirely appropriate emphasis to the fundamental importance of groundwater protection. This has been given increasing emphasis since then (eds. Gibert, Danielopol and Stanford 1994).
This period also saw greatly increased recognition of the role of microbiota, going largely hand-in-hand with the recognition of hypogene karst processes (Klimchouk 2007)

Contemporary Perspectives

The move to a holistic and ecological perspective then reached its epitome with *Subterranean Ecosystems* (eds. Wilkens, Culver & Humphreys 2000) and then Subterranean *Biology in Australia* (eds. Humphreys & Harvey 2000).

But today we are seeing a return to a taxonomic perspective based in both a more comprehensive view of the subterranean world (eds. Austin, Cooper & Humphreys 2008) and the growing reliance upon molecular biology.

The focus upon molecular biology has proved to be extremely valuable. First, karst provides an especially appropriate biome for studies on continuing evolution and this has important implications for enhancing our understanding of all other habitats.

Second, it is only with this technology that we have been able to fully recognise and explain the incredible biodiversity of the subterranean world (Humphreys in Austin et al, op.cit.)

But it also has some problems. It has already done a great deal to strengthen our knowledge of taxonomy and distribution and hence the quality of inventories.

But each study generally (and necessarily) is confined to one species group. It brings with it a new challenge for renewal of integrated knowledge within the holistic and ecological framework.

Given the ubiquitous and self-generating fragmentation of knowledge through such boundaries as those of disciplinary specialization, management structures and political identities, I believe this is a central issue in understanding and conceptualization of karst.

An analogy which appeals to me is that the narrow focus of the new taxonomy is excellent in producing new and better bricks, but leaves us with the problem of how best to use them to improve our buildings.

* *Opening Address* at the International Symposium on Subterranean Biology, Perth, Western Australia.

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Postscript. Even the language used by some of the molecular researchers in presentation of their work at this symposium was a major barrier to wider understanding and integration of their work. Some presentations could only be understood by others familiar with molecular methodology and logic. Many others of us could not even make any judgment about the quality of their research!

Elery Hamilton-Smith (third from the right) with friends – 16th ACKMA Conference, New Zealand, 2005.