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BALTHASAR HACQUET, PREDECESSOR OF MODERN KARSTOLOGY

Andrej KRANJC*

Izvleček
Balthasar (Belsazar) Hacquet je preživel 20 let (1766–1787) na ozemlju današnje Slovenije, kot kirurg pri idrijskem rudniku in profesor anatomije v Ljubljani. Najbolj ga je zanimalo naravoslovje (geologija, mineralogija, paleontologija, kemija, hidrologija, geomorfologija in krasoslovje, kot tem vejam pravimo danes). Veliko je potoval po Kranjskem in severozahodnih delih Dinarskega gorstva. Svoja naravoslovna zapažanja je objavil v knjigi *Oryctographia Carniolica*, ki je izšla v štirih delih v letih 1778–1789. Opisal in tudi razložil je vrsto kraških oblik in pojavov. Glede na današnje poznavanje je mogoče reči, da je bil marsikdaj prvi, ki je to poizkusil oziroma ki mu je to uspelo (npr. podzemeljske vodne zveze, geološki razvoj, korozija). Hacquet je razlikoval med kraškim in drugim svetom. Poznal je pokrajino Kras, ki se mu je zdela kot *»kamnita Arabija«*. Napravil je zemljevid Kranjske in severozahodnega dela Dinarskega gorstva z dogovorjenimi znamenji za geološke pojave – prvo geološko karto. Razločeval je apnenec od dolomita, pisal o koroziji apnenca, o različnem razpadanju kamnine itd. Čeprav je težko ugotoviti njegov pogled na kras, je gotovo vedel, da gre za poseben tip pokrajine, za pokrajino na apnencu, ki je topen v vodi, in kjer so posebne kraške oblike, kot so npr. kraška polja in jame.

Abstract
Balthasar (Belsazar) Hacquet spent 20 years of his life (1766–1787) in present-day Slovenia where he was a surgeon in the Idrija mines and professor of anatomy in Ljubljana. However, his main interest was natural sciences (geology, mineralogy, palaeontology, chemistry, hydrology, geomorphology, karstology as they are called nowadays). He travelled a lot throughout Carniola (Krain) and the northwestern parts of Dinaric mountains and published his observations in 4 volumes of *Oryctographia Carniolica* (1778–1789). He described and even explained karst phenomena and karst features. It is believed that in many cases he has been the first who tried to do this or whose explanation was considered correct (for example, underground water connections, geological development, corrosion). Hacquet discerned the difference between karst and normal relief. He also knew that a part of Carniola was called Kras (Karst) that seemed to him like *"stony Arabia"*. He produced a map of Carniola and of northwestern Dinaric Mountains with the signs for lithology, the first geological map. He discerned limestone and dolomite, he wrote about a sort of corrosion of limestone, of different weathering processes, etc. Although it is difficult to find out his general perception of karst, it is certain that he knew that it was a special type of landscape situated on limestone rocks soluble in water and that they were characterized by special geomorphological features, karst poljes and caves, for example.

Ključne besede: zgodovina krasoslovja, Balthasar Hacquet, dinarski kras
Key words: history of karstology, Balthasar Hacquet, Dinaric Karst

1. INTRODUCTION

Balthasar (Belsazar) Hacquet was presumably born in 1739/40 in France. Le Conquet in Brittany is usually referred to as the place where he was born whereas according to a research later on, it is a place in the eastern part of France around Metz (Gauchon 1999). Actually, a lot has been written about his work and life (Pilleri & Mušič 1984). He came to Carniola (Kranjska, Krain) in 1766 as ap-

*Inštitut za raziskovanje krasa ZRC SAZU, SI-6230 Postojna, Titov trg 2. E-mail: kranjc@zrc-sazu.si

pointed surgeon to the Idrija's mercury mine. Consequently (1773) he moved to Ljubljana where he held different positions, being a secretary of the Agricultural Society of Carniola, lecturer in chemistry for the courses in agriculture and handicrafts, and lecturer in anatomy, surgery and obstetrics at the Ljubljana Lycaeum. He was an enlightened, free-thinking intellectual and often not understood and well respected by his co-citizens in the provincial and narrow-minded town of Ljubljana. He called himself *"a stranger in my nation"* and in 1787, he left the *"bigoted and uncultured"* Carniolians for Lviv (Lvov) in Ukraine (Kornhauser & Wraber 1990). In 1815, he died in Vienna.

Like G. A. Scopoli, the Idrija's mine physician at the time of Hacquet's arrival in Carniola (Kranjska, Krain), Hacquet also spent a lot of time travelling around Carniola and nearby regions studying rocks, minerals, waters, relief, plants and also human activities, in particular mining and metallurgy as well as folklore and languages. Hacquet's most complete published bibliography (Valjo 1997) consists of 90 original works and some translations including many books. For Kranjska and present-day Slovenia, his most important work is *"Oryctographia Carniolica oder Physikalische Erdbeschreibung"* ... (Oryctographia Carniolica or Physical description of the Duchy of Carniola, Istria and partly the neighbouring lands), tetralogy, published between 1778 and 1789 in Leipzig (Names, titles and words given *in italics* are written according to the Hacquet's original). The title *"Physical description"* covers geology, mineralogy, morphology, topography, hydrology (especially springs and thermal springs) and some industry (mining, metallurgy). This work can be considered as the continuation of the Valvasor's topography *"Die Ehre ..."* (Sitar 1987) dated 1689 but in a completely different spirit. Four volumes encompass 623 pages. Carniola is the land where karst areas prevail and therefore, Hacquet's *Oryctographia* is dedicated to karst, the most of all his works. Additionally, there are about ten other Hacquet's works dealing with karst. In some of them, karst is only mentioned marginally while the others include important descriptions and discussions on karst like *"Physical-political travel from Dinaric through Julian, Carnian, and Rhaetien to Noricum Alps ..."* (1785) or his *"Mineralogical-botanical Travel from Triglav in Carniola to Glockner in Tyrol"* (1794).

His shorter works like the list of Idrija fossils (1771) or the description of newly discovered platinum (1777) are precise treating a narrow topic, while the descriptions of his voyages are *"topographies"* where a lot of topics are assembled. I will try to extract his knowledge of karst and his opinion about karst.

Regarding the topographical and geographical names in Hacquet's works it has to be stressed that Hacquet's principle was to write the names in the native language of the inhabitants of the country or region. In this case it was the Slovenian language, which Hacquet referred to as his mother tongue, as stated in *Oryctographia.* He wrote the name of the Idrijca River as *Iderza ... in unserer Sprache ...* (... in our language ...) and the well known north-western wind burja is ... *den wir in unserer Muttersprache Buria ...* (... as in our mother tongue *Buria ...*). The same is applied to the names on the maps. Hacquet's maps are among the earliest ones bearing Slovenian names. On the map of Carniola added to the Vol. I of *Oryctographia* the names like *Poßtoina, Suet Kozian, Suet Sacerb,* and *Koper* are indicated instead of the names like Adelsberg, Sanct Kanzian, San Servolo or Capodistria. On his map, the region of Kras is marked *Na Krassi* (on Kras), which means that the Slovenian form Kras was used instead of the German Karst. In *Oryctographia,* native names are written in Latin alphabet resulting in numerous printing mistakes in names. Like other Hacquet's books, *Oryctographia* was printed far away and Hacquet could not correct it in time. Prior to interpreting the Slovenian names in *Oryctographia,* one has to check 10 pages of errata at the end of the volume IV (Hacquet 1789).

2. HACQUET'S IDEAS ON KARST GEOMORPHOLOGY

From the text accompanying the *vignette* of the foreword to the first volume of *Oryctographia Carniolica* Hacquet's general geological principles and his attention paid to carbonate rocks can already be observed. Due to the lithological structure, the mountains of Carniola and the Alps (including the Dinaric Alps as he called them) are divided into *Montes primarii* or *Hauptgebirge* (the main mountains) of non-carbonate rocks, *Montes secundarii* or *Mittelgebirge* (the middle mountains) of grey limestone and *Montes tertiarii* or *Vorgebirge* (the foremountains) of limestone or non-carbonate weathering products, scree and rubble (Hacquet 1778: Vignette 2).

Apart from the detailed observations indicated

Fig. 1: The title page of Hacquet's book Oryctographia Carniolica *with the cross-section of the Sveta jama cave, Kras (Hacquet 1778).*

in the *Oryctographia,* Hacquet's general views on the geological evolution of larger regions can be seen. A good example is the Outer Dinarides as they are called nowadays. According to Hacquet's

own observations of sediments, rocks and morphology, the region of Kras and other similar lower and flat parts of the country along the Adriatic Sea were once lakes or gulfs of that sea. Where there are mountains nowadays there was a string of islands stretching from Kras to Dubrovnik (Southern Dalmatia) (Hacquet 1789: 42). This is, in fact, the palaeogeographical situation during the Eocene (Tertiary Era), when lower parts of the land along the Adriatic Sea submerged by transgression and the higher parts were firm soils or islands. In the submerged parts, the flysch rocks were deposited.

When describing karst topography, either small surface features or big geomorphological units, Hacquet can be considered as a karst geomorphologist. When describing the country of Kras (Karst), he compares it to the *"Rocky Arabia"* – *Arabia Petraea* (Hacquet 1778: 65). In his opinion, *Kras* or *Karst* (the actual region of Kras or Karst in the strict sense of the word) was the first of the *"plains"* of the Istrian (Istra) peninsula, where the *Krashauze* (Kraševci) live and further down, in the same belt, the *Zhitschen* (Čiči) and *Pinzhene* (Hacquet 1778: 65). He mentions the fissured surface area covered with loose stones where all rainwater penetrates immediately underground. Among the karst surface features, large depressions fascinated Hacquet most. These are deep *dolines* on high karst plateaux which are described as *Kessel* (kettle) by Hacquet and where he observed temperature and vegetation inversion. This type of doline has a special name in the Slovenian terminology, i.e. *"konta"*. Other larger forms are represented by *Kesseltäler* (kettle valleys), i.e. karst *poljes*. He underlines the importance of closed depressions in connection with the Cerkniško jezero intermittent lake. Some bottoms of closed depressions, for example, on the Bloke plateau above the Cerkniško polje and the karst polje Dobrepolje are interpreted by him as a seasonal lake in the first case and the former lake bottom in the second one. These conclusions were reached by observing the topography and sediments and after all his suppositions were correct (Melik 1955).

Hacquet's view on the weathering and dissolution of carbonate rocks is of a special interest to us. For that purpose he found various reasons and various explanations for the difference between the rocks, the exposition, and the contents of *"elements"*. Hacquet has been considered as a predecessor of climatic geomorphology and a *"father"* of corrosion theory by some authors (Gams 1974: 14).

On the Kras plateau (Karst in the strict sense), around Lipica and elsewhere, Hacquet paid attention to the difference between the relief on the limestone (*Lapis calcarius*) and that on the dolomite, which he called *Stinkstein* or *Lapis suillus*, i.e. *"stinking rock"* (Hacquet 1778: 65). This happened 13 years before Déodat de Dolomieu (1791) published his classical work on dolomites. It is not superfluous to mention that Hacquet and Dolomieu knew each other personally, they met in Ljubljana in 1784 (Šumrada 2001). However, Hacquet did not only observe, he was a real researcher. He tested limestone with mineral acid and found it inhomogeneous, what should result in the irregular weathering of limestone.

Hacquet also ascertained that there are differences in the weathering due to the exposition, i.e. to the position on the sunny or on the shadow side of mountains or slopes. The reason is the high temperature on the sunny side causing limestone to calcinate. In this process the *calx* (currently called oxide) is produced and it is dissolved and washed away by rain (Hacquet 1778: 46). Moreover, Hacquet's work has to be read cautiously. His *"lime"* as the essential part of all metals is called *calx* (oxide) by him and is not what is nowadays called $CaCO_3$.

With regard to the formation of *dolines*, Balthasar Hacquet was the first who made a suggestion that they were formed by solution. He stated that the *dolines* were formed by the disintegration of limestone due to weathering and erosion processes (Shaw 1992: 171).

In general, Hacquet observed and proved that limestone weathers into clay shale and finally into clay (Hacquet 1778: 107). Hacquet also knew that water dissolved the limestone, but not the dolomite. The time Hacquet lived in was still the time of Peripatetic logics of substances and four elements. In the same way as two hundred years before, the simple minerals were classified into soils, solidified juices, stones and metals (Agricola 1950). The principle of *flogiston* – a substance with a negative weight arising from the burning substance (Kovač-Artemis 1984: 106) – was still acceptable at that time, partly also by Hacquet.

It is difficult to deduce and to summarise Hacquet's works from different, long, complicated and (in our reasoning) sometimes contradictory statements on the dissolution of limestone. In order to understand his explanations it is important to keep in mind the following statements:

Three main components of all bodies including the rocks are:

- *fixe Luft* (stable or permanent air), *Elementarerde* (elementary earth or soil) and *fixe Feuer* (stable or permanent fire or *flogiston);*
- all bodies contain *fixe Luft* and *fixe Feuer (flogiston);*
- limestone also contains soil (*Elementarerde*), although never in a pure form.

His statements about the acids:

- there is only one acid but in various forms like in flintstone, in limestone, in animal and in plant world;
- in the air, there are not only alkaline acids but also other (salted rain);
- *calx* can also contain *Acidum universale*;
- acid is the cause of the dissolution of limestone depending on the proportions of *Luftsäure* and *Elementarerde.*

It can be concluded that water dissolves limestone but not dolomite. Limestone is either *calcinated* (and resulted *calx* washed away by rainwater) or dissolved by water (with acid intervention). Dissolved limestone remains in water (and can be deposited later). However, water cannot dissolve much dolomite (because of *flogiston*).

Regarding the corrosion (of course, it was not designated *"corrosion"*), Hacquet's essential question that he did not resolve was: If the acid dissolves limestone by taking away the essential part of *calx* (*fixe Luft* or *Luftsäure*) and clay remains, where does the acid come from? Does it come from the air (*Vitriolsäure*) or does it develop from the *Luftsäure* that is contained in limestone itself?

"Vitriol" was the name for the acid which is nowadays called sulphuric acid. The *fixe Luft* was discovered by J. Black and is in fact CO_2. It was A.-L. Lavoisier (1743–1794) that refuted the *flogiston* theory and J. von Liebig (1803–1873) that analysed and showed the importance of CO_2 a few decades after Hacquet (Tišler 2003).

Although the deposition of calcium carbonate is not directly a part of geomorphology, it is closely connected to corrosion. I would like to present Hacquet's view about it in this section. According to Hacquet, water deposits calcite in the following way: *"When water dissolves limestone, it takes it into the caves where it is deposited in a form of speleothems* (Tropfsteine) *or crusts* (*vielfältige Steinrinden or incrustationes*)*"* (Hacquet 1778: 138). However, water cannot dissolve much dolomite (because of *flogiston*) and therefore it does not deposit flowstones or speleothems (Hacquet 1784: 166).

3. HACQUET'S KNOWLEDGE OF KARST HYDROLOGY

Cerkniško jezero, intermittent (karst) lake, was in Hacquet's time the most known natural phenomenon of Carniola. Since Hacquet disagreed with explanations of lake periodicity provided by previous authors like Valvasor (1689) and Steinberg (1758), he himself studied, described and explained its functioning in details (Hacquet 1778: 129–141). To his opinion, the primordial reason for the existance of the lake is the rain. When there is too much of precipitation, there is water and consequently, there is lake, otherwise it is a dry bottom, the *polje*. He observes that karst surface absorbs all the precipitation immediately. He agrees with underground reservoirs, but not in the sense of Kircher's (1678) *"hydrophilatia"*. For Hacquet, the proof of these reservoirs is also karst caves that can contain a lot of water (made watertight by clay and flowstone). In this sense, he speaks of a sort of perched aquifers or perched water tables. Additionally, he underlines various elevations of springs and ponors. Last but not least, he investigated the complete permeability of limestone surface.

Underground water connections are often mentioned in Hacquet's works. Some of them were also stated by older authors like connections between the Škocjanske jame caves and the springs of Timavo; between the rivers in Postojnska jama and Planinska jama caves; and between the Lokva stream sinking under the castle of Predjama and the springs of the Vipava River. According to Hacquet, the last one is based upon trustworthy investigation. It is surprising that Hacquet knew certain underground connections that have been proved only recently and for which we do not know if they result from folk tradition. The fact that the water from the Bloke plateau flows underground to the springs in the Cerkniško jezero is not surprising. However, in order to find out that water from the Triglav lakes in the Julian Alps flows underground to the Savica spring or that sinking water in Cerkniško polje flows from some ponors directly to the springs near the monastery of Bistra (part of Ljubljanica river springs) and not via Planinsko polje like from the other ponors, a detailed observation or a very good intuition are required. Close observation of water discharge and rain water (probably based on folk tradition) is confirmed by the statement that the Bohinjska Bistrica spring (Bohinj) has its catchment area behind the main Alpine ridge (Spodnje Bohinjske

Fig. 2: The map of Europeische Alpkette *(Europe's Alpine Chain) from the title page of Hacquet's book* Physikalisch-Politische Reise aus den Dinarischen ... *(Hacquet 1785).*

gore). Of course, Hacquet's statements are not always correct. He knew the general opinion that the Unica river (flowing over the Planinsko polje) flew underground into the springs of the Ljubljanica river, but he himself believed that it might flow westward into the Divje jezero, a big karst spring near the town of Idrija (Hacquet 1778: 126).

Although no water gauging data were available, Hacquet found out the discrepancies when comparing the inflow and outflow of the Bohinj lake. Thus he arrived at conclusions that some underwater springs had to be located in the lake. This was not seriously taken into consideration until 1970 (Lajovic 1982). The investigations starting that year and later on including water tracing in 1972 (Novak 1979) proved that karst underwater springs existed in the lake what had already been supposed by Hacquet.

Since he was also a *"chemist"*, Hacquet often analysed water of the karst springs. To be able to illustrate how difficult it was to perform this task in Hacquet's time, I would like to emphasize that he had to carry on him a thermometer, a water balance, reagents, etc. and for the purposes of analysing water, he took (or sent) home a sample of a few buckets of water. As to the well-known springs of the Timavo river (later used for the water supply of the city of Trieste) he wrote that water was cold and unhealthy due to the particles of clayish marl transporting with it. He proposed that a water sample should be sent to Vienna to check if there are metals in it (Hacquet 1778: 63) like mercury in the Idrijca stream flowing through the mining town of Idrija.

It is interesting that among the people who studied the problem of floods in Carniola's *poljes* Hacquet has never been mentioned. He himself stated that four years before (1774?) during his two months long *"economical travel"* to the central part of the country, he visited all these closed valleys (i.e. *poljes*) to be able to establish how to prevent the floods. He communicated the results of this travel to the *"Imperial and Royal Economic Society of the Duchy of Carniola"* (Hacquet 1778: 126). It would be interesting to get to know if his report was published.

4. HACQUET AS A SPELEOLOGIST

Although Hacquet's speleological work is not so important regarding karstology and speleology as a whole, his speleological activities in Carniola are well known (Wester 1956a; Wester 1956b).

Hacquet is often mentioned in literature as a speleologist but in fact he was no more a speleologist than an alpinist. He was curious, he wanted to see and to study phenomena by himself and, therefore, he had to visit high mountains (he was the second to climb up the Slovenia's highest peak, Triglav, 2864 m) (Lovšin 1946) and caves. In *Oryctographia Carniolica*, many caves were partly described or just mentioned. In some places, Hacquet cited even cave research or technical details (climbing down the Sveta jama cave near Socerb) or passing through the dry siphon of the Pivka river disappearing into the Postojna cave. His attitude towards the visiting of caves can be best seen from his description of the reason for going into the mentioned siphon in 1774 when it was completely dry. *"I was ignorant of anybody who would dare to go there and thus it seemed even more necessary that I do it."* Besides the mentioned Sveta jama and Postojnska jama caves Hacquet wrote about other ones like Vilenica (Cornealhöhle), the most beautiful of all he had seen (Hacquet 1789: 40), Črna jama, Luknja (*Lueg*) near Novo mesto, and Matjaževa jama, not far from Ljubljana. Some of the caves he mentioned are difficult or impossible to identify today (for example cave *"pri Kosire"*) and some are mentioned just in general without any further precise details (caves in the *Plešivica* Mountain).

Hacquet usually visited and described a cave for a specific purpose. Normally, caves were mentioned or described in connection with various questions. The rock in which Podpeška jama developed attracted his special attention. He found out that it was the *"stinking rock"* (*Stinkstein* or *Lapis suillus*), the dolomite. According to his observations of this and some other caves he stated that dripstone did not precipitate from the water dropping from these rocks (and percolating through it). As regards the underground water and its connections, reservoirs, springs, etc., he wrote about the cave of Savica spring (the spring of the Sava river), the cave under the Devin (Duino) castle near Trieste which reaches the sea level, Škocjanske jame, the caves of Jama (*Lueg*) near Predjama not far from Postojna and Kompoljska jama at Dobrepolje. When describing the Coprniška jama cave on the Slivnica Mountain above Cerknica and the cave under Lačna gora hill (now the entrance part of the show cave, Županova jama) he discussed fog and ice. The cloud which could arise from the Coprniška jama (Witch Cave) and could cause storm with hail according to the local people and to Valvasor (1689), was due to the cave air blowing through the entrance as maintained by Hacquet. Consequently, it must be connected with some other entrance elsewhere.

5. HACQUET AS A CARTOGRAPHER

Today, the term Dinaric karst means a classical karst terrain and is also a toponym for a special type of karst. The name results from the great limestone mountain Dinara on the border between Croatia and Bosnia. Among the authors who first applied the name of Dinara in a broader sense is Hacquet himself. In the second part of his *"Mappa Litho Hydrographica Nationis slavicae"* (Litho-hydrographic map of the Slavic Nation) (Hacquet 1789) the name *Dinarska planina* (planina = mountain) appears. It extends from the town of Novi at the Adriatic coast to the Dinara Mountain at the Bosnian border. This is a much larger region than the Dinara planina itself. In 1785, Hacquet published another book entitled *"Physikalisch-politische Reise aus den Dinarischen durch die Julischen, Carnischen, Rhätischen in die Norischen Alpen"* ... (Physical-political travel from the Dinaric through Julian, Carnian and Raetien to Noric Alps ...). The title and the title page illustration (map) show that Hacquet designates the whole system as the Dinaric Alps, i.e. the system of the same class or scale as the Julian or Carnian Alps. If Hacquet is the first who expanded the name of the Dinara Mountain to a larger region, he deserved without any doubt that this concept was propagated by the 18th century scholars.

As it can be evident from the above-mentioned, Hacquet was also a cartographer. He did not produce general maps but in the case of *Oryctographia Carniolica* he published a kind of geological maps which may be considered as the first geological maps of karst in Slovenia. He himself called the main map *Litho Hydrographica*, probably because the waters were also shown on it. Besides the two conventional signs for *Ketten* (= chains), for ridge mountains and for *Mittel-* or *Vorgebirge*, he used signs for 9 various rock formations: limestone, gypsum, limestone or marl shale, clay shale, quartz shale, sedimentary rock, sandstone, quartz, and porphyry. From the karstological point of view, a

Fig. 3: Legend to Hacquet's Mappa Litho-Hydrographica Nationis Slavicæ *with signs for different rocks (*Gybs, Kalk, Thon, Quarz, Schiefer*) and for caves (Grotten) (Hacquet 1784).*

special sign for caves (*Grotten*) or a cave (*Grotta*) is of great importance. Many authors (Schmidl 1854) have agreed for a very long time that this is the first published map where such a sign was used. Hacquet's geological maps are very different from the modern ones. The maps in a big scale are only plans, while those in a small scale are shown simultaneously as maps (plans) and as side views (panoramas). On both types of maps, lithology, but not the stratigraphy, is shown. To be able to show it, Hacquet used conventional signs but he shows no limits (lines) between different rocks.

6. CONCLUSION

B. Hacquet is most important as karst geomorphologist using modern terminology. He wrote about geological evolution of the land, about rocks, especially about the difference between limestone and dolomite, about limestone relief, and about karst surface (small scale and big scale features). For the purposes of karstology, his views on the weathering (he found various causes) and dissolution of limestone are the most important ones. Of course, the background to his ideas and his knowledge, the bases for chemical and physical processes involved were far less extensive than they are nowadays. His ideas are good and correct but there is a lack of theoretical grounds. Although Hacquet was rather familiar with a contemporary professional literature, his ideas developed mostly on the basis of his own observations in the field, his personal experiments and not by digesting the ideas of the others.

As a karst hydrologist, Hacquet is important for his knowledge and descriptions of underground water connections, for his correct explanations of the functioning of seasonal (karst) lake (Cerkniško jezero), for his study how to prevent inundations, and for his water analyses including drinking water. His visits and descriptions of numerous caves,

mostly local ones, and his explanations in the field of cave meteorology, cave geology and cave hydrology are very important for speleology. He published first geological maps of Carniola and used a conventional sign for the cave, he used (or introduced) the term Dinaric Alps and he used strictly Slovenian place and topographical names.

His works, in particular *Oryctographia Carniolica*, prove that Balthasar Hacquet was an outstanding person in the field of karstology and speleology in general and especially in the field of geology, mineralogy, morphology and hydrology of karst in Carniola. Balthasar Hacquet helped greatly to develop modern views on nature and evolution of karst.

7. ACKNOWLEDGEMENT

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8. POVZETEK

Balthasar Hacquet – predhodnik sodobnega krasoslovja

Kot razsvetljenskega naravoslovca je Balthasarja Hacqueta narava zelo zanimala, posebej so ga privlačili še neraziskani pojavi. V njegovem času sta bila v srednji Evropi neznana in neraziskana poleg najvišjih delov visokogorij predvsem kraško podzemlje ter kraški svet sploh. Na Kranjskem je kras Hacqueta zanimal z vseh vidikov, tako zgradba in oblika površja (geologija, geomorfologija), kraške vode (prenikanje padavin, izviri, požiralniki, podzemeljske vodne zveze, poplave na kraških poljih, kvaliteta voda) in kraške jame. V njegovem času je bilo literature o krasu malo, starejša (npr. Valvasorjeva *Slava*) pa je bila daleč od tega, da bi kras razlagala ustrezno Hacquetovim razsvetljenskim in racionalističnim nazorom.

Hacquet je svoja spoznanja, odkritja in poizkuse vestno objavljal: njegova bibliografija obsega okoli 90 del, med njimi nad 10 knjig. O krasu na Kranjskem najdemo največ v njegovem najobsežnejšem delu *Oryctographia Carniolica* … (1778–1789), ki je izšlo v štirih zvezkih na skupno 623 straneh. Delo po današnjih merilih ni pregledno – ni podrobnejše razdelitve snovi, tematika ni zbrana –, ampak je napisano bolj v obliki popotnega dnevnika, kjer avtor sproti zapisuje in razlaga terenska opažanja in dosežke (spust v brezno v Sveti jami), opisuje in razlaga pojave (presihanje Cerkniškega jezera, razliko med raztapljanjem apnenca in dolomita ob obisku Podpeške jame), svetuje dodatne raziskave (analizo vode Timave glede vsebnosti živega srebra in drugih kovin) in polemizira z drugimi avtorji.

Ob raziskovanju krasa na Kranjskem je bil Hacquet marsikje prvopristopnik v kraškem podzemlju (dostop v Postojnsko jamo skozi suhi sifon), kot prvi je opisal marsikateri pojav in ga tudi skušal razložiti, zaradi česar ga je mogoče šteti za predhodnika teorij v zvezi z nastankom in razvojem krasa (raztapljanje oziroma korozija apnenca, selektivna korozija, odlaganje sige, poplave na kraških poljih, nastanek vrtač). Ker pa je bilo poznavanje narave in procesov v drugi polovici 18. stoletja daleč od današnjega, tudi Hacquetovih spoznanj ne smemo gledati preprosto z vidika današnjega znanja. V zvezi s krasom je treba upoštevati tudi njegova dognanja v geologiji. Posebej pomembno, a obenem najtežje, je vrednotenje Hacquetovih raziskav v zvezi z razpadanjem oziroma raztapljanjem apnenca. Tega se je lotil kot kemik, a ravno kemija je tista veda, ki je v zadnjih dveh stoletjih tako napredovala, da je morda razkorak med Hacquetovimi, v principu pravilnimi dognanji in njegovo teoretično razlago procesov največji.

Kljub temu, da je bil Hacquet rojen v Franciji, da je umrl na Dunaju in preživel na Kranjskem dobrih 20 let, se je štel za Kranjca, kar potrjujejo tudi njegove navedbe v delu *Oryctographia Carniolica* …

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