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“DISCIPLINING METADISCIPLINARITY”: THE POWER OF SCIENTIFIC HANDBOOKS AND THE EMERGENCE OF SPELEOLOGY (1870–1925)

RIASSUNTO

“DISCIPLINARE LA METADISCIPLINARIETÀ”: Il potere dei manuali scientifici e l’emergere della speleologia (1870 – 1925)

L’emergere della speleologia (studio delle grotte) come uno dei primi campi integrativi della scienza risale a 150 anni fa, quando i suoi primi manuali furono pubblicati sia da studiosi riconosciuti che da autodidatti come William Boyd Dawkins (1874), Franz Kraus (1894), Édouard-Alfred Martel (1900), Carlo Caselli (1906), Walther von Knebel (1906), e Georg Kyrle (1923). Questi primi passi nello studio delle grotte non furono fatti solo nel mondo accademico, ma anche nelle società di storia naturale, nei musei e nelle agenzie governative. Sintetizzando gli approcci scientifici e popolari e organizzando le informazioni in modo gerarchico per scopi didattici, i primi manuali di speleologia riunirono diverse comunità di conoscenza e pratica. Influenzarono il discorso scientifico controllando specifici modi di pensare e introducendo termini tecnici e norme unificate. Nello studio in grotta, l’influenza dei manuali era ancora più forte che in altre discipline a causa dell’assenza di formazione universitaria, l’instabilità delle istituzioni speleologiche, la diversità dei metodi, e la mancanza di riviste internazionali, che potevano competere con i manuali.

Analizzando criticamente questi primi manuali di speleologia, questo articolo esamina il loro impatto sull’approccio metadisciplinare del campo e il successivo riconoscimento dello studio delle grotte come disciplina accademica in Europa centrale. Essi hanno plasmato significativamente la comprensione odierna della speleologia. Un’attenzione speciale sarà data alle varie strategie con cui gli autori hanno affrontato la metadisciplinarietà del campo. Queste includevano, per esempio, lo sviluppo di concetti teorici, la subordinazione a discipline accademiche più consolidate, o la graduale marginalizzazione dei “non professionisti”.

Parole chiave: manuale, storia della scienza, speleologia, divulgazione scientifica, disciplina accademica

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ABSTRACT

The emergence of speleology (cave study) as one of the early integrative fields of science dates back 150 years when its first handbooks were published by both acknowledged scholars and autodidacts such as William Boyd Dawkins (1874), Franz Kraus (1894), Édouard-Alfred Martel (1900), Carlo Caselli (1906), Walther von Knebel (1906), and Georg Kyrle (1923). These first steps in cave study were not taken in academia alone but also in natural history societies, museums, and governmental agencies. By synthesizing scientific and popular approaches and organizing the information hierarchically for instructional purposes, early speleological handbooks brought different communities of knowledge and practice together. They influenced the scientific discourse by policing specific ways of thinking and introducing technical terms and unified norms. In cave study, the influence of handbooks was even stronger than in other disciplines due to the absence of university training, the instability of speleological institutions, the diversity of methods, and the lack of international journals, which could compete with handbooks.

By critically analyzing these early speleological handbooks, this paper examines their impact on the field's metadisciplinary approach and the subsequent recognition of cave study as an academic discipline in Central Europe. They significantly shaped today's understanding of speleology. Special attention will be paid to the various strategies with which the authors addressed the field's metadisciplinarity. These included, for example, the development of theoretical concepts, the subordination to more established academic disciplines, or the gradual marginalization of "non-professionals".

Keywords: handbook, history of science, speleology, science popularization, academic discipline

1. INTRODUCTION

As I have experienced first-hand years ago, authors of a scientific handbook are limited by certain conditions. First, the reference literature that has already been published on a topic sets the framework. Secondly, the imagined presence of future reviewers or non-cited scholars seem to look over an author's shoulders like hungry vultures. Thirdly, handbook editors may find the ideas discussed in the manuscript too bold for a scholarly handbook. Lastly, many years can pass before the publication of the voluminous book, which may require final revisions to the content. In turn, handbook authors hold a high degree of interpretive power. By selecting and compiling scientific knowledge, they indirectly evaluate, highlight or neglect the work of other researchers. For instance, editors of reference literature often tend to write themselves into the history of a field.

Obviously, scientific handbooks undergo not only a different development process than journal articles, but they also select and present information in a specific way. By providing and disseminating authorized knowledge to a wider audience, handbooks occupy a mediating position between specialized scientific communities and the general

public. They thus have a greater reach than articles in periodicals (GROTE, 2020). Not all new research results published in journals find their way into reference literature (CSISZAR, 2018). Due to their claim to completeness and credibility, handbooks have a significant impact on their respective disciplines. Authors are ascribed a high level of competence and in turn distribute scientific reputation by quoting colleagues (JARDINE, 2000).

This is certainly true for the field of speleology. Early handbooks such as William Boyd DAWKINS' *"Cave Hunting"* (1874), Franz KRAUS' *"Höhlenkunde"* (Cave Study, 1894) or Édouard-Alfred MARTEL's *"La spéléologie, ou science des cavernes"* (Speleology, or Science of Caves, 1900) are still known by many cavers today and even reach high prices in the antiquarian book trade. Illustrated with impressive drawings and maps, they aimed to arouse public interest in this new field of research and achieved large circulation rates (SHAW, 1992: 244). By codifying the expertise of early speleological communities, such compendia accumulated local knowledge, established credibility and made their contents available in private libraries of scholars, associations, research institutes, or public institutions worldwide. To what extent did handbooks then affect the practices, tools, and instruments used in speleological fieldwork? Taking into account that caving as a marginal phenomenon bases upon a diversity of standard and non-standard techniques, it has always involved improvisation, experimentation, and learning by doing under the guidance of senior practitioners (MATTES, 2016; PÉREZ & MELO ZURITA, 2020; SAMBENTO, 2020). In underground sites, scholarly concepts or *"handbook knowledge"* certainly could face challenges that it might fail. I do not know of any instances of reference literature actually taken into caves for either guidance or instruction. Undoubtedly, handbooks often are too unhandy, heavy, and fragile for fieldwork below or above ground, even if the name suggests the opposite.

Topical scholarship in the history of science has broadened our understanding of handbooks and reference literature as powerful tools to gain new insights into the framework of creating knowledge, its distribution and application in practice (e.g. BENSUADE-VINCENT *et al.*, 2003; CAMPI *et al.*, 2008; SIMON, 2016). The project "Learning by the Book", conducted by the historians Angela Creager, Mathias Grote, and Elaine Leong at the Max-Planck-Institute for the History of Science in Berlin, is significant in this regard. A recent outcome is a volume of the journal "BJHS Themes" that investigates the making, use, and aftermath of manuals, handbooks, and compendia acting as focal points for various knowledge-based practices related to texts. Questioning the distinction between handbooks and manuals, CREAGER *et al.* (2020: 3) argued that *"the formation of scientific disciplines entailed other forms of writing, storing and circulating knowledge ... , further encouraging the expansion of instructional or reference literature. Many such handbooks were not restricted ... to merely conveying instructional information. Rather, they offered the précis of a discipline or field, or ordered inventories of their objects"*. In the second half of the nineteenth century, the emergence of *"this novel type"* of reference books that provides a reader with a comprehensive overview of a field at hand referred to major transformations of the book market, improvements of the printing technology, and differentiation of scholarly literature. As the historian James SECORD (2008: 460) pointed out,

despite the growing dominance of scientific periodicals, books “*retained specific roles of great significance: as a practical form of reference, as a means for opening out an extended argument, and as a symbol.*”

The interaction of these two media was described by the physician and philosopher Ludwik FLECK (1979: 163) in his classic 1935 study “*Entstehung und Entwicklung einer wissenschaftlichen Tatsache*” (Genesis and Development of a Scientific Fact) with the dichotomy of “*journal science*” and “*handbook science*”. While journal articles are characterized by the individuality of methods, approaches, and the provisionality of results, handbooks select, categorize and restructure the knowledge accumulated in journals, thereby provide the rapid access to factual information. According to Fleck, the reorganization of information in these compendia determines which knowledge is awakened as a scientific key concept or is forgotten. What is recognized as a truth is historically and socially determined, dependent on an evolved state of knowledge and thus on the activity of a community. FLECK (1979: 160) described the communities that stabilize and transmit knowledge as “*thought collectives*”, to which both a narrow circle of professionals and a wider range of lay people belong, whereby individuals can be part of several collectives. Handbooks, journal and popular articles correspond to the inner structure of a thought collective and the exchange of knowledge between these groups is an important driving force for scientific change (MÜLLER-WILLE *et al.*, 2017: 5–6).

Taking these considerations into account, my essay aims to unearth the significance of early speleological handbooks in the light of the development of cave study between 1870 and 1925 and its subsequent recognition as an academic discipline in Central Europe. Due to the initial lack of coherent terminology, methods, university training, academically acknowledged institutions, and journals, they set the boundaries of the new field and communicated them to a broad readership. In this sense, they were no longer dedicated to the description of specific karst areas or caves as earlier monographs had been. Instead, by defining the aims, program, methods, history, bibliography, and current state of research, handbooks created the basis of what we still understand speleology to be today. Of particular importance is the fact that cave study itself represents an integrative field of research consisting of various disciplines, popular scientific and sporting practices, as emphasized in later reference books such as GÈZE (1965: 2), TRIMMEL (1968: 4), FORD & CULLINGFORD (1976: IX), and GUNN (2004: 7). Lee FLOREA & H. Len VACHER (2011) have argued that speleology is based on an exchange of knowledge between scientists and cavers. The framework of this communicative relationship was negotiated at the turn of the twentieth century, with handbooks playing a significant role. Their authors regulated scientific discourse by giving unequal space to distinct groups within the community through citations and by assessing the relevance and truth of statements. As I argue in this paper, early handbooks assumed an important monitoring function by selecting and reorganizing the knowledge of the traditionally metadisciplinary field of speleology and placing it on a unified theoretical and methodological basis.

My article is divided into two sections. First, the six probably most influential speleological handbooks published between 1870 and 1925 and their contents are dis-

cussed separately and examined in the context of the development of the research field. The second section offers an analytical approach and examines the handbooks comparatively in terms of three aspects: multiple audiences, citation strategies, and the formation of a scientific discipline.

This essay, written at the invitation of Dr. Enrico Merlak, is dedicated to the journal “Atti e Memorie della Commissione Grotte E. Boegan”, its previous and present editors and authors. In already 50 rich volumes by now, the journal has not only contributed significantly to the development and dissemination of knowledge on all areas of cave and karst research, but has also provided the groundwork of current compendia on speleology (SHAW, 2015). My special admiration goes to Pino GUIDI & Graziano W. FERRARI (2020) for their recently published “*Essay of Venezia Giulia caving bibliography*”, to Trevor SHAW & Christine BALLINGER for the “*Biographical Bibliography of Explorers, Scientists and Visitors in the World’s Karst*” (2020) and to the Commissione Grotte “E. Boegan” for the fabulous digital sources provided on its website. The fact that nowadays we have unlimited access to this rich knowledge in reference literature or the worldwide web is due to the contributions of countless scholars and cavers in books and periodicals such as the present volume of “Atti e Memorie”. My sincere congratulations for this impressive milestone!

2. EARLY SPELEOLOGICAL HANDBOOKS

2.1. A Guidebook for Finding Fossils and Artifacts: W.B. Dawkins’ “Cave Hunting”

If we disregard the rich contributions of the geographer Adolf SCHMIDL (1854), who coined the term “Höhlenkunde” (cave study) but still devoted his publications to the description of specific karst areas (e.g. in Carniola, Hungary, Littoral, Lower Austria, Transylvania), William Boyd DAWKINS’ classic “Cave Hunting” (1874) is often recognized as the first book that sought to establish speleology as a field of research (Fig. 1) (SHAW, 1972; CRANE & FLETCHER, 2015: 29). The author (1837–1929), who was appointed the first professor of geology at Owen’s College in Manchester in the month of its publication, summarizes his results of 15 years of investigating caverns for paleontological and prehistoric finds in England and Wales

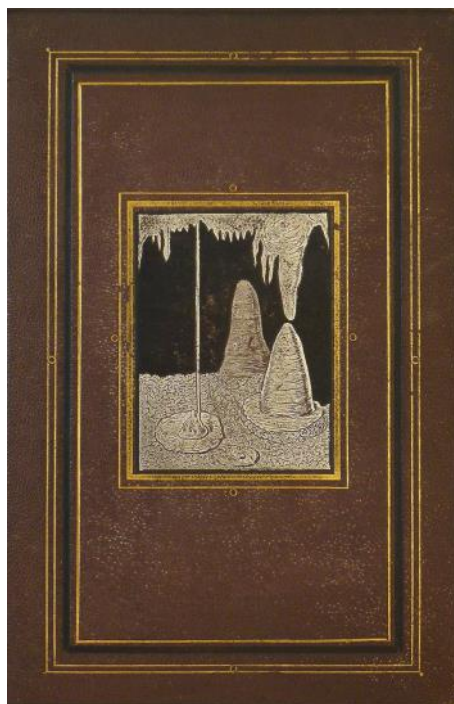


Fig. 1: Book cover of “*Cave Hunting*” (DAWKINS, 1874) with a woodcut of speleothems from the Fairy Chamber on Caldey Island, Wales.

(WHITE, 2018: 69). Nourished by romanticism, early geological thinking and reports of ossiferous caverns, a veritable “hunting for caves” had emerged in Victorian Britain (SHORTLAND, 1994).

Similar to William BUCKLAND’s renown monograph “*Reliquiæ diluvi-anæ*” (1823), whose impressive illustrations of caves and paleontological objects had inspired a generation of scholars, Dawkins’ “Cave Hunting” contained numerous tables, maps, and drawings of finds (Fig. 2). Although DAWKINS (1874: X) himself did not call his work a handbook, he aimed to draw a “*faint outline of a new and vast field of research*,



Fig. 2: “Enamels from the Victoria Cave” (Yorkshire Dales), England. Colored Frontispiece of “*Cave Hunting*” (DAWKINS, 1874).

in which I [the author] have attempted to give prominence to the more important points, rather than a finished and detailed history of cave-exploration". In addition to an introduction on the origin, fauna, and history of cave research, the already broadly conceived work dealt primarily with the climate, geography, and fauna of the Ice Age as well as cave deposits such as Pleistocene fossils and remains or tools of Paleolithic humans. The practical aspects of cave study were also covered, although only in a short section containing instructions on how to search for and survey caves, how to make excavations and how to use the specific tools required.

2.2. Three Popular Compendia on Cave Study: F. Kraus' "Höhlenkunde", É.A. Martel's "La Spéléologie" and C. Caselli's "Speleologia"

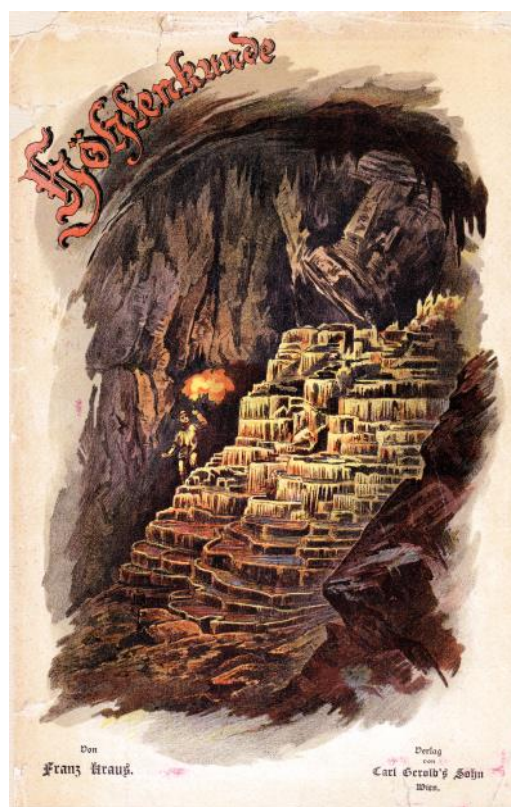


Fig. 3: Cover page of "Höhlenkunde" (KRAUS, 1894) with a depiction of "Dvorani ponvic" (Grotta delle Fontane/Brunnengrotte) in Škocjanske jame, Slovenia.

More balanced in terms of content was the book "Höhlenkunde" (Cave Study, 1894) (Fig. 3) by the independent gentleman and autodidact Franz KRAUS (1834–97). Due to his initiative, the "Verein für Höhlenkunde" (Society for Cave Study) and the very first speleological periodical, the "Literatur Anzeiger" (Literature Gazette), had been established in Vienna in 1879 (MAIS, 1984; MATTES, 2015a). With the aim of "recruiting new friends for the genuine, scientific investigation of caverns" and of "providing a useful handbook" for the caving community, he wanted to bring together the "entire scope" of the new research field. Kraus thus equally considered "geographical, geological, physical, anthropological, and technical conditions" (KRAUS, 1894: Preface, 289–290). For this purpose, he made use of both reference books of established disciplines and scattered periodical literature. The latter even involved comprehensive accounts of cave study by the agronomist Carl FRUWIRTH (1883/85) and the prehistorian Josef SZOMBATHY (1883), who achieved less attention due to the publication of their contributions in periodicals.

During the preparation of his handbook, KRAUS (1894: 294) received significant support from the fellows of the Vienna Imperial-Royal Geological Survey, the Natural History Museum as well as cave researchers from Austria-Hungary, Southern Germany and Paris, who provided expertise, literature, illustrations, and maps. His rather compilatory handbook comprised of an introductory literature review, a section on speleogenesis, a systematic overview of primary, secondary and artificial caves as well as a chapter on above-ground karst phenomena. A 100 pages long appendix summarized the state of research on ice caves and meteorology, cave deposits and legends and provided detailed practical advice on exploration and documentation techniques (MAIS, 1994).

Although, surprisingly, KRAUS (1894: Preface) hardly referred to Schmidl, he situated the “*still not recognized specialized subject*” of cave study at the intersection of recently established research fields such as geography, geology, paleontology, meteorology, zoology, anthropology, prehistory and ethnology. The fact that cave study developed at the intersection of these subjects and their popularization brought speleology many supporters, but also fostered dependence on these disciplines and their representatives. It was not for nothing that KRAUS (1894: Preface) described it as a “*risk*” to intervene as an “*autodidact*” in a “*field of academically educated scholars*”, who were rather called upon to “*fill a gap in the literature*”. However, according to Kraus, cave research represents an integrative field, in which trained “*laymen*” and “*professionals*” are dependent on each other. Similar to other disciplines such as meteorology or prehistory, cave study bases on the pooling, comparison, and evaluation of measuring data and findings. While, according to Kraus, laymen should collect data on site, the scientific interpretation should be left to professionals. The need for cooperation and the inherent distinction between theoretical and practical knowledge that Kraus addressed for the first time in such clarity were adopted in later speleological handbooks (HERRMANN, 2009). In the long run, Kraus’ contribution moved cave study into the vicinity of alpine sports and thus away from its recognition as a scientific field.



Fig. 4: Cover page of “*Les abîmes*” (MARTEL, 1894).

The book “*Les abîmes*” (The Abyss, 1894) (Fig. 4) by the renown Parisian advocate Édouard-Alfred MARTEL (1859–1938) maintained a lively exchange with Kraus

(MAIS, 1994; SCHUT, 2006). Although it is often quoted together with the aforementioned opus, “Les abîmes” cannot be called a “handbook”². Equally rich in illustrations, maps, tables, and photographs, Martel provided a comprehensive outline of the scientific fields, (sporting) practices, and instruments significant to cave study in the introductory chapter. The other book chapters contained gripping accounts of his explorations in France, Belgium, Austria-Hungary, and Greece between 1888 and 1893.

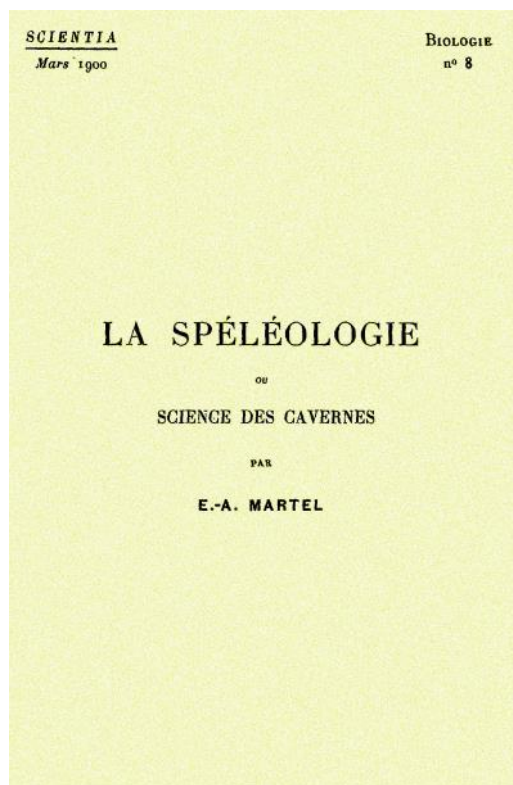


Fig. 5: Cover page of “*La spéléologie, ou science des cavernes*” (MARTEL, 1900).

However, MARTEL’s paperback-sized and 120 pages long monograph “*La spéléologie, ou science des cavernes*” (Speleology, or Science of Caverns, 1900), published six years later, can be considered a handbook (GINÉS & GINÉS, 2020). Due to its plain design, it probably became less well-known than “*Les abîmes*” (Fig. 5). MARTEL’s opus “*La spéléologie*” appeared in the biological series of “*Scientia*”, a collection of handy volumes dealing with topical fields of research that were edited by members of the renown “*Institut de France*”. In no less than 16 compact chapters, Martel covered all fields of knowledge that addressed caves, their deposits, living organisms and climate. He also provided a nomenclature of cave terms in different languages and an overview of the development of cave research in Austria-Hungary, France, Germany, Italy, Spain, and the United States, among others. The title of the handbook was programmatic: MARTEL (1900: 5) claimed for speleology “*a small place among the subdisciplines of the physical and natural sciences*”. In-

troduced as distinct from the German word “*Höhlenkunde*” (cave study), which implies different knowledge-based practices of dealing with caves and has already become wide-

² Despite an age difference of 25 years, Kraus and Martel had a close friendship and extensively exchanged letters, literature, proofs of publications, and research results. Both handbook authors were born in the social upper middle class, were financially independent, never went through natural scientific university training, and got in touch with cave study during their activity in Alpine clubs. Kraus, the elder of the both, was used to write good reviews for his friend’s publications. In the opus “*Höhlenkunde*”, KRAUS (1894) likewise quoted Martel more than 30 times and even used about ten maps and photos, provided by his friend, as illustrations. MARTEL (1894), in turn, cited Kraus not less than 52 times in “*Les abîmes*” (MAIS, 1994: 195).

spread during the middle of the nineteenth century, Martel used the term “spéléologie”. Coined by the archeologist Émile Rivière around 1890 (MARTEL, 1894: 1), the new appellation underlined the scientific claim on which emphasis was now laid (SCHUT, 2007: 26–29). As a review in the American journal “Science” illustrates, Martel’s handbook indeed was acknowledged as a “*admirable and timely contribution to current scientific literature*” (HOVEY, 1900: 610). The reviewer was none other than the well-known Reverend Horace C. HOVEY (1833–1914), whose book “Celebrated American Caverns, especially Mammoth, Wyandot, and Luray” (1882) was the first popular work on grottos published outside of Europe (HALLIDAY, 1972; FORTI, 2004). In the introductory chapters, Hovey provided a brief overview of the structures and varieties of caves, their mineral, animal and vegetable contents, and use as dwellings, but unlike Martel, did not deal with speleology as a scientific field.

Just as handy and comprehensive in scope as Martel’s monograph, although without any illustrations, was the handbook “Speleologia. Studio delle caverne” (Speleology. Study of Caves, 1906) (Fig. 6), published by the naturalist, writer, and newspaper journalist Carlo CASELLI (1867–1944) (ANTONELLI, 2006: 47). In later years president of the “Accademia Luni-gianese di Scienze ‘Giovanni Capellini’”, he had composed an Italian language handbook for the popular “Hoepli Manuali”. Comprising several hundred volumes on various fields of knowledge, this extensive book series was published by Ulrico Hoepli (1847–1935) in Milan, who sold and shipped the manuals postage-free throughout the Kingdom of Italy. Accordingly, CASELLI (1906: IX) addressed a wider readership and aimed “*to encourage*

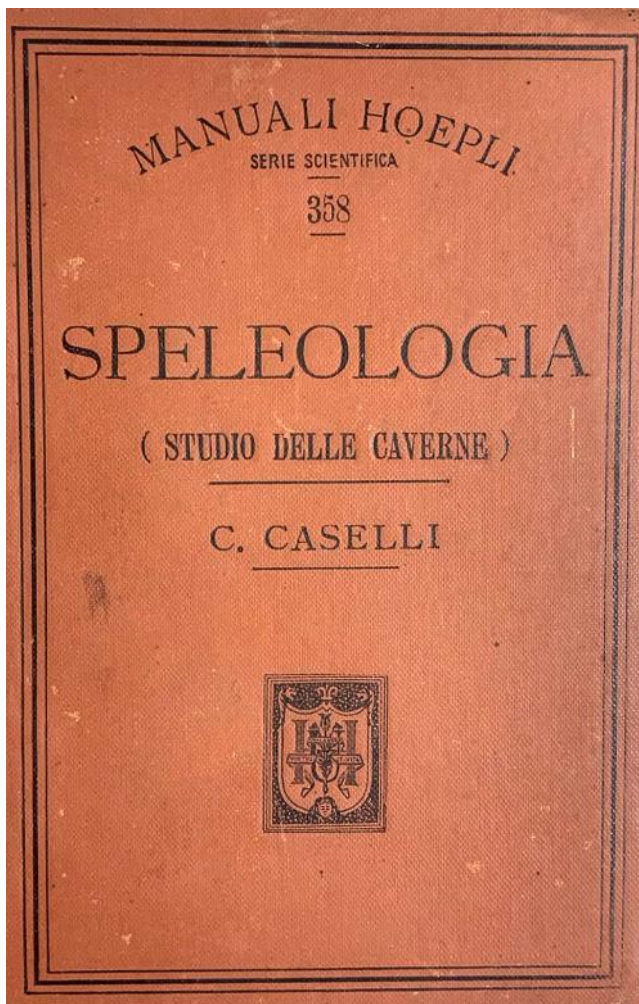


Fig. 6: Book cover of “*Speleologia*” (CASELLI, 1906).

young people to explore the caves, of which Italy is so abundant". While he introduced the French term "spéléologie" into Italian, he, unlike Martel, notably did not call it a science. Nevertheless, CASELLI (1906: 5, IX) called speleology the "*study*" of "*natural cavities under multiple aspects*" and recognized it as a driving force for the "*scientific unity to all the knowledge*" scattered in the literature. Accordingly, he mentioned not less than ten different branches of speleology. In contrast to Martel, Caselli, however, placed a chapter on speleological fieldwork, methods and required instruments at the beginning of his handbook and paid considerably more attention to practical instructions such as conducting measurements. In the appendix, he additionally offered a detailed compilation of the world's most famous caves, although his focus remained mainly on Europe.

The fact that Caselli's handbook was mainly negatively reviewed, for example by the Austrian geographer Norbert KREBS (1910), who called it a "*poor compilation with many inaccuracies*", may have had several reasons: Since Caselli was neither closely involved in the speleological community nor in geographical and geological scholarship, the renowned speleologist Eugenio BOEGAN (1906: 144) accused the author of an "*evident lack of knowledge on the subject*". At the turn of the twentieth century a fierce controversy raged in karst hydrology as to whether caves were formed by solution in the groundwater zone (GRUND, 1903) or by underground rivers (KNEBEL, 1906: 49). Speleologists such as MARTEL (1909) were also involved in this debate (SHAW, 1992). Caselli's apparent lack of expertise in karst studies led to open criticism. In addition, he had wrongly attributed the founding of the Italian-speaking "Società degli Alpinisti Triestini" and its "Comitato alle Grotte" in Trieste in 1883 to the initiative of Franz Kraus (CASELLI, 1906: 6). With regards to the long-lasting national rivalries between the speleological societies in the Austrian Littoral, this was certainly considered a severe faux pas and contributed to Boegan's scornful book review.

2.3. Academic Approaches to a New Discipline: W. v. Knebel's "Höhlenkunde" and G. Kyrle's "Grundriß der theoretischen Speläologie"

The handbook "Höhlenkunde mit Berücksichtigung der Karstphänomene" (Cave Study with Consideration of Karst Phenomena, 1906) (Fig. 7) by the young German geologist Walther von KNEBEL (1880–1907) further brought the aforementioned distinction drawn between scientists and laymen to the fore. Published in a popular scientific book series, the paperback-sized and rather unobtrusive monograph, unlike previous handbooks, featured only black and white illustrations. Since, according to KNEBEL (1906: V, VII–VIII), "*scientific cave study*" was as dependent on "*tourists*" for its development as glacier science was on Alpine sports, the handbook aimed to provide "*non-professionals*" with "*stimulation and directives*" and to offer "*professionals*" a "*critical exposition of the entire karst phenomenon*".

Knebel's understanding of caves as a distinguished aspect of karst studies, which were advanced at the turn of the twentieth century significantly by the contributions of the geographers Jovan CVIJIC (1893) and Alfred GRUND (1903), weakened the scientific claim

of cave study. Accordingly, Knebel devoted most of his handbook to the geological formation of caves and other karst phenomena, while, at the end, he however dealt in short chapters with the meteorological and biological conditions in caverns, the history of their research and use as dwellings. While Kraus' and Martel's compendia still aimed at establishing speleology as an independent field, KNEBEL (1906: VI, 3) subordinated it to other disciplines and called cave study *"primarily a part of geography"* and later a *"branch of geology"*. It is astonishing that he did not recognize the handbooks that have appeared so far as such: *"Now, however, in all the specialist and popular scientific literature there is no work that really does justice to the scientific purposes and tasks of speleology. ... Too few scholars have devoted themselves to this field of research"*.

Likewise, KNEBEL's (1906: 220) comments on Kraus' "Höhlenkunde" were not very flattering. Even if it is only a *"compilatory work"* containing *"excellent illustrations"* and *"literature references"*, it is of *"great use to the expert because of a series of own scientific observations"*.

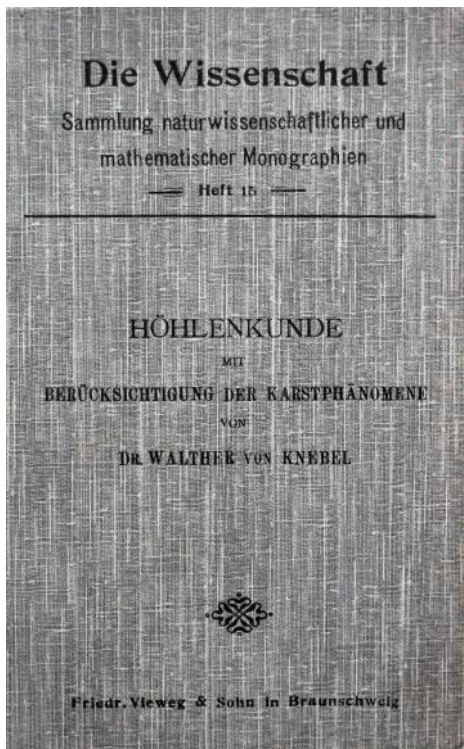


Fig. 7: Book cover of *"Höhlenkunde mit Berücksichtigung der Karstphänomene"* (KNEBEL, 1906).

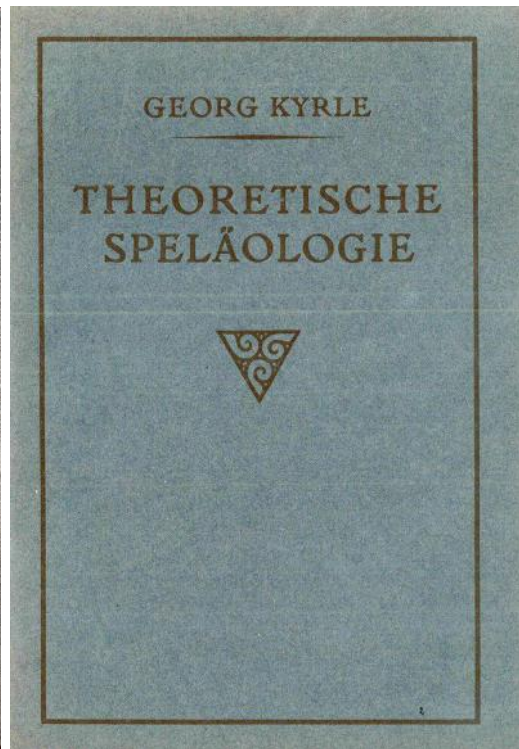


Fig. 8: Book cover of *"Grundriß der theoretischen Speläologie"* (KYRLE, 1923).

If we disregard the “Kleine Höhlenkunde” (Little Cave Study, 1917), a handy textbook dedicated to members of speleological associations and authored by the Austrian ministry official Rudolf WILLNER (1878–1926) during World War One, the monograph “Grundriß der theoretischen Speläologie” (Outline of Theoretical Speleology, 1923) is the last of the handbooks that appeared between 1870 and 1925 (Fig. 8). Written by the prehistorian and anthropologist Georg KYRLE (1887–1926), later the first professor of cave study at the University of Vienna, it takes an exceptional position among the aforementioned books. Illustrating the close ties between state interests, cave study, and resource extraction in interwar Austria (MATTES, 2020), the Federal Printing Office published the large-format handbook. Despite hyperinflation and the poor supply conditions after World War One, the monograph featured at least 200 schematic illustrations, photos, and maps. Used as a key argument for the founding of the very first chair of cave study at the University of Vienna, which finally succeeded in 1929, the handbook meant to “*establish a methodical-ordered system*” for all branches of speleology (KYRLE, 1923: 2).

Thus, KYRLE (1923: 10) aimed at nothing less than creating a “*research and teaching method capable of collecting, sifting and processing the totality of speleological phenomena*”. This was intended to refute the accusation that speleology was merely an “*intermediate scientific discipline*”. Therefore, Kyrle referred to the concept of “*group science*” that should lay the theoretical groundwork of the field’s metadisciplinary position within the framework of science (MATTES, 2018). Already discussed for anthropology among German and Austrian scholars at the turn of the twentieth century (e.g. MARTIN, 1914: 1), the model of group science was transferred to speleology by the botanist Richard von WETTSTEIN in the aftermath of World War One (1921: 112). Although KYRLE’s handbook (1923: 10) intended to present the “*interplay and interaction of all disciplines*”, he dedicated the largest part to geographical and geological features such as speleogenesis, and cave deposits, while meteorological, botanical, zoological, paleontological, anthropological, prehistoric, and ethnographic aspects were addressed surprisingly briefly at the end. Practical research, on which a second, but ultimately not realized volume was planned, was not addressed. Kyrle thus introduced a distinction between speleology and cave study both in terminology and practice. Whereas the term “speleology”, adopted from French, was limited to a scientific examination of caves carried out at state research institutions by academically accredited scholars, the term “cave study” now denoted fieldwork pursued by non-professionals in privately organized associations. On the one hand, the increasing “*boundary-work*” (GIERYN, 1999) between speleologists and cavers promoted by Kyrle’s handbook concerned the different valuation of their work. On the other hand, it affected the institutionalization of speleological research in form of state-owned departments (e.g. in Austria, Italy, Romania) or caving associations, which oftentimes existed more side by side than actually worked together.

3. THE POWER OF HANDBOOKS

3.1. Multiple Addressing

As mentioned in the introduction, the actual impact of speleological handbooks on practical research might have been rather insignificant. With the founding of caving societies, individual communities of practice emerged that developed their own methods, tools, and instruments for exploring and surveying caves. Although there is little evidence if and how handbooks circulated among the members of speleological societies or if they were even used for instruction, it is more likely that practical knowledge was passed from participant to participant during fieldwork than studied academically. Handbooks however had a much greater influence in communicating the goals, program, terminology, and methods to various audiences such as professionals and practitioners of related fields as well as the broader public. The same applied to the international exchange between the speleological communities, where early journals did not have the same international reach as monographs. Even though the first handbooks often appeared in large numbers, their impact remained largely confined to their own language community. Among the aforementioned authors, only Martel regularly attended international congresses, published in another language than his mother tongue and thus received a high level of attention even in the United States (SHAW, 1992: 248). Nevertheless, the demand on the book market outside of France, where parts of Martel's rich oeuvre became bestsellers, was not enough for a translation of his handbook. Among the described compendia, only Dawkins' "Cave hunting" was translated by the young German zoologist Johann Spengel (1852–1921), in later years president of the University of Gießen. In the foreword, the naturalist and priest Oscar Fraas (1824–97) introduced the handbook to the "*German [reader] circles*" and explained the need for a translation by the high popularity given to cave study there (DAWKINS, 1876: V–VI).

While early handbooks such as those by Dawkins and Kraus attracted a wide circle of supporters through the use of impressive artistic illustrations that were also intended to appeal to the reader on an emotional level, later handbooks relied on a rather plain book layout. The use of photographs, maps, and schematic sketches served to objectify the presentation and aimed to underscore the scientific pretensions of the new field (DASTON & GALISON, 2007). In this way, the authors distinguished themselves from the "*popular*" approach of earlier handbooks, which, as the geologist Franz von HAUER (1894: 742) noted in a review of Kraus' monograph, were intended to "*provide rich stimulation and arouse general interest in speleology, especially for the numerous friends of natural history who are not strictly scientifically trained*".

A significant communicative strategy of handbook authors was multiple addressing, which made it possible to reach various types of readers at the same time (HOFFMANN, 1984). In this regard, prefaces play a significant role. Here, readers could check if a book met their expectations. At the same time, a preface enhances the credibility of the author, guides the readers' attention and contextualized the object of research in science. By addressing different readers at the same time, in prefaces handbook authors divided the audi-

ence in groups and attributed reading attitudes to them. In speleology, this distinction corresponded to particular groups of actors such as scientists from recognized disciplines, experienced cavers, and the broader public. While all aforementioned handbooks, with the exception of KYRLE's "Theoretische Speläologie" (1923), appealed to a wider readership by using generally understandable language, there were considerable differences in multiple addressing. While Caselli, Dawkins and Martel acted rather cautiously, the handbooks published in Austria and Germany, where many recognized scientists were involved in speleology, introduced a clear distinction between "professionals" and "laymen". According to KRAUS (1894: Preface), cave study is based on a clear division of labor:

The specialists of cave research ... are nowadays still very thinly spread, and it is therefore mostly carried out ... only incidentally by geologists, geographers, entomologists, etc., depending on whether the respective specialists are interested in one or the other phenomenon related to cave study or in some locality that is important for the respective branch of knowledge. The purpose of this book is therefore mainly to acquire new followers for cave research, who will help to process the mass of study material distributed all over the world and to provide reliable information about it. No professional is in a position to describe this immense material from his own perspective and to check the correctness of the information available in the literature. Therefore, even laymen can successfully participate in cave research, if they are familiar with certain basic principles as well as the method according to which they have to proceed. The processing of the scientific material obtained in this way will, however, always remain a matter for experienced professionals.

While it remains vague whom Kraus actually addressed by "*professional*", KNEBEL (1906: V–VII) was more specific. According to him, academically untrained cavers should serve as auxiliaries. They needed guidance, instructions, and clear directives how to collect finds and conduct measurements for recognized geographers and geologists to evaluate. An integration of "laymen" should advance the field and, subsequently, lead to the creation of large data collections, nowadays known as cave cadasters:

With general descriptions, usually considered as 'cave research', scientific cave study does not advance. ... Everyone should inform himself about the nature of cave study, its purpose and tasks. Then, the view will be sharpened and the observations of each individual will provide components for an edifice that could be built on a broader basis than the previous one. For this to come about, however, it is necessary that very specific directives be given to the observers – I do not mean by this the specialists alone. ... Cave study is dependent on auxiliary forces for its further development. It is not always possible for discipline-oriented scholars to verify and complete the studies of others.

This rather hierarchical division of labor between "professionals" and "laymen" refers to the nowadays fashionable term "citizen science" (IRWIN, 1995) that is sometimes

used for speleology and its narrow understanding as a “*sporting science*” as well (MENCARINI *et al.* 2021).

In the second half of the nineteenth century, collaborations of specialists with various learnt backgrounds already affected many fields of the natural sciences and humanities such as meteorology, zoology, or (pre)history, where the compilation and comparison of extensive sources, data, measurements, and finds, were required (MAHR, 2014; SCHEIDEGGER, 2017). Unlike the aforementioned disciplines, speleology however was not established as a subject, so that the division of labor and the prestige associated with the different tasks had to be negotiated within the community first. Due to their multiple addressing, handbooks pioneered in this regard. This is also true to a limited extent in Western Europe and the United States, where the late founding of national speleological societies diminished the field’s scientific claims and thus the hierarchies within the community (SCHUT, 2007). By ascribing specific tasks to the various practitioners, handbooks not only mirrored relations of power in practical fieldwork, but also promoted the boundary-work within the community. In doing so, compendia disregarded the fact that cave exploration was not carried out by either established scholars or scientific laymen. Often, the practitioners active in cave research had hybrid biographies, interacted between science and its popularization, and could not be clearly assigned to one discipline or scientific institution alone.

3.2. Citation Strategies

By calling on different literature when assembling all the information, handbooks create a reference network of (journal) authors which they accredit for their work (MORRISSEY *et al.*, 2013). The review (and often criticism) of previous reference literature plays a vital role in positioning the new handbook in the field and legitimizing its publication. The tendency that speleological handbooks – with the exception of Kraus and Martel – hardly quoted literature and that only Caselli’s “*Speleologia*” contained a bibliography at the end is striking.

KRAUS (1894: 1–10) at least offered in an introductory chapter an overview of the previous literature published in German, French, and English and listed all speleological periodicals and publishing societies. MARTEL (1900: 9–10), in turn, provided a two-pages long literature review, which widely coincided with the titles mentioned by Kraus. According to the metadisciplinary nature of the field, both authors included journals from recognized disciplines in their respective chapters. While Martel additionally considered articles published in the bulletins of the “*Société Spéléologique*” by renown authors such as the Serbian geographer Jovan Cvijić (1865–1927), Kraus referred to popular bulletins such as “*Antiqua*” (Strasbourg), “*Globus*” (Braunschweig), “*Natur*” (Halle), or “*Stein der Weisen*” (Vienna). Furthermore, both authors openly addressed the incompleteness of the mentioned literature. KRAUS (1894: 3) even admitted that “*the overview of ... the literature sources listed exceeds the capacity of an individual. A division of labor would be very beneficial here, which could best be brought about by a free international association of all friends of speleology. The members of this association could, by means of mutual ex-*

change, also obtain information about the literature in foreign languages, which would hardly be accessible to them in any other way”.

A different strategy was followed by Knebel and Kyrle, who, in order to establish the field scientifically, hardly addressed the literature published so far in speleological periodicals. In particular contributions by non-academically trained authors were often omitted. Accordingly, KNEBEL (1906: V) noted that *“the literature related to speleology is quite broad. But most of the writings are very similar to each other; they are limited to a more or less exact description of cave galleries, the stalactite ornaments contained in them, and other things; then usually follow some speculations about the age and the mode of cave formation. It all usually culminates in some remarks about the eerie beauty of the grotto world or the splendor of the stalactites.”* Similarly, KYRLE (1923: 3) harshly judged the entire previous literature on cave study right at the beginning of his handbook: *“If one looks around in the whole speleological literature, as far as it is considered for scientific use at all, one will miss a sharp demarcation and systematic arrangement, which tries to classify all speleological phenomena and to determine their mutual dependence.”*

The consideration and evaluation of other reference works in the handbooks differed as well. Only Caselli rated all previous compendia positively. While Kraus and Martel mentioned Dawkins and other reference literature, albeit partly critically, KNEBEL (1906: 220) referred to Kraus’ and Martel’s works only at the end of his book and assigned them a rather popularizing role. He even wrongly described Martel as *“now deceased”*. Kyrle likewise delineated his work from previous handbook authors and then evaluated their consideration of the various branches of speleology. According to KYRLE (1923: 3–4), only Martel had published *“a study which, albeit brief, treated most speleological sub-fields approximately evenly according to their significance.”* Due to his one-sided discussion of cave formation, Knebel, on the other hand, *“was not able to advance to a unified compilation of the overall cave phenomena and thus did not clarified or more sharply delineated the position of speleology within the framework of the other scientific disciplines”*. Thus, according to Kyrle, Knebel’s *“Höhlenkunde”* did not represent a handbook at all. In this regard, the lack of citation or critical review of previous compendia can also be understood as a strategy for attributing a pioneering role to one’s own handbook. Nevertheless, it is obvious that the compendia essentially built on each other in terms of content.

3.3. (Academic) Discipline and Metadisciplinarity

At the turn of the twentieth century, it was not yet foreseeable that speleology would not develop into an internationally established academic discipline. Even in case of nowadays acknowledged research fields such as geography, anthropology, oceanography, or prehistory, university chairs were only established gradually and the authors of speleological handbooks were very well aware of their role in making the scientific claim of their field heard. The metadisciplinary nature of cave study, however, posed a challenge to its formation as an academic discipline (MATTES, 2015b). Handbook authors such as Dawkins or KNEBEL (1906: Back cover text) tried to *“steer”* the methodological diversity of

speleological fieldwork into “*expedient channels*” by prioritizing one discipline such as prehistory or geology. Martel and Kyrle in turn made the metadisciplinarity itself the subject of their handbooks and aimed at “disciplining” the field’s diversity by theoretically structuring it and including or excluding certain players.

According to the French philosopher Michel FOUCAULT (1991), academic disciplines represent spaces, where people can be instructed, supervised, and efficiently controlled. Freezing specific relations of power and enforcing social discipline to constrain discourse, disciplines tend to encapsulate as a strategy of protection and develop internal rituals of probation. In this context, they can also be regarded as a form of intense training turning out graduates being “*disciplined by their discipline for their own good*” (KRISHNAN, 2009: 8; WILDFEUER *et al.*, 2020: 16–17). In this context, especially handbooks as immovable boundary and corner-stones play a significant role in identifying, reintegrating, or excluding deviators. In speleology, handbooks aimed at influencing scientific discourse by policing specific ways of thinking, introducing a compulsory terminology and norms. This was realized in a very direct way, for example by KRAUS (1894: 270) through the warning against the danger of undisciplined research parties. By accepting the handbook’s concepts as their own, practitioners were policed without the need of strict regulations. This concerned in particular the introduced terminology, which began to stabilize with the publication of the first compendia in speleology and karst studies (e.g. CVIJIC, 1893; GRUND, 1903; KATZER, 1909; DAVIS, 1930).

Comparing the metadisciplinary claim with the content of these early handbooks, it is astonishing that their authors often preached water but drank wine. Although Dawkins mostly focused on prehistorical and anthropological issues and the other authors brought geographical and geological aspects to the fore, all of them underlined the metadisciplinary nature of speleology. According to KYRLE (1923: 3), the “*lack of [scientific-theoretical approaches in cave study] is the result of the historical development of scientific speleology. A large amount of individual observations has probably been made and published, but the general summary attempts always strike out in favor of certain specialized speleological chapters, while others of equal importance are merely cursorily dismissed.*” This critique however applied to Kyrle’s own work as well. His aim to “discipline” metadisciplinarity on a theoretical level through the power of handbooks did not consider on-site fieldwork, about which his compendium’s second volume “*Grundriß der praktischen Speläologie*” (Outline of Practical Speleology) never appeared. Due to the demanding conditions at underground sites, researchers – regardless of their status as “professionals” or “non-professionals” – have always collaborated across and beyond academic discipline(s). Thus, the handbook authors’ claim for metadisciplinarity, communicated via their compendia, was rather a professional discourse than a question of practice.

4. CONCLUSION

The emergence of speleology as an integrative field of science goes back 150 years, when its first handbooks were published and the term “Höhlenkunde” (cave study) was used in a methodological way. Besides geology and geography, “Höhlenkunde” also referred to research fields such as botany, zoology, paleontology, prehistory, anthropology, ethnology, or meteorology as well as to various types of knowledge acquisition and dissemination. The first steps in cave study were taken not in academia alone, but also in scientific societies, alpine clubs, museums, schools, and many other sites. Due to the specific position of speleology in-between different cultures, practices, and spaces of knowledge, handbooks were key for the justification of the field as a “group science”, its methodological consolidation and popularization at the turn of the twentieth century. They maintained this powerful position until the interwar period, when the first extensive speleological periodicals were established which began to restrict the monopoly of handbooks.

As the examination of caves has always required different forms and fields of knowledge, its metadisciplinary orientation was challenged during the period of increased discipline formation in the earth sciences. Handbooks responded to these processes in a variety of ways, attempting to legitimize the field’s status as a distinct subject through the inclusion or exclusion of “non-professionals”, the development of theoretical concepts, or the subordination to powerful disciplines and their key figures. By synthesizing a scientific and popularized approach and organizing the information hierarchically for instructional purposes, these handbooks merged different communities of knowledge and practice.

Handbooks such as Kyrle’s “Theoretische Speläologie” still have a significant influence on the present understanding of speleology. Frequently cited but rarely read in their entirety, they form unifying reference points for the diverse speleological communities, discuss the field’s metadisciplinary nature and its distinction from other disciplines. The extent to which these compendia were tied to the research field is shown by the choice of the title of the German-speaking handbooks, which, as Hubert TRIMMEL’s following “Höhlenkunde” (1968) illustrates, served as representatives of the field itself. That the writing of a handbook also involved national claims to leadership in science demonstrates an article of the paleontologist Kurt EHRENBURG (1953: 18, 14), who called for a revised edition of Kyrle’s handbook in the course of the institutional reorganization of cave study in Austria after World War Two (KLOS, 2021). A renewal of Kyrle’s “*scientific groundwork*” should “*contribute to Austria regaining and asserting its rightful place in speleology*”.

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