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A greeting from the President

For years now, we have been living in troubled times. Not only in Italy has the economic crisis conditioned social and development policies. And when the certainties which once existed seem to disappear, the reaction is often that of closing oneself, taking refuge in small things which are seen as being more reassuring. But those are reactions which contain the risk of us insulating ourselves from the knowledge of those who have other experiences.
Carrying these behaviours over to the speleological community, which is a metaphor and a mirror of society as a whole, the danger is that of losing chances for exchange and enrichment (cultural, social, scientific and relational).
Being involved in and practicing speleology can be done at many levels, both individual and collective, and it's nice to see that it is still possible to do so without much equipment or having to invest a lot. The important thing is to not lose sight of the fact that all this needs to be carried out in close cooperation with others, trying not to make one's own interests prevail, putting aside prejudices, frustrations, personal dislikes and easy criticisms of others' work. Often one forgets that the foundation of speleology is volunteer work, which thrives on sudden bouts of enthusiasm but often doesn't guarantee continuity.
With limited resources and growing difficulties, for over 60 years the Italian Speleological Society has been the reference national association of Italian speleology. For this reason, it has always been engaged in coordinating, promoting and developing synergies between all groups, speleological and otherwise.
For years the SSI has made efforts to guarantee contacts with other national and international organisations that have at heart the knowledge and preservation of the underground world, first among them the Italian Alpine Club. At the same time it is involved so that the importance of speleological activities becomes recognised at all levels, activities which cannot be separated from the involvement in the protection of caves. The latter is a task which sees us more and more involved in cooperation with other organisations involved in the defence of the quality of our natural and urban landscapes. However, at the same time we aim to protect speleologists so that they can continue to freely practice their activity, while respecting rules and laws.
We are naturally the debtors of many experiences, which you will find in this particular and special issue of Speleologia. A huge job, with many contributions and made possible by the editorial staff coordinated by Michele Sivelli, to whom I give my personal thanks.
I'll take the opportunity to send a greeting to Italian speleologists and to those who, from all over the world, will come together and be present at the 16th International Congress of Speleology at Brno. You have in your hands a synthesis of Italian speleology, a snapshot of current excellence, but also of odd differences. I hope that this is a stimulus to get to know us and exchange experiences at an international level, for the continued progress of speleological knowledge and spirit.

Giampietro Marchesi
President, Società Speleologica Italiana

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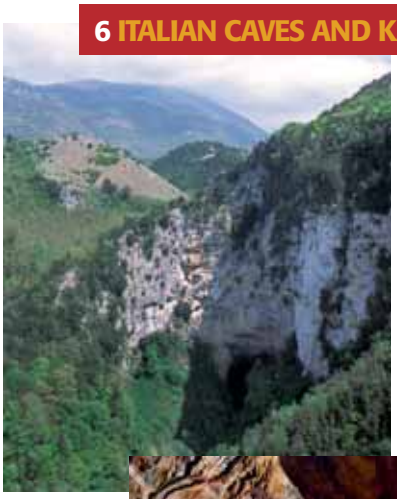

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Speleologia in Rete
Explore the online section of issue 68
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Cover photo: Caving. (Photo F. Grazioli)
Back cover: "*Chiare, fresche, dolci acque...*". (Photo V. Crobu)

Speleologia 68 present itself, the ideas go to the Congress!

*E tirato dalla mia bramosa voglia, vago di vedere la gran copia delle varie e strane forma fatte dalla artificiosa natura, raggiratomi alquanto infra gli ombrosi scogli, pervenni all'entrata di una gran caverna, dinanzi alla quale, restando alquanto stupefatto e ignorante di tal cosa, piegato le mie reni in arco, e ferma la mano stanca sopra il ginocchio, e colla destra mi feci tenebre alle abbassate e chiuse ciglia, e spesso piegandomi in qua e in là per veder dentro vi discernessi alcuna cosa, e questo vietatomi per la grande oscurità che là entro era. E stato alquanto, subito valsero in me due cose: paura e desiderio; paura per la minacciante e scura spelonca, desiderio per vedere se là entro fusse alcuna miracolosa**

Leonardo da Vinci, *Pensieri*

It's the first time that Speleologia has come out with an issue especially made for an international speleological congress.

For Italian speleologists, the pages that follow might not be especially new or innovative, but despite that, we are certain that even they can discover or rediscover things in this issue: oddities, information and facts which aren't very widespread.

On the other hand, the participants of the 16th International Congress of Speleology can enjoy a novel panorama of the Italian speleological movement. While it is certainly not exhaustive, this panorama is free from bias or membership loyalties.

To be honest, this initiative isn't completely original. Already in 1986, for the 9th International Congress in Barcelona, a booklet was published which was attached to Speleologia number 15, with the title "Caving in Italy". It was edited by Arrigo Cigna and had many similarities of content with the current issue.

But a lot of water has passed through caves since then; the world has changed and speleology with it. We therefore thought that the moment had come for the international speleological community to become better acquainted with the speleological news from our country. Among other things, we hope that this will inspire fellow speleologists to come visit us and to share activities, cultural exchanges and companionable moments.

About the contents of issue 68: what and why.

As mentioned, this is a snapshot of speleological Italy, in which some of the many peculiarities existing in Italy are presented in a general way by the best specialists in each field of research.

Furthermore, the karst phenomena of some of the major karst-speleological areas are described. However, this isn't a list ordered in order of importance. Actually, the choice of writing about some areas rather than others was based on the most recent and representative exploration results, as well as on scientific studies and researches carried out in an innovative fashion. Apart from these aspects, we have tried to cover the entire "boot", including karst areas from the North to the South of Italy.

Among these large speleological areas, some "small pearls" were found which are worth mentioning. Despite their small size when compared to other areas, they are producing exceptional scientific discoveries, thanks especially to the skills and abilities shown by those studying them. One example, the Monte Kronio cave complex near Sciacca in Sicily: an environment where, perhaps more than anywhere else in Italy, speleology has become truly multidisciplinary and where the exploration is facing unprecedented organisational and athletic problems. For the same reasons, we are also mentioning the small Grotta della Monaca in Calabria, perhaps the most ancient mine within a cave in Europe.

Also, the many research centres need to be mentioned, such as the Research Centre of Monte Cucco, which is in the forefront of its field internationally, or the scientific laboratories in Grotta Gigante or in Bossea, and many other examples which can be discovered or rediscovered while reading these pages.

The making of this issue hasn't been easy. As we progressed, we became ever more aware of the difficulty of choosing the subjects to be covered, since many were worthy of attention. However, we have tried to do this job in the most rational way possible, the result being the magazine you have in your hands. It is the fruit of many people's effort, who passionately gave their large or small contribution. All this makes us proud and also optimistic for the future of this magazine.

Enjoy reading.

The Editorial Staff

… with many apologies to those which we may have forgotten: the Editorial Staff invites you to a toast during the Casola 2013 Underground (October 30 - November 3)... To everyone, thanks again and see you at *Speleopolis*!

A special thanks to Jo De Waele, Paolo Forti, Leonardo Piccini e Francesco Grazioli, as well as Fabrizio Galluzzo and Marco Pantaloni of the *Istituto Superiore per la Protezione e la Ricerca Ambientale*.
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Note to the attached map

This special issue of *Speleologia* comes with a map of Italy in 1:1,500,000 scale. On a geological and cartographic base created and made available to us by ISPRA (who we thank for their extreme helpfulness and the collaboration we received), we have overlaid our country's karst phenomena. Within these, but not only, we've created an imaginary journey through speleological sites. It is evident that, given the limits of space and the wish to ensure a wide representation, the number and variety of the places chosen is limited. The map, or better, the journey we propose, is one of the many possible in our beautiful and fascinating peninsula.

** I, urged by my great desire and longing to see the blending of strange and various shapes made by creating nature, wandered for some time among the dark rocks, and came to the entrance of a great cave, in front of which I long stood in astonishment and ignorance of such a thing. I bent my back into an arch and rested my left hand on my knee, and with my right hand shaded my downcast eyes and contracted eyebrows. I bent down first on one side and then on the other to see whether I could perceive anything, but the thick darkness rendered this impossible; and after having remained there some time, two things arose within me, fear and desire; fear of the dark and threatening cave, desire to see whether there were anything marvellous within.*
Leonardo da Vinci, *Pensieri*

Italian caves and karst systems

A great natural theatre of hypogean differences

Leonardo Piccini, Jo De Waele

The Italian peninsula is characterised by great geological and morphological variety; this not only influences the many different landscapes, but is also reflected in the differences between caves and in the nature of the karst phenomena.

Most of Italy's carbonate rocks were formed along the European and African continental margins during the Mesozoic, during which huge deposits of limestones and dolostones were sedimented on the continental shelf. The Alpine orogenesis first, the Apennine one afterwards, lifted these carbonate series giving rise to elongated mountain ranges (the Alps and the Apennines). Besides these mostly marine deposits, there are also outcrops of coastal or even strictly continental carbonate rocks, such as the travertines, that are also often the subject of relevant karst processes. Karst phenomena are also well developed on both Triassic and Messinian evaporitic rocks (gypsum), these last related to the Messinian Salinity Crisis during which the Western Mediterranean almost completely dried out. These Messinian evaporites crop out especially in the Northern Apennines, in Calabria and in Sicily.

In the Alps, karstifiable rocks reach altitudes of up to 4000 m a.s.l., but most of the main karst systems are located at lower levels, with the recharge areas generally located at altitudes ranging between 1500 and 2500 m a.s.l. and characterised by mostly vertical active caves. The resurgences of these systems are generally found in the valley bottoms, often with horizontal, and sometimes well-developed, ac-

Mount Canin, located in the extreme eastern part of the Alpine chain, is composed of vaste high limestone plateaus hosting many karstic shafts. The entrances of extended cave systems reaching 1000 m depth on the Italian side, and over 1400 on the Slovene one, are found in the areas less covered with detritic materials. The picture shows Mount Canin seen from the Foran del Muss mountain trail. (Photo S. Sedran)

Right: the Oliero springs, in the valley of the River Brenta, are the access to one of the most extended submerged cave systems in Italy and in Europe. Cave divers have explored over 3500 metres of drowned passages that develop underneath the Asiago Plateau. (Photo M. Sivelli)

tive caves. Some of these springs have been explored by cave divers down to depths of 212 m (Gorgazzo) and 189 m (Elefante Bianco), with extensions of even more than 9 km (Oliero-Covol dei Veci-Covol dei Siori karst system, Veneto).

In general, the big alpine karst systems contain levels of palaeophreatic conduits suspended high above the present-day springs, probably related to past pre-Quaternary base levels (> 2My), but also active or semi-active epiphreatic cave levels connected to today's base level, created by the post-glacial aggradation of the major Alpine valley floors. Quaternary glaciation doesn't appear to have had a direct role in the formation of these alpine cave systems, which were certainly formed well before the onset of glaciation. The ice ages, instead, have surely had an important role in modifying the recharge areas, uncovering and eroding the epikarst caves, often filling them with glacial till and fluvioglacial sediments.

In the western sector of the Alps the major cave systems are located between the Ligurian and the Marittime Alps (Marguareis, Mongioie, etc.), in the central part limestones and dolostones crop out especially in the Prealps, divided in several sectors by the major Alpine valley incisions which are today partly occupied by large lakes. The Valle del Nosé karst system (development of over 61 km) and the Northern Grigna System, containing the deepest alpine cave (around -1190 m) belong to this central sector. In the eastern sector the major outcrops of carbonate rocks are located in the Dolomites, but no large cave systems

The Dolomites contains several large areas in which carbonate rocks outcrop, not only dolostones, but also extensively karstified limestones. Despite this no real big cave system have yet been discovered in this region, probably due to the widespread occurrence of glacial deposits that cover wide areas. In the picture the karst plain close to the mountain house of Brentei is shown (Brenta Dolomites, Trentino Alto Adige). (Photo D. Sighel)

The Venetian Prealps are entirely composed of carbonate units, often covered with less karstifiable rocks and with caves concentrated in only a few areas. One of these is the Corno d'Aquilio, close to which the famous Spluga della Preta Abyss opens, one of the deepest caves of the region. The picture shows the Lessini Mountains from the summit of the Corno d'Aquilio; to the right the Adige Valley can be seen, while Lake Garda is barely visible up right. (Photo U. Sauro)

are known there so far. The most important cave systems are, like in the central part of the Alps, found in the prealpine belt in Veneto (Piani Eterni, Lessini Mountains, Asiago plateau, etc.) and in the Julian Alps (Col delle Erbe cave system, Mount Canin).
The entire prealpine belt has many springs on the valley floors, mostly of the vauclusian type because of permeability barriers, and characterised by average flow rates of several cubic meters per second, due to the elevated hydrogeological fragmentation of the carbonate outcrops.
A different situation, at least in the Alpine context, is represented by the Karst of Trieste, a small part of what is known as the Classical Karst that extends mostly within Slovenia. From this area, as most cavers know, comes the word Karst itself, because of the characteristic morphologies of this geographic area. Especially the surface karst landforms are particularly well developed, with areas having extreme doline densities, while the most important caves are connected to the underground pathway of the famous Reka-Timavo river, swallowed at Skocjanske Jama in Slovenia and springing out along the coast at Aurisina, close to San Giovanni Duino, after having flowed 40 km (measured along a straight line) underground.
In the Apennines the situation is very different from the Alps and the most important cave systems are located in at least three completely diverse conditions.
The Apuan Alps (Tuscany), which despite their name are part of the Apennine chain, are a very special case. This karst area is home to the deepest Italian caves, despite its highest peaks hardly reaching 2000 m a.s.l.

Marguareis hosts the biggest cave system of the western Alps, which main entrance is the well-known Carsene of Piaggia Bella, a sinking stream that has been explored for over 50 years. (Photo B. Vigna)

The Central Apennines have impressive limestone ridges, but important karst systems are mostly lacking, except for some extensive hypogenic cave systems. The picture shows the Great Plain of Castelluccio di Norcia, a very large tectonic-karstic closed plateau, with Mount Velino in the background. (Photo M. Vianelli)

The cave systems are very similar to the Alpine ones from a morphological point of view, although they are slightly younger (Lower Quaternary) with the notable exception of the Monte Corchia cave system, which had already formed during the Middle-Late Pliocene. This cave is an exceptional example of a polyphase system with several levels, developed in an uplifting mountain with several stable periods which allowed the formation of very well developed epiphreatic cave levels.

The Northern Apennines, on the other hand, have only very limited karst areas, but its most southern parts, between Umbria and Marche, contain among the best studied hypogenic cave systems in Europe. The Monte Cucco cave system, for instance, is the deepest hypogenic cave in the world, while the Frasassi Cave is a well developed polyphase system formed in a rapidly uplifting tectonic context. Other important hypogenic caves of smaller size are known in Tuscany, such as the Giusti and Montecchia caves, in both of which the thermal water table can be reached, and more

The Bussento sinking stream, in Campania, is the most classical example of blind valley in the southern Apennines. Sometimes, during extreme floods, the cave is not able to swallow all the incoming waters and a temporary lake is formed, almost covering the entire entrance, up to 40 m high. (Photo M. Vianelli)

Maiella is composed of a long and impressive limestone ridge cut by deep canyons. The intense fracturing of the limestones and the deep weathering of the surface rocks by ice have produced wide and deep covers of detritic material that make the discovery of cave entrances rather difficult. This area is among the most promising ones of Italy for the possible discovery of extensive new cave systems, but at the moment only small caves are known. (Photo G. Antonini)

to the south the Cittareale cave in Latium and the caves of Rio Garrafo in the Marche. The Pozzo del Merro deserves a special mention: close to Rome, this submerged shaft has been explored by a Remote Operated Vehicle up to 310 m below the present sea level. The entire Northern Apennines only have springs of moderate flow rate, mostly around a few hunderds of litres per second, except for the Apuan Alps where at least three springs have flow rates greater than a cubic metre per second.

The Central-Southern Apennines are characterised by great limestone ridges that almost reach 3000 m a.s.l. and with a vertical potential over 2000 metres. In some cases though, the intense tectonics, manifested by the widespread presence of fractures, the recent and rapid uplift and the time needed for the removal through erosion of the clastic deposits that generally cover the sediments of carbonate platforms, did not allow the formation of great subterranean karst systems. In fact, in this area the caves of a significant development and depth are localised in very well-defined areas, where the local geological and structural conditions have allowed for the formation of easily accessible karst systems. Among these areas we can recall the Lepini and Simbruini mountains (Latium), the Matese chain (Campania-Molise) and the Al-

Apulia is almost entirely composed of a vaste limestone platform surrounded by the sea. While the inland areas are characterised by plateaus with impressive collapse dolines (the so-called "gravine"), the coast is dotted with submarine caves, many of which have evidences of sea level changes. The picture shows Polignano village, built on top of deeply karstified limestones forming vertical cliffs. (Photo M. Parise)

For what concerns the karst landforms, Sicily is one of the richest in gypsum areas, where surface rivers enter at the bottom of blind valleys in through caves, many of which have extremely well-developed morphologies. The picture shows the Sant'Angelo Muxaro blind valley, Agrigento. (Photo M. Vattano).

burni mountains (Campania). However, the Central Apennines host the largest karst springs in Italy, having flow rates even greater than 10 cubic metres per second, characterised by a very regular hydrodynamics. This is due to the lack of a well organised and highly transmissive karstic drainage system, and thus of well developed cave systems. It is worth mentioning that, still in this sector of the Apennines, there are several cave systems that have recharge areas outside of the karst (allogenic), feeding sometimes very spectacular resurgences, such as the Rio Bussento. Apulia is mostly composed of carbonate rocks and is the only region that hasn't been directly involved in the Alpine and Apennine orogenesis. Karst phenomena are very well developed here, especially through large and widespread surface landforms (collapse dolines), however caves, although numerous, have rather limited extensions, mainly due to frequent infillings which interrupt their extension.

Sardinia deserves a special mention, both for the beauty of its caves and for having some of the largest cave systems in Italy, including the one that feeds the Su Gologone spring. Also, in the South-western part of the island the Cambrian carbonate rocks crop out, being the oldest sedimentary rocks in Italy, and these host some important caves of great mineralogical interest.

Italy, surrounded by the sea on three sides (Tyrrhenian, Ionian and Adriatic Seas), and its islands are characterised by long limestone coastlines that sometimes form high cliffs. In these coastal karst areas some very important cave systems have formed, and these are often partly or entirely submerged. The speleothems that decorate these marine caves up to a depth of more than 50 metres, record the changing sea level over the past 200 thousand years and more. The most interesting of these coastal karst areas are the Gulf of Orosei and Alghero in Sardinia, South Tuscany (Argentario), the Salento coastline and San Vito lo Capo in Sicily.

Regarding gypsum karsts, the main caves are situated on the Po Plain margin in the Northern Apennines, between Modena and Forlí, and in Sicily.

The first caves are mostly through caves, often with a still active stream inside, sometimes developed on several levels related to the changes in base level due to the glaciations and to the different supply of sediments from the Apennine rivers.

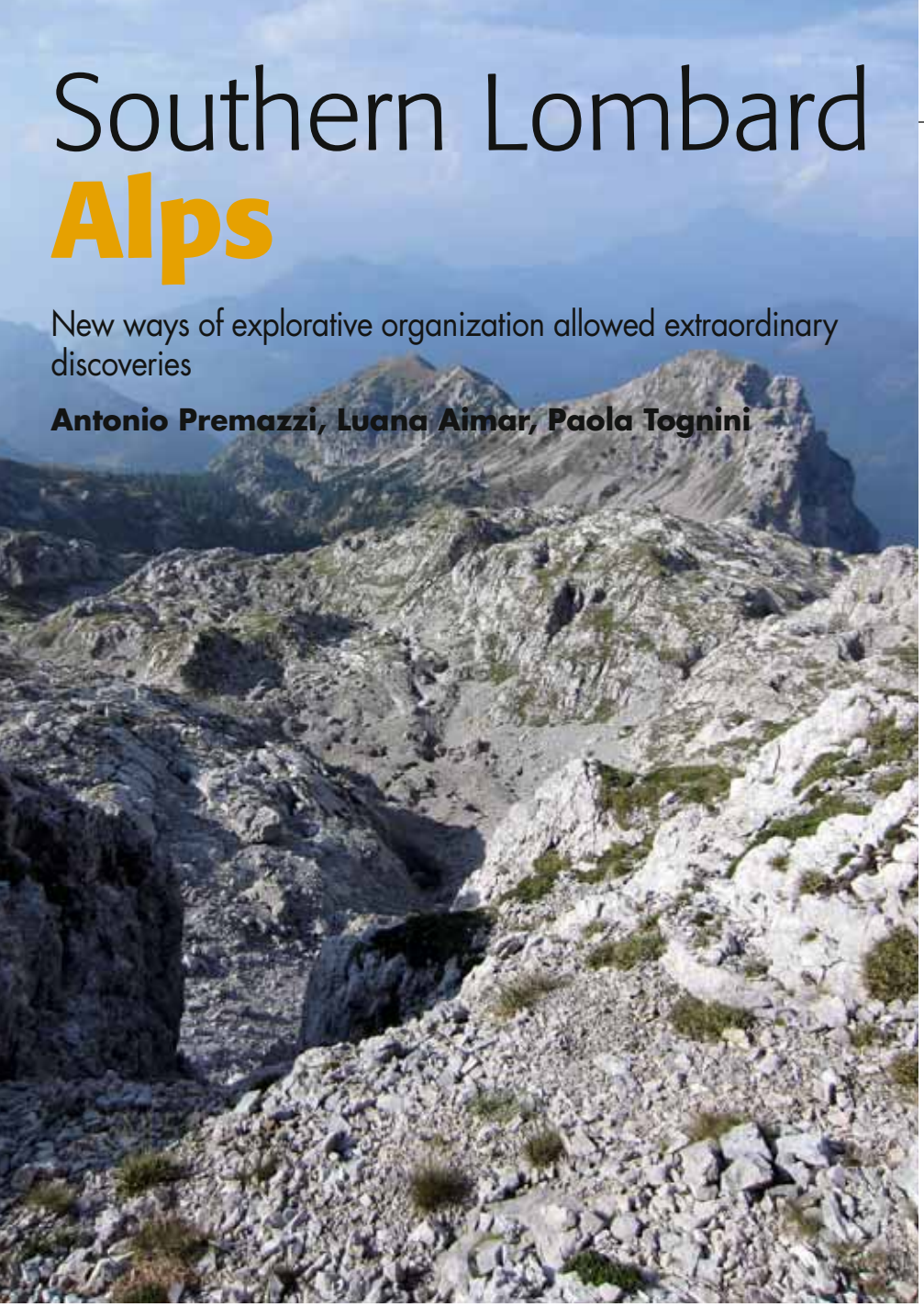
It is worth mentioning that in Sicily there are caves which are created by processes very different from the karstic ones. Mount Etna, the largest active volcano in Europe, hosts several extended lava tube cave systems, which are still formed every time the volcano spills out its lava flows. ■

Although not formed by typical karst processes, Sicily is also known for the presence of very well developed lava tube cave systems, on the borders of Mount Etna, the biggest active volcano in Europe. (Photo G. Giudice)

Southern Lombard Alps

New ways of explorative organization allowed extraordinary discoveries

Antonio Premazzi, Luana Aimar, Paola Tognini



The sedimentary rocks affected by karst processes described in this paper are spread over less than 14 % of the land in Lombardy and are mainly concentrated in the Southern Alps, or Pre-alpine belt.
Here speleologists have explored most of the approximately 4200 caves which are currently recorded in this region of Northern Italy.
Although these karst areas have been studied for decades, in the last ten years several explorations have been carried out, whose results have sometimes vastly exceeded all expectations. In this short time span, over 120 km of underground voids have in fact been explored.
This exploring liveliness has been possible thanks to a dense cooperation network between caving groups, which on the one hand gave life to a common representative organisation, on the other hand created new entities arising from the necessity of sharing specific projects, knowledge, equipment and expertise concerning specific karst areas.
The Lombard Speleological Organisation (Ente Speleologico Lombardo), which was the original representative body of some regional caving associations, has been replaced by the Lombard Speleological Federation (Federazione Speleologica Lombarda - FSLo), with the aim of gathering

LOMBARDIA

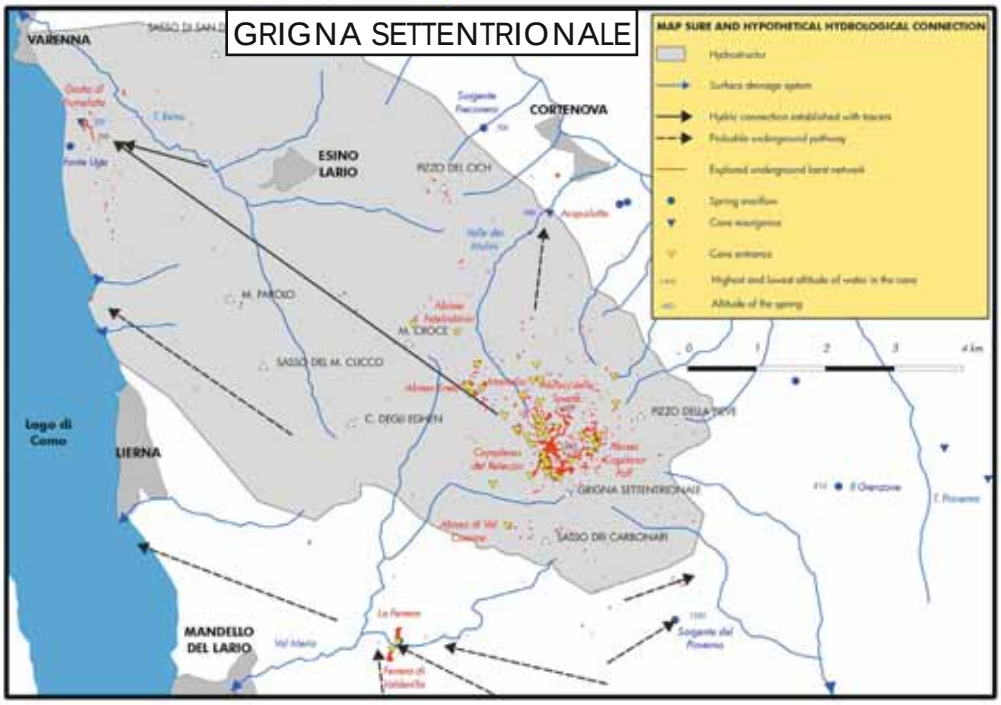
ID CARD – NORTHERN GRIGNA

Name and surname: Grigna Settentrionale karst; Grignone cave system
Location: Lombardy, Province of Lecco, in the area of the municipalities of Mandello del Lario and Esino Lario
Exploration start date: 1984
Height: –1190 m, with a vertical karst potential of 2200 m, from the peak of Grigna Settentrionale (2410 m asl) till the level of Lake Como
Length: > 22 km, with 12 different accesses; in the area there are more than 600 caves, all mainly developing vertically
Lithology type: Esino limestone, limestones and Triassic dolomite limestone (Ladinian)
Geological structure: syncline fold in a system of thrust sheet
Destination: a water tracing carried out in the Abisso W le Donne in 1989 proved the connection with Fiumelatte cave-spring, located a little bit above the level of Lake Como (325m asl): in this cave the latest cave diving explorations reached the depth of 90m, very close to the level of the lake
Specific marks: one of the three largest karst systems of Prealpi lombarde and the deepest in Lombardy, and one of the deepest systems in Italy
Date of origin: the current karst started developing between the end of Oligocene and beginning of Miocene, but some remains of hypogean cavities have been found, linked to the phases of the Alpine orogeny.

Although the Southern Alps are homogeneous from a geographical point of view, the geological evolution cut this area into several portions having very different features.
The picture shows a view of the Northern face of Grignone (Northern Grigna). Even if it is not very high (the maximum altitude slightly exceeds 2400 m a.s.l.), this area exhibits typical high mountain karst features. Vegetation is scarce and many surface karst features are visible, such as dolines and *karren*, with a very high density of cave entrances (often vertical open-pit shafts), mainly in the highest portion of the mountain.
The karst system is mostly vertical, the commonest forms being waterfall shafts (often very large and deep) connected by meandering passages. Some of the caves are quite deep, but only the deepest passages of the Grignone karst system, on the bottom of Abisso W le Donne, have a different morphology, becoming a complex system of mainly horizontal fossil galleries and active meandering passages.
Presently nothing is known about the flow path of water from the bottom of W le Donne to the Fiumelatte spring (the connection between the two was nevertheless proven by a dye tracing test in 1989), but explorations which took place last winter might write a new chapter in the exploration history of the mountain. (Photo D. Corengia)

Despite having a long speleological tradition and many karst areas, Lombardy is still one of the few Italian regions which does not yet have a regional regulation about caving activity. Nevertheless, in 2010 the Lombard Regional Authority assigned the FSLo a project about regional karst areas, called "Osservatorio delle Aree Carsiche Lombarde" (Lombard Karst Areas Observatory). Divided into three different parts, this project made it possible to create an atlas of the main karst areas, together with specific researches on the supply basin of the River Olona and on the underground drainage system of the Western Sebino area. The picture shows the introduction of dye during a dye tracing test in Bueno Fonteno cave. (Photo M. Brega)

together all interested parties in the region and to be a single and qualified interlocutor with public bodies and local governments.
The first example of cooperation was the InGrigna! Project, born over ten years ago. Created with the goal of sharing the exploration of the numerous caves in the Northern Grigna massif (Lecco Province), it soon also extended its working range to other nearby karst areas, mainly to the



As can be easily seen in the picture, known underground voids are mainly found in the highest portion of the mountain. Presently over 600 caves are known, with a total length exceeding 50 km of cave passages, 25 of which have been explored over the last 10 years.
(Plan M. Merazzi 2013)

Speleologia in Rete
Go to the Lombard Prealps photo gallery
http://tinyurl.com/68-prealpi-lombarde

Speleologia in Rete
Watch the video of the In-Grigna explorations
http://tinyurl.com/68-grigna

The structure of the karst system is deeply characterised by a large syncline fold, with a WNW-ESE axis dipping to the West. Underground features are also influenced by the geological structure, with many galleries developing along bedding planes. In the picture, the Frenesia branch in the Valle del Nosè karst system. (Photo M. Inglese)

Speleologia in Rete

Watch the video of the Tivano explorations
http://tinyurl.com/68-tivano

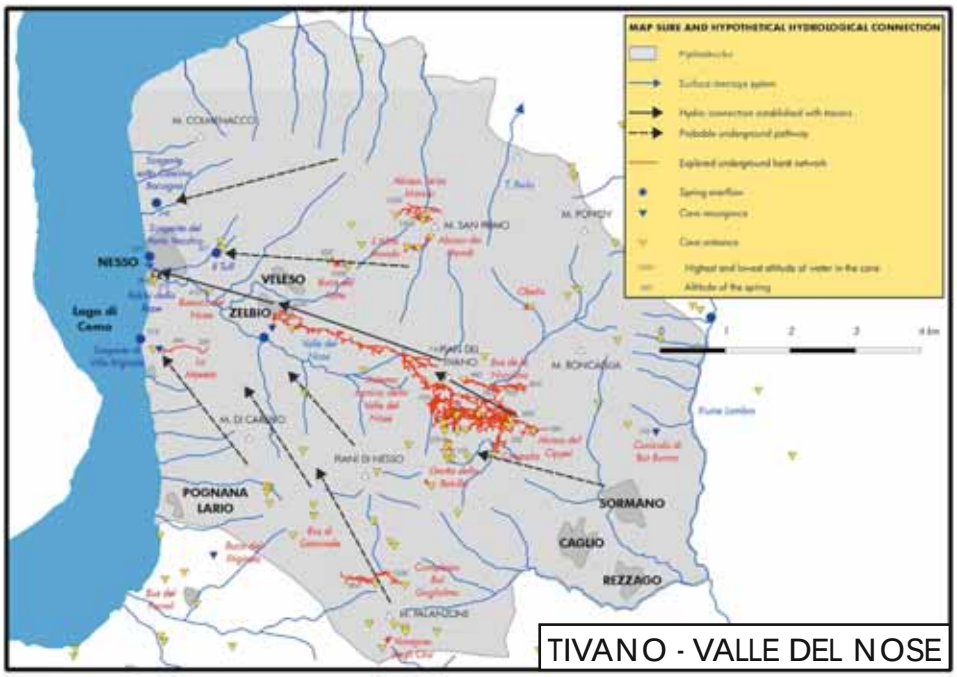
and the video of the Sebino Exploration Project
http://tinyurl.com/68-progetto-sebino

ID CARD - TIVANO VALLE DEL NOSE

Name and surname: Valle del Nosê cave system (caves: Ingresso Fornitori, Abisso presso la Capanna Stoppani, Tacchi Zelbio, Aurora); Pian of Tivano-Nosê valley karst area
Location: Lombardy, Province of Como, in an area known as Triangolo Lariano
Exploration start date: '30s
Height: – 440 m, with a karst potential of 1400 m, from the peak of Mount San Primo (1686 m asl) till the Lake Como level (200 m asl), with potential flooded areas below the lake's level
Length: 61 km, still being explored, other cavities are present in the areas (around 50), for a total development of more than 80 km
Lithology type: Moltrasio limestone, siliceous marly limestones (Jurassic: early Lias)
Geological structure: syncline fold
Destination: water tracing proved a connection of the main system with Falchi della Rupe springs (Nesso – 300 m asl)
Specific marks: it is currently the karst system with the greatest verified planimetric length in Italy; it develops almost entirely within the southern side of a great syncline fold, therefore its explorative potential is still very high
Date of origin: the genesis of the system took place with the uplifting of the area above sea level, between the end of Oligocene and beginning of Miocene.

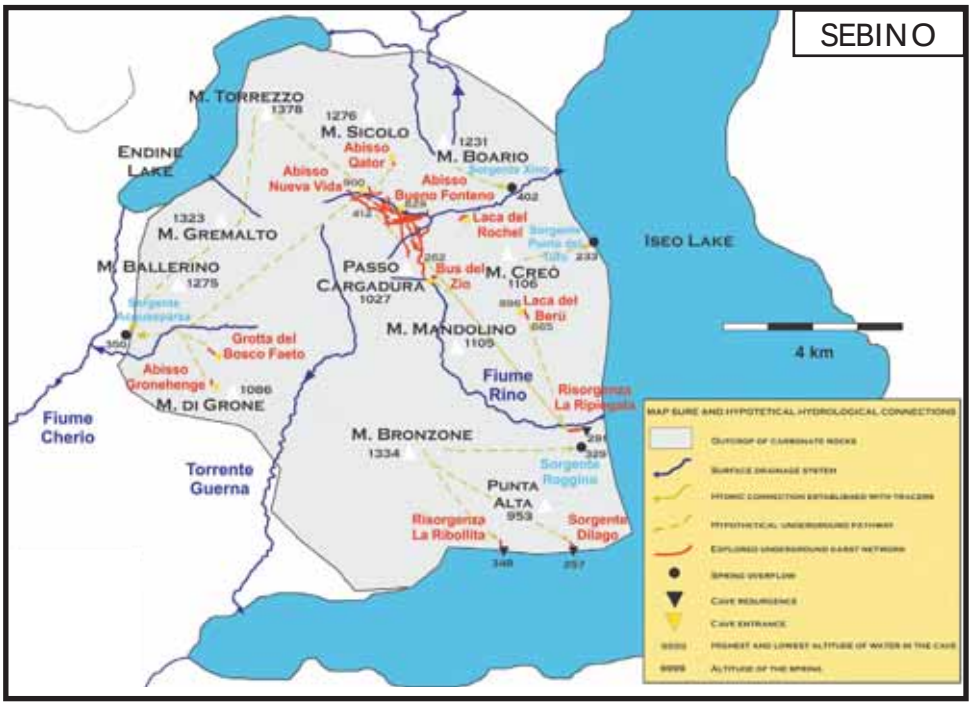
Pian del Tivano (Como Province). This informal association increased the number of its members over the last years and is starting to become international with the participation of several Polish cavers.
In 2006, the Sebino Project was created by four local caving associations who wanted to combine their forces to study and explore an area

In the Pian del Tivano-M. San Primo area, over 50 km of cave passages have been explored in the last 10 years, adding to the dozens already known. Explorations reached their climax in February 2012, with the connection of the Tacchi-Zelbio cave system to the Ingresso Fornitori-Stoppani one, thus creating the Valle del Nosê karst system, with a surveyed length exceeding 60 km. Possibilities for new explorations are still many: in particular, the northernmost portion of the area, along the Mt. San Primo ridge, is still poorly known. (Plan M. Merazzi 2013)



ID CARD - SEBINO

Name and Surname: Abisso Bueno Fonteno pothole; Sebino Occidentale karst area
Location: Lombardy, Sebino occidentale, province of Bergamo, municipality of Fonteno; area between Val Cavallina and Lake Iseo (Bergamo side)
Exploration start date: 2006
Height: –475 m, with a karst potential of 1200 m, from the peak of Mount Torrezzo (1378 m asl) till the level of Lake Iseo (180 m)
Length: > 22 km, still being explored, the Abisso Bueno Fonteno is among the three longest systems of the region. In the area other 130 caves are known
Lithology type: Moltrasio limestone, Domaro limestone: siliceous marly limestones (Early Lias)
Geological structure: syncline fold
Destination: water tracing verified the connection between Abisso Bueno Fonteno (access height 775 m asl) with Milesi spring, in Tavernola Bergamasca (300 m asl); but there are most probably other springs below Lake Iseo's level (180 m asl)
Specific marks: one of the largest karst systems of Prealpi lombarde, with a high explorative potential; the system stands out among Lombardy's caves for its dimensions and complexity. The recent discovery of another great cave (Nueva Vida) presumes the existence of a very complex and largely developed karst system
Date of origin: as all systems in Prealpi lombarde, the genesis of the system started with the uplift of the area, between the end of Oligocene and beginning of Miocene.



Western Sebino has an area of about 100 km^2 and is characterized by reliefs whose maximum height does not exceed 1400 m a.s.l.. Until 2006, this area was considered to not be very important from a speleological point of view, since less than 3 km of underground passages were known. In the last few years, over 25 km of new passages have been discovered, mainly concentrated in the Bueno Fonteno and Vida Nueva caves. This is however only the starting point for speleological research in this area, whose hydro geologic structure still needs to be investigated. (Plan M. Pozzo and F. Gatti 2013)

The underground passages of the Western Sebino caves are mainly very large active canyons cut by deep shafts. Passages are often surprisingly large, if compared to average passage sizes in other Pre-alpine caves. The structure of the explored caves is influenced by a large km-scale syncline fold and by some important faults. In the picture, the Portorotondo Hall in Bueno Fonteno cave. (Photo M. Brega)

(the Western Sebino, Bergamo Province) which was lacking in caves until that time. The newborn association was soon rewarded by the discovery of Bueno Fonteno, a very complex cave with a high karst potential: its exploration surely furthered the consolidation of the association. The Sebino Project pays much attention to communication and relations with local authorities and governments, for whom it has become an important reference point.
Besides the two examples mentioned, cooperation between groups also exists in other parts of the region, such as in Campo dei Fiori (Varese Province) and Mt. Arera (Bergamo Province), showing that "transversal" speleology is becoming more rooted. ■

Piani Eterni

An exploration which is continuous evolution of acquired knowledge

edited by Marco Salogni and Francesco Sauro

The Piani Eterni lie within the Dolomiti Bellunesi National Park and are additionally contained within an integral nature reserve, so access and any type of activity requires specific permits. In the last twenty years, the outstanding natural qualities of this area, which has an area of 8 km^2 situated between 1700 and 2100 m a.s.l., have been further enriched by impressive speleological explorations which are still underway.

The first surveys in the 1980s led to the discovery of a great number of entrances, though they were only cavities having limited extensions (more than 400 cavities are registered in the 13 areas involved in the research). 1989 was a decisive year for the explorations thanks to the discovery of 2 entrances, PE10 and V35, which gave access to the under-

ID CARD

Name and Surname: PE 10, PE 25, PE 3, V 35, PE 130, Isabella Cave; Piani Eterni System
Exploration start date: 6 August 1989
Height: –971 meters, but with a growth potential of -1300 and more
Length: 34 km, with still high explorative potential
Location: Veneto, Province of Belluno, Alpi Feltrine, municipality of San Gregorio delle Alpi, Sospirolo and Cesiomaggiore, located in a fully protected reserve zone of the National Park of Dolomiti Bellunesi
Lithology type: mainly dolomitised limestone and limestones only in the first 200 meters of depth
Destination: while no water tracing have been carried out, three main springs are considered as possible exits of the system: Fontanon de la Stua (540 m asl), Bus del Caoron (730 m asl), and San Vettore Veses (495 asl)
Specific marks: one of the largest karst systems of the Alps, mainly developed in dolomitic lithologies
Date of origin: the U-Th dating of a stalagmite indicated an age of 365ka, but probably the upper phreatic galleries of the system are older than 1 million years.

Piani Eterni are located in an integral nature reserve, which is part of the Parco Nazionale Dolomiti Bellunesi. Over 400 cavities have been recorded in the area. In the photograph: the Dolina Bianca basin, where the most important entrances of the karst system are located (PE10-V35), its dominating feature being a fault which crosses the dolomitised formations of the *Calcari Grigi* and the *Dolomia Principale*. In the background is the peak of Mt. Pizzocco, the direction in which the most recent explorations of the deep paleophreatic network head towards. (Photo M. Salogni)

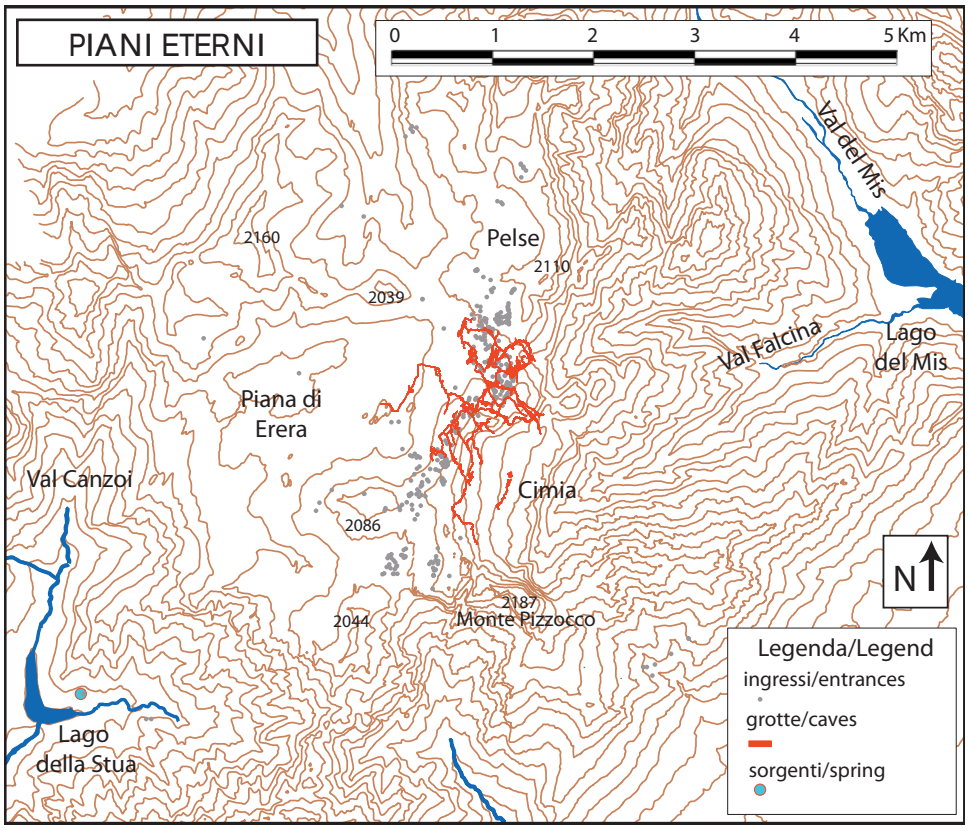
Speleologia in Rete

Go to the Piani Eterni photo gallery
http://tinyurl.com/68-piani-eterni

lying karst system. In 1993 these two abysses were joined at -450 m and that same year PE10's fossil bottom was reached at -971 m.
Then in 2005, with the discovery of major horizontal branches, the complex reached a length of 12 km.
A turning point in the complex's exploration occurred in 2007, thanks to the discovery of a large paleophreatic level at -550 m. This led to the exploration of several kilometres of conduits which had formed within a particular lithology: the bituminous unit.
Of great significance was also the conjunction with the Grotta Isabella, a cavity located on the steep rocky slopes to the northeast of Pian di Cimia.
This conjunction now allows a spectacular traverse (about 6 km long and

In the first metres of the Piani Eterni abysses, one meets massive ice deposits which sometimes completely block the access to the cavities, as in the case of the Abisso Scomparso (Disappeared Abyss) which remained inaccessible after its first exploration in 1993. In recent years, the ice has retreated again, allowing explorations to reach -153 in environments characterised by spectacular ice formations. (Photo F. Sauro)

The Erera Plain, location of Casera Erera and Casera Brendol, is the most extended of the glaciokarst basins which characterise the area. During the thaws of the Col del Demonio and Passo dell'Omo peaks which rise above it, a large torrent descends and, after having crossed the alluvial cone, it gets completely absorbed by a series of impassable fractures and sinkholes. In the foreground is the Sella del Colsento, while in the background are the Pale di San Martino. (Photo M. Salogni)



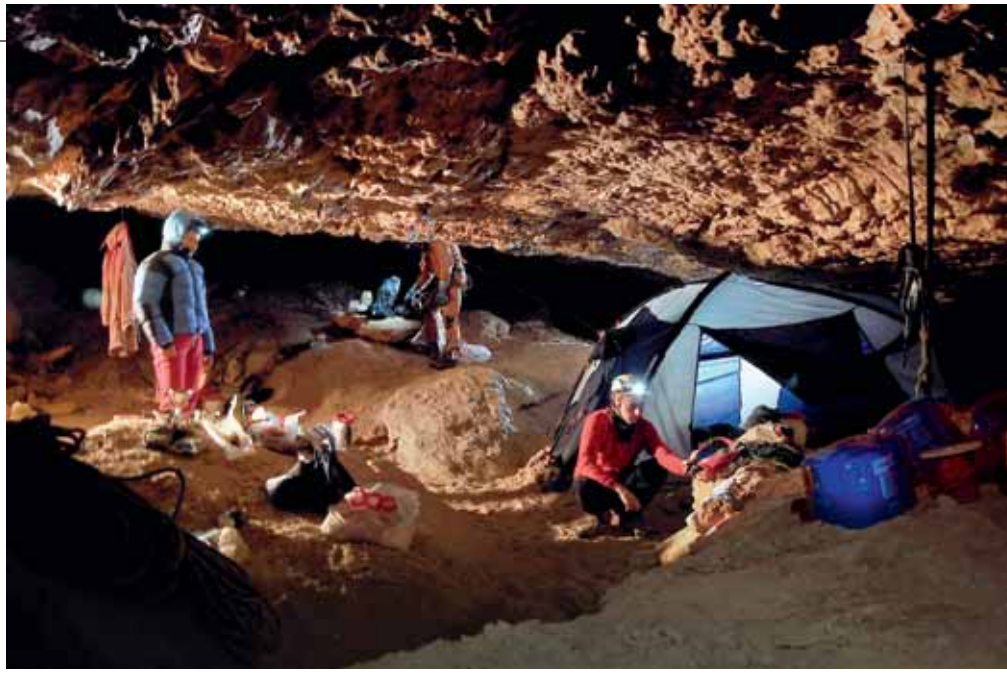
almost 700 m accumulated elevation difference).

Also very significant are the recent discoveries in the most remote parts of the system, those which follow the Creste di Cimia ridge to the south-west (Samarcanda Branch).

This part of the complex seems to offer the promise of a conjunction with two other recently discovered cavities (the F&F cave; -90 m with 800 m length and Bluette; -70 with 500 m length, both characterised by large paleophreatic galleries). Another remote part of the complex needs to be remembered, an area called "Bimbi Sperduti" (Lost Children), whose parts under exploration are reached after 12 hours of progression and is currently 911 m deep. It then moves on towards the West, under the external areas of Piazzole and Piana di Erera.

During the course of the explora-

tions, scientific research in cooperation with the Park were carried out on karstic dissolution, on the lithologic-structural controls in speleogenisis and, especially, on the biological ecosystem (Progetto Biodiversity Hotspot), which has led to the discovery of 3 new species of copepods and a new species of annelid, *Rhyacodriloides aeternorum*, belonging to an ancient pre-quaternary genus found exclusively in this cave and in the depths of Lake Baikal in Siberia.
The complex is currently 34 km long, with branches extending in all directions. Current explorations are very strenuous (4 to 7 days inside the cave are needed in order to explore the more remote parts), so the need to find new alternative entrances, which would shorten the path within, will certainly be one of the main research goals in the next years. ■

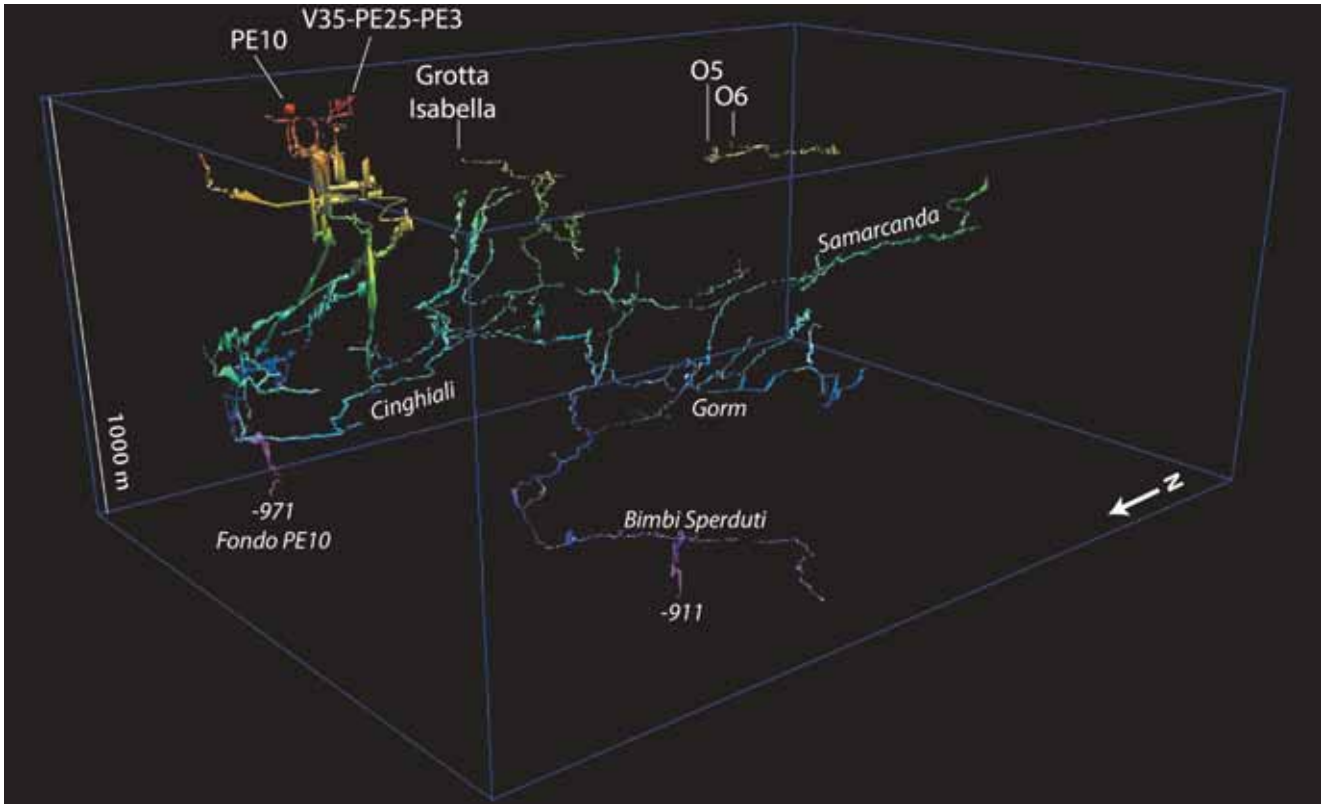


The Locanda dei Bucanieri ("Buccaneer's Inn"), the camp located at -550 m in the heart of the deep paleophreatic network. It's the logistic base of the current explorations. By now explorations in these parts of the cave require stays of 5-7 days underground. The camp is about 6-8 hours from the PE10 entrance, while the current exploration limits (Samarcanda, Bimbi Sperduti) require a further 7 hours of progression from the internal camp to be reached. (Photo F. Sauro)

A fossil conduit in the deep paleophreatic network. This sector of the cave is characterised by the stratigraphic arrangement of a formation of bituminous dolomites, together with the progressive lowering of the water table, step by step, to different levels. The final result is a network of conduits at different levels, connected by gorges and canyons formed successively under a vadose regime. The stalagmites which formed after the disappearance of the phreatic waters have been dated back to over 365 thousand years. (Photo F. Sauro)

The explorations which took place in 2012-2013 have led to the discovery of a new sector of the system, called "Samarcanda". Here a large stream was found, which was followed up through large galleries almost to the cliffs of Monte Pizzocco. Towards the valley, the stream dives into a series of yet unexplored shafts. It takes over 7 hours of progression from the internal camp to reach this area, through low galleries and a narrow section half a kilometre long.
(Photo F. Sauro)

The 3D model of the karst system, created with Compass Cave software. In the last decade, explorations in Piani Eterni are planned by analysing the 3D model. The areas to be explored are chosen depending on the possibilities of them intercepting known gallery levels or heading out towards the slopes of Pian di Cimia.



References

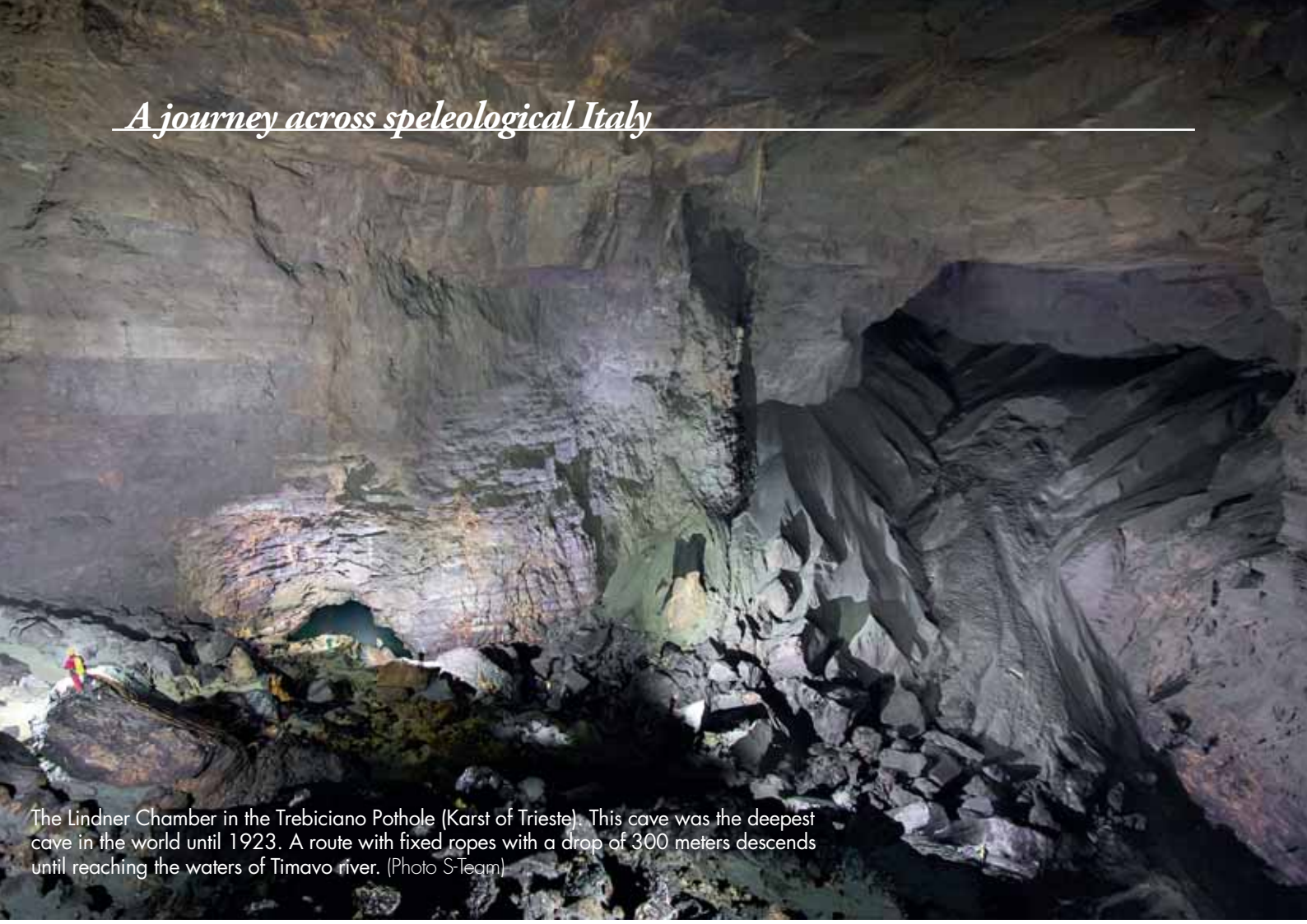
Ferrarese G., Zoppello C., Salogni M. (2006): Il fascino discreto dei Piani Eterni. *Speleologia*, n.53, p. 14-33.

Salogni M. (a cura di) (2004): *Le Grotte dei Piani Eterni*. Gruppo Speleologico Valdobbiadene, Gruppo Speleologico CAI Feltre, Agorà libreria editrice: 168 p.

Sambugar B. (2010): La fauna acquatica delle grotte del complesso dei Piani Eterni e Isabella nel Parco nazionale Dolomiti Bellunesi. *Rapporti*, n°7 del Parco Nazionale Dolomiti Bellunesi, p. 7-32.

Sauro F., Zampieri D., Filipponi M. (2012): Development of a deep karst system within a transpressional structure of the Dolomites in north-east Italy. *Geomorphology*, http://dx.doi.org/10.1016/j.geomorph.2012.11.014.

Sauro F., Zampieri D., Filipponi M. (2011): Analisi morfologica di sistemi carsici tramite software di elaborazione 3D: il caso dei Piani Eterni nel Parco Nazionale Dolomiti Bellunesi, Veneto, Italia. In: Atti del XXI Congresso Nazionale di Speleologia, Trieste, 2011, in stampa.



The Lindner Chamber in the Trebiciano Pothole (Karst of Trieste). This cave was the deepest cave in the world until 1923. A route with fixed ropes with a drop of 300 meters descends until reaching the waters of Timavo river. (Photo S-Team)

Monte Canin (Friuli Venezia Giulia), entrance of Boegan pothole. (Photo S. Sedran)

Monte Corchia

The complexities and results of exploring a labyrinthine system

Leonardo Piccini

The Monte Corchia Karst system is one of the largest karst systems in Europe.
Its developed section is about 58 km, to which at least 4-5 km of explored, but not yet mapped, secondary branches should be added. The height difference between the upper entrance and the bottom is 1187 metres.
The main particularity of this large underground system isn't it size, but rather its extreme morphological complexity, which makes it unique among the known underground caverns in Italy.
The explorative history of this underground system began in 1840, with the discovery of the first entrance,

Speleologia in Rete
Explore the Corchia through the photo gallery
http://tinyurl.com/68-corchia

ID CARD

Nome and Surname: Mount Corchia cave system; Alpi Apuane
Exploration start date: 1840
Height: –1187 m, with a potential of about 1500 m
Length: 57 km (official data - May 2013), with several new ramifications currently being surveyed; estimated development of more than 63 km
Location: Tuscany, Province of Lucca, Municipality of Stazzema
Lithology type: mainly dolomites (Grezzoni – Trias: Norian) and then marbles, dolomitic marbles and metamorphic siliceous limestones (Jurassic: Rhaetian – Early Lias)
Geological structure: multiphase reverse syncline fold
Destination: water tracing showed a fast connection with the Fontanacce springs, in Ponte Stazzemese (176 m asl)
Specific marks: it is a very complex system morphologically, with an evolution characterized by phases of different hydrodynamic regimes, it currently counts with17 accesses
Date of origin: it is most probably the oldest cave of the Alpi Apuane, developed in the first phases of uncovering of the metamorphic nucleus, starting from the end of Pliocene and beginning of Quaternary (3-2,5 million years), that potentially makes it the oldest karst system of the Appennine chain.

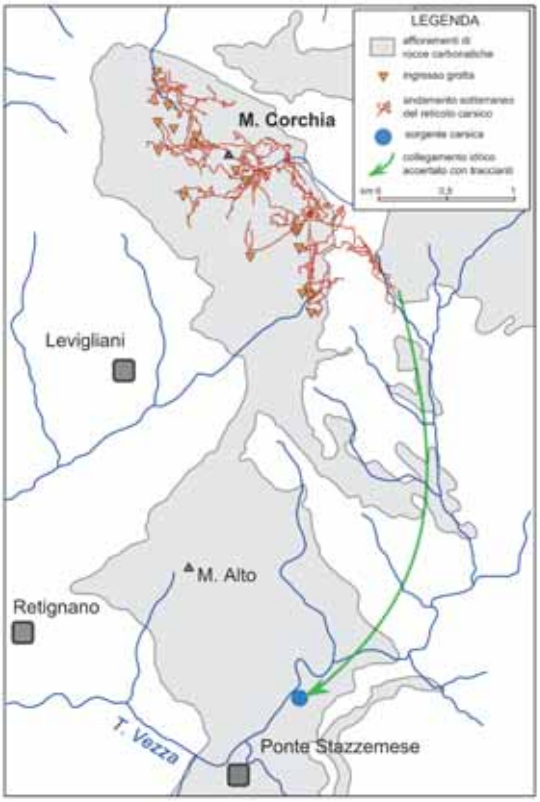
Mt. Corchia is composed of a Mesozoic metamorphic carbonate sequence that lies on a Paleozoic basement of impermeable rocks (phyllites). The carbonate sequence consists of Carnic dolostones (Grezzoni) followed by the famous Apuan marbles and by cherty meta-limestones a few dozen meters thick. In the picture to the left, the dolomitic "towers" of Mt. Corchia, north slope. (Photo L. Piccini)

The exploration history of Corchia spans over 170 years and is very eventful. The first descents carried out by the Gruppo Speleologico Fiorentino in the thirties were a true exploit at that time, as in 1934 the Florentine cavers reached 520 m depth,
a level surpassed only over 30 years later by cavers from Triest, Bologna and Milan. But it was between the middle of the seventies and the middle of the eighties that the Corchia experienced a period of intense explorations which in a few years would increase the total length of the cave from 5 to 50 km.
In the picture, the Pozzacchione during an exploration in the sixties.
(Photo F. Salvatici by "L'Antro del Corchia" F. Utili ed.)

starting a series of events which have become part of speleological history in Italy and beyond.
After the explorations by Florentine speleologists in 1930-34, which for a few years made it the deepest cave in the world, the bottom was finally reached in 1960 by speleologists from Bologna and Milan. But it's the end of the 1970s which witnessed the start of a great exploration saga which included speleologists from all over Italy and involved other caves in the area.
Also from this aspect it's unique in Italy, where explorations of karst complexes are normally the domain of just a few groups.
"The Corchia" can be considered "Italy's Cave", the symbol of Italian speleology.
Corchia was the main birthplace of the explorative mindset which today lets us see caves as complicated three-dimensional systems, where explorations are guided by air currents, where traversing pits rather than descending them was learned and where climbing – exploring caves from the bottom up – began.
At least a third of Corchia's 60 km were explored by climbing up.
Also at the scientific level Corchia has several particularities.
After the explorative frenzy of the 1980s, a research project began which still involves Tuscan speleologists and various research bodies, mainly the Universities of Florence and Pisa, the Regional Agency for the Environment (Agenzia Regionale per l'Ambiente - ARPAT), the Institute of Geological Sciences and

The Mt. Corchia cave system consists of a tri-dimensional network, half of which are phreatic and epiphreatic conduits, locally heavily incised by open-air water flow. The water flowing through this system today flows toward the Vezza valley and out-flows at the Fontanaccio spring, close to Ponte Stazzemese.

Around 1400 m a.s.l. is an old and well-developed level of phreatic conduits, the morphology of which indicates a high discharge coming from surrounding areas. The allogenic feeding is demonstrated by the presence of pebbles composed of non-metamorphic sandstone. Fighierà, main gallery. (Photo L. Piccini)



Resources (Istituto di Geoscienze e Georisorse - IGG) of the National Research Council (CNR) of Pisa and the National Institute of Geophysics and Volcanology (Istituto Nazionale di Geofisica e Vulcanologia).
The project aims to study the structural-geological and geomorphologic aspects of the system, as well as carrying out meteorological and environmental monitoring.

Above: Around 900 m a.s.l. are some of Corchia's most beautiful galleries, decorated with very nice stalagmites and stalactites. Galleria dei Lucchesi. (Photo R.Cagnoni)

The medial sector (1000-1200 m a.s.l.) of the cave system consists of a vast and labyrinthic system of phreatic and epiphreatic conduits, showing several superimposed evolutionary phases., This level is probably evidence of a long period of base level standing which precedes the main uplift phase of the Apuan ridge.
Below: Abisso Farolfi, towards the Erika base camp. (Photo A. N. Palmer)

At the same time, a large research project on speleothems started, which also involves many foreign researchers and whose results have now reached a scientific relevance of international level.
Finally, in 2010, a project started to revise the topographical survey of the cave, sponsored by the Tuscan Speleological Federation (Federazione Speleologica Toscana), aimed at creating a new detailed vector map and the construction of a three-dimensional digital model.
Despite over 170 of research, this system still continues to reward its explorers and could potentially contain some big surprises, as the distance between the current bottom and the resurgences is 200 metres elevation and over 3 kilometres distance. ■

A large part of the Corchia cave system develops in dolostones. Percolation waters are enriched with magnesium so, where conditions are favourable, very nice aragonite helictites are formed.
Next page below: the Galleria Formentini, only discovered in 2008. (Photo R. Cagnoni)

The main stream in Corchia's cave has a mean discharge of about 100 l/s and descends to the bottom of this underground system through a long canyon interrupted by several waterfalls. The deepest point of the cave is formed by collapsed boulders, surmounted by a big chamber at the contact between overturned carbonate rocks (dolomitic breccia) and the paleozoic basement. Left: Vianello stream. (Photo S. Sedran)

The deepest sector of the cave features nice tubular conduits. Photo in the middle Galleria Calenzano. (Photo G. Della Valle)

References

Fallani F., Piccini L. (1990): Pianta generale del Complesso Carsico del Monte Corchia. *Talp, supp.*, n. 2, p. 10.

Piccini L. (1996): Caratteri morfologici ed evoluzione dei fenomeni carsici profondi nelle Alpi Apuane (Toscana - Italia). *Natura Bresciana*, n. 30 (1994), p. 45-85.

Piccini L., Zanchetta G., Drysdale R.N., Hellstrom J., Isola I., Fallick A.E., Leone G., Doveri M., Mussi M., Mantelli F., Molli G., Lotti L., Roncioni A., Regattieri E., Meccheri M., Vaselli L. (2008): The environmental features of the Monte Corchia cave system (Apuan Alps, central Italy) and their effects on speleothem growth. *International Journal of Speleology*, v. 37, n. 3, p. 153-172.

Piccini L. (2011): Speleogenesis in highly geodynamic contexts: The quaternary evolution of Monte Corchia multi-level karst system (Alpi Apuane, Italy). *Geomorphology*, n. 134, p. 49-61.

Piccini L. (1998): Evolution of karst in the Alpi Apuane (Italy): relationships with the morphotectonic history. In: 4th International Conference on Geomorphology, Bologna, August 28 - September 3, 1997. *Geografia Fisica e Dinamica Quaternaria*, *supp.* III, t. 4, p. 21-31.

Lepini Mountains

The most recent discoveries in this big karst massif reveal a still enormous exploration potential

Giovanni Mecchia, Maria Piro
Speleo Club Roma

In the two areas described in this article some high mountain plains are located: Pian della Faggeta and Pian della Croce; some of the most important caves in Latium are found on the bottom and on the edges of these plateaus. (Photo G. Mecchia)

The carbonate massif of the Lepini Mountains develops in an appenninic direction for approximately 37 km with an area of almost 500 km^2. It is mostly composed of Cretaceous limestones with some rare Miocene calcarenite outcrops.
Its is composed of two tectonic units having a NW-SE direction, overthrusted along the Montelanico-Carpineto Romano line which can be followed for a length of about 20 km and along which the thin Miocene limestone, sandstone and clay beds outcrop discontinuously. On the north-western border, the limestones dip beneath the volcanic deposits of the Albani hills; to the West they are limited by the border of the Pontina Plain, with a set of subvertical NW-SE faults that lower the limestones under the recent lake and alluvial sediments.
The western unit is characterised by a series of monoclinal ridges dipping toward the NE, while the eastern unit is composed of monoclinal ridges dipping westward, cut by faults and with some wide anticlines (Mt. Malaina) that evolve toward a frontal fold on the NE side, overthrusting the terrigenous sediments of the Latina Valley.
The tectonic Carpineto-Montelanico Line, also being an important limit for speleogenesis and hydrogeology in the area, has been interpreted as a backthrust with appenninic orienta-

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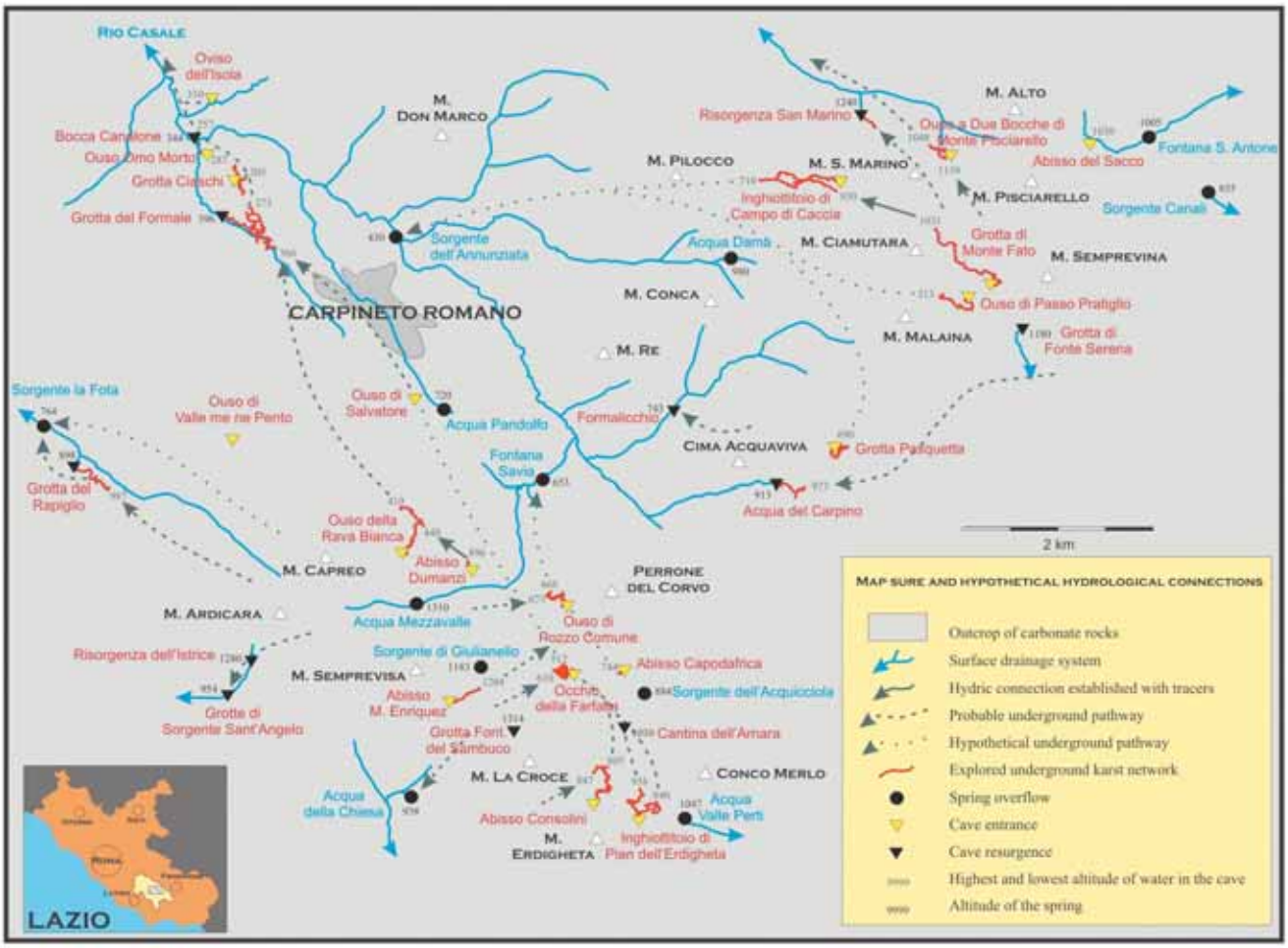
tion, dipping 45-50° toward the NE and with a vertical throw of 700 m (Parotto & Tallini, 2000). The part of this tectonic line that outcrops at high altitude cuts the eastern slopes of the closed valley of Pian della Faggeta, which is covered with pyroclastic rocks and limestone debris mixed with terra rossa and is dotted with many dolines. In Carpineto Romano's valley bottom, a Quaternary pyroclastic cover partially hides the Mesozoic and Miocene carbonate rocks.

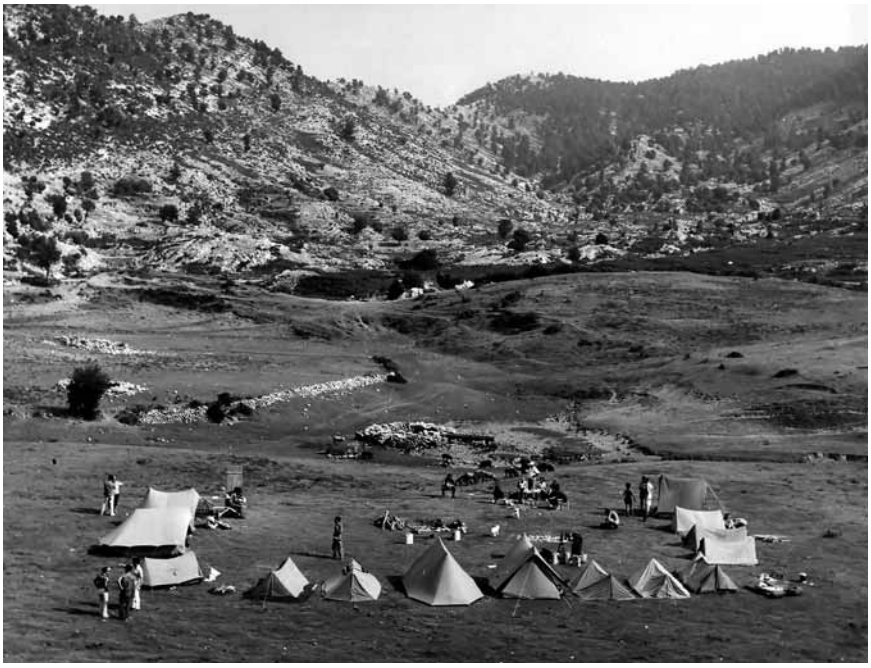
The presence of this tectonic Carpineto-Montelanico Line also determines the underground flow paths. The main springs, located at the base of the mountains, are aligned along the south-western border, and feed the network of channels flowing across the Pontina Plain. The Springs lie between 2 and 29 m a.s.l. and have mean flowrates between 0.1 and 2.7 m3/sec. The main spring, the northernmost and located at a higher elevation, is the Ninfa spring (29 m a.s.l., mean flowrate over 2 m3/s) having a typical karstic bicarbonate-calcic character (Boni et al., 1988). Further to the South the mixing of karst waters with a hydrothermal circuit generates the karst system of Acquapuzza, which is made up of over ten caves through which sulphuric waters flow. Only small springs are located along the margin of the Latina Valley (above the altitude of the Pontina Plain). There are also many small springs located on the mountain, connected to local systems and with mean flowrates never over 3 l/s,

ID CARD

Name: Monti Lepini karst system
Location: Latium, province of Frosinone, Latina and Rome; municipalities of: Artena, Bassiano, Carpineto Romano, Cori, Giuliano di Roma, Gorga, Maenza, Montelanico, Morolo, Norma, Patrica, Priverno, Prossedi, Rocca Massima, Roccagorga, Segni, Sermoneta, Sezze, Sgurgola, Supino, Villa Santo Stefano
Number of caves: 551 (by 31 December 2012)
Exploration start date: 1926-28
Longest caves:
Grotta del Formale (La 39), more than 2920 m, –123/+25 m
Ouso I della Rava Bianca (La 240), more than 1020 m, –715 m approx.
Abisso Consolini (La 310), 1390 m, –555 m
Inghiottitoio di Campo di Caccia (La 335), approx. 2600 m, –610 m
Grotta degli Ausi (La 342+720+721), 1505 m, –32 m
Grotta di Monte Fato (La 419), 1615 m, –336 m
Inghiottitoio di Pian dell'Erdigheta (La 483), approx. 2000 m, –400 m approx.
Ouso di Passo Pratiglio (La 931), approx. 1000 m, –840 m approx.
Abisso Occhio della Farfalla (La 1500), more than 850 m, –453 m
Absorption rate: 900-1200 m asl
Destination: Ninfa springs (29 m asl), Cavata and Cavatella Rivers Spring Group (6 m asl), Ufente River Spring Group (3 m asl), Vescovo Lakes Spring Group (3 m asl), Fiumicello Springs (44 m asl)
Lithologies: limestone ridges, mainly Cretaceous.



although sometimes they can have high discharges during floods.
The area around the village of Carpineto Romano is the richest in caves: there are 253 caves in the Cave Register of this town, 96 in the village of Supino, 37 at Bassiano, 19 at Gorga and 18 at Maenza.
Pian della Faggeta is a 2 km long karst plain, bordered to the NE by the Caprineto-Montelanico Line and to the SW by the mountain ridge of Mts. Semprevisa and Erdigheta. Many of the deep caves of the Lepini Mountains are located in this Plain. The underground water flow, although not completely defined, probably heads toward the NW, and can become surficial flow after heavy rainfall. This vertical rise of the water level can be observed in some of the vertical caves, in the area immediately downstream of Carpineto Romano, where these caves that normally behave as swallow holes can become temporary springs (Bocca Canalone, Ouso dell'Omo Morto, Grotta Ciaschi).
To the NE, beyond the tectonic Line, another important caving area is located, with Mt Malaina having the highest elevation and characterised by a series of closed depressions. In this area the underground water flow goes in many directions, although the deepest flows seem to also converge downstream of Carpineto Romano. This hypothesis still needs to be confirmed, due to the greater distances and the scarce knowledge of deep and active caves.
The Lepini Mountains still have an enormous exploration potential, as demonstrated also by the important discoveries of the last 10 years. The Gruppo Speleologico CAI Roma found a continuation in the Ouso Iº of the Rava Bianca Cave in 2005, reaching a depth of 715 m. In May



Along the slopes at high altitude many springs are found, related to local drainage systems having a seasonal character. The picture shows the Acqua del Carpino Cave (here in winter period). Despite being only a temporary spring, it has been used, enlarging the entrance passage and constructing some collecting infrastructure, since the end of the XVIIIth century, when Pope Leone XIII decided to give his home town (Carpineto Romano) an acqueduct. (Photo A. Binni)

The explorations in the Carpineto Romano area were begun in 1926-1928 by the Circolo Speleologico Romano, but intensified in 1968-1977, especially thanks to the Speleo Club Roma. In 1959 only 14 caves were registered, becoming almost 200 in 1977. The results have been published in a splendid article by Alberta Felici (1977) which still today, despite the many discoveries made since then, is a reference work for this area.
The picture illustrates a summer camp organised on the Pian della Faggeta by the SCR in 1961, during which the explorations in the Consolini Abyss (-238 m) were completed, becoming the deepest cave of the region. This expedition also hosted cavers form Trieste and Spain.
(Photo Pais and Sartarelli, archive of the Speleo Club Roma)

2011 a pseudosump at -320 m was passed and in October 2012 the explorations have reached the top of a shaft, still to be descended, at a depth of -500 m from the entrance.
The Speleo Club Roma discovered and explored the Dumanzi Abyss in 2005 (-101 m). The dye tests in the cave's final sump show that these waters flow toward the SE tributary of the Ouso Iº della Rava Bianca Cave (Olivetti et al., 2012).
The discovery of the Occhio della Farfalla Cave by A. Zambardino and V. Battisti (august 2004), a 453 m deep cave that ends in a very large hall with collapsed boulders, awakened the interest in the other caves of this area, like the Erdigheta and Consolini Caves, which are currently considered to be the upper entrances of a single karst system that carries the waters towards the great underground canyon discovered in the Occhio della Farfalla Cave, explored upstream for around 300 m (explorations still in course: A. Zambardino, G. Antonini, S. Mariani, P. Turrini).
The Matrix Branch of the Erdigheta Cave, after 1 km of a narrow and challenging meander and a pseudosump, continues for another 400 m intersecting an underground stream. Unfortunately this passage closes almost completely on a calcite flowstone. Also the Lungo Sonno Branch, explored by the Associazione Speleologica Romana in 1986 and the GS CAI Roma (1997-2006), has been revisited, ending at a lake-sump at -400, still to be explored by cave divers; some fossil passages might enable to by pass this sump. Between 2009 and 2012 the following cavers have participated in these explorations: G. Antonini, A. Benassi, L. Grillandi, P. Grillantini, S. Mariani, V. Olivetti, L. Russo, P. Turrini.
A dye test has been carried out at the Enriquez Abyss, a cave that terminates in a boulder choke that cavers are trying to dig through, placing the charcoal bags at the Occhio della Farfalla Cave (P. Turrini, A. Zambardino, G. Antonini). The spectrofluorometric analysis (L. Longo) has given negative results, indicating that the waters of the Enriquez flow underground downstream of the Occhio della Farfalla Cave. At the bottom of the Consolini Abyss, an artificial climb above the lake sump and an exploration in the fossil passages at the bottom of the cave did not lead to the results cavers had hoped for (F. Felici, P. Turrini; October 2012).

Alien 3 Abyss: in the Mount Lepini caves, narrow and challenging meanders, developed along fractures, are often encountered. (Photo A. Luciano)

In the area's caves, large underground spaces are relatively rare, but in the Occhio della Farfalla Cave a great shaft allows the descent into one of the widest chambers of the Central Apennines. (Photo F. De Paolis)

The current goals of the explorations are focussed on the underground canyon of the Occhio della Farfalla Cave and in the Lungo Sonno Branch in Erdigheta Cave, and to carrying out tracing tests between these two caves in order to find out whether they are connected or not.
In the eastern part of the Lepini Mountains, A. Benassi, P. Turrini and others (explorations 2004-2007) passed the pseudosump at 299 m

The vertical pits that interrupt the meanders are often cylindrical-conical in shape, with a narrow departure and a wide bottom. Capodafrica Abyss. (Photo F. De Paolis)

depth in Ouso di Passo Pratiglio Cave. These explorations led to the final sump located at a depth of 840 m, making this cave the deepest in the Latium Region.
The same Benassi and Turrini have also carried out a dye test in the Monte Fato Cave. The charcoal bags, placed in the upstream sump of the Campo di Caccia sinkhole, have given a positive result.
Finally, the Circolo Speleologico Romano has resumed the exploration in the Pasquetta Cave in 2008, discovering a sump at 360 m depth. This cave still has a great potential for further discoveries.

Many of the Caving Clubs of Latium have worked and are still operating in this area, with many explorations but never obtaining extraordinary results, but bit by bit these small discoveries are making this extraordinary karst region better known. ■

Some of the smaller karst plateaus dimensions develop at various altitudes along the mountain chain. In the picture, Piano dell'Erdigheta and a group of cavers entering the swallow hole of the same name. The Consolini Abyss is located close to the mountaintop in the background of the picture. (Photo G. Mecchia)

References

Benassi A., Turrini P. (2007): Action Mutante. La nuova frontiera dell'Abisso di Passo Pratiglio: una grotta per veri sifonauti... *Speleologia del Lazio*, n. 5, p. 25-32.

Boni C., Bono P., Capelli G. (1988): Carta idrogeologica del territorio della regione Lazio. Regione Lazio - Università Roma "La Sapienza".

Felici A. (1978): Il carsismo dei Monti Lepini (Lazio). Il territorio di Carpineto Romano. *Notiziario del Circolo Speleologico Romano*, anno XXII, n. 1/2 (1977), p. 3-224.

Gruppo Speleologico CAI Roma (2007): *L'eco del pipistrello*, n. 1, 74 p.

Mecchia G., Mecchia M., Piro M., Barbati M. (2003): Le grotte del Lazio. I fenomeni carsici elementi della geodiversità. Regione Lazio, Collana Verde dei Parchi, Serie Tecnica n. 3, 413 p.

Monteleone M, Sirtori F. (2012): Relazioni e immagini sull'esplorazione di Grotta Pasquetta (Pozzo della Macchia). *Notiziario dello Speleo Club Roma*, n. 16, p. 93-99.

Olivetti V., Mecchia M., Gigante C. (2012): Le acque segrete dei Monti Lepini, nuove colorazioni e ipotesi idrogeologiche. Notiziario dello Speleo Club Roma, n. 16, p. 42-47.

Parotto M., Tallini Parotto M. (2000): Neogene compressive deformations of the Latina Valley thrust front hangingwall: kinematics and geometry of the Montelanico-Carpineto backthrust (Central Italy). In: Atti Convegno "Evoluzione geologica e geodinamica dell'Appennino", Foligno, 16-18 febbraio 2000, p. 256-257.

Zambardino A. (2009): L'Occhio della Farfalla. L'occhio del profondo buio dei Lepini. *Speleologia del Lazio*, n. 6, p. 18-24.

Alburni Mountains

The exploration as a method, sharing and participation

Umberto Del Vecchio, Francesco Lo Mastro, Francesco Maurano, Mario Parise

The Alburni Massif in Campania is the most significant karst area of Southern Italy, containing hundreds of caves and a great variety of karst landforms.

Speleologia in Rete

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Covering about 280 km^2, the massif mostly consists of Mesozoic and dolomitic limestones, originating in carbonate platform environments. Karst features are concentrated within the Cretaceous sequence, with an overall thickness over one thousand meters. Miocene terrigenous formations can be found along the sides of the massif and as filling materials within structural basins on the plateau.

The massif is a monoclinal structure gently dipping to the SW; delimited by fault scarps, it has a summit plateau, developing in elevation between 1,000 and 1,500 m asl, where many closed basins of karstic origin

Pools and striking chambers filled with speleothems characterize Castelcivita cave. (Photo F. Maurano)

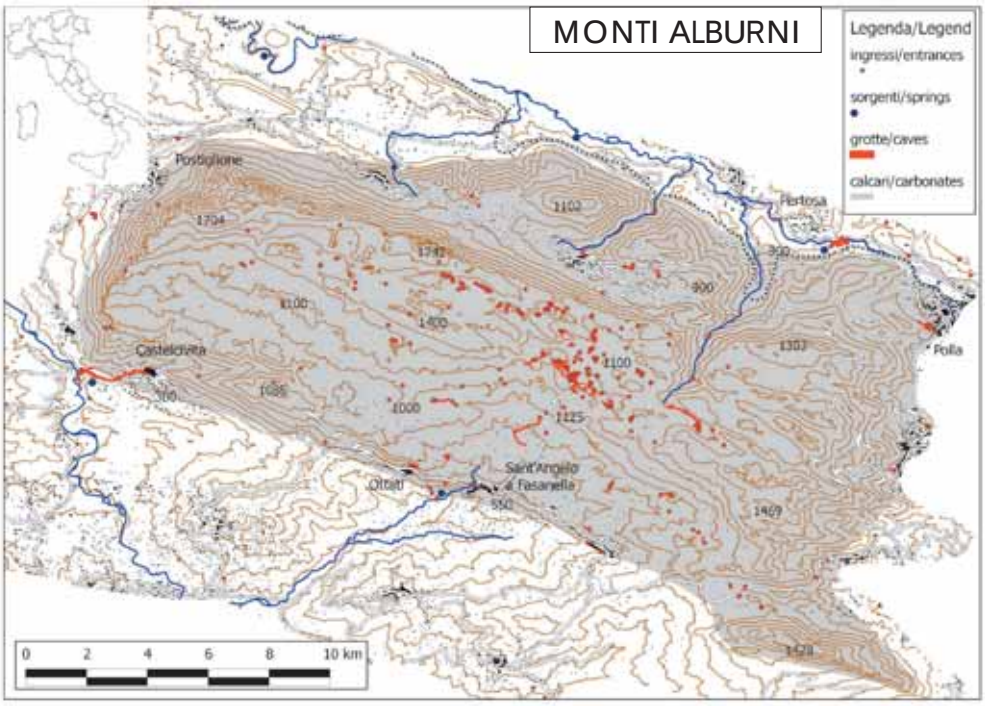
ID CARD

Name: Alburni Massif
Location: province of Salerno, southern Italy. Municipalities: Aquara, Auletta, Castelcivita, Controne, Corleto Monforte, Ottati, Petina, Pertosa, Polla, Postiglione, San Rufo, Sant'Angelo a Fasanella, Sant'Arsenio, San Pietro al Tanagro, Sicignano degli Alburni.
Number of registered caves: 275
Years of the first explorations: 1920
Longest caves:
Grotta di Castelcivita (Cp 2), length 5400, depth 33 m
Grotta di Pertosa (Cp 1), length 3300, depth 46 m
Grava del Fumo (Cp 94), length 1590, depth – 443 m
Grava dei Gentili (Cp 255), length 2042, depth – 440 m
Inghiottitoio III dei Piani di S. Maria (Cp 472), length 1850, depth – 422 m
Grava del Campo (Cp 1406), length 1543, depth – 403 m
Grava I dei Gatti (Cp 244), length 657, depth – 402 m
Grava dei Vitelli (Cp 253), length 1800, depth – 385 m
Highest elevations of water infiltration: 1100-1200 m asl
Springs, and related elevations: Grotta di Castelcivita, 65m asl; Grotta di Pertosa e F. Tanagro, 220-263 m asl; Basso Tanagro, 100 m asl; Risorgenza dell'Auso, 280 m asl
Lithologies: Mesozoic and Tertiary carbonate platform limestones, and Miocene flysch deposits

are present. Basal springs are distributed at the SW and NE margins (mean discharges ranging from 3 to 7 m^3/sec).
The oldest caving activities date back to the beginning of the 1920's, but more intensive activity took place in the 50's and 70's, when systematic surveys and explorations were carried out, producing remarkable results in terms of numbers of explored caves. The activities were particularly well organized and productive at the end of the '80s, with joint explorations and researches carried out by teams from multiple cave groups. The main outcome of this crucial period in the explorative history of the area is the book by Bellucci et al. (1995). After a few decades of varying levels of activity, in recent years a joint effort was again made, which resulted in the "Alburni Exploration Team" and in new discoveries in several caves, as well as in new speleological and hydrogeological projects in the Alburni Massif.
At Grava d'Inverno, the known extension of the cave was greatly increased, reaching 201 m of depth, and a length over 1.4 km, which makes it one of the longest caves in the massif. The same happened at Grava del Campo, which is today

NE slope of the Alburni Massif, showing the Il Figliolo peak (1337 m asl) to the left. The ridge slopes with steep gradients down toward the plain below, where the Miocene flysch deposits crop out (Petina).
(Photo N. Damiano)

Below: access meander to the Fra' Gentile Cave (Cp 250) - Sicchitiello valley, territory of S. Angelo a Fasanella.
The meander (on average, 80 m-long, 30 m-high, and 10 m-wide) is one of the most remarkable karst formations in the Alburni Massif. The cave develops for 335m, reaching depth of 232 m, through two main shafts (respectively, 30 and 60 m-deep). It's a inactive swallow hole, that was once fed by waters flowing from the upper reaches of the Sicchitiello valley.
Today, these waters flow into Grava del Fumo, whose entrance is located 35m below Fra' Gentile.
(Photo F. Lo Mastro)



Above: One of the most typical shafts (Carmen pit) in the Grava dei Vitelli cave (Cp 253). Located in the initial portion of the cave, this pit is the cave's first direct vertical extension underground. At its bottom begin the three main directions of development of this complex karst system.

Below: passages rich in speleothems in the non-touristic section of the Castelcivita Cave, at the NE boundary of the Alburni Massif. The Castelcivita karst system became a show cave in 1930, followed two years later by the nearby Pertosa cave. It is the longest show cave in Southern Italy with a total length of 5,4 km. At this site the pioneering activity in the massif began during the 19th century.
(Photo F. Maurano)

the fourth deepest cave in Campania. Even at much frequented caves, as Grava dei Vitelli, new passages have been found, and explorations are currently blocked by an intermittent sump. The complexity of the karst systems in the Alburni Massif and the presence of underground passages connecting ancient (inactive) cave entrances with the currently active swallow holes, has been proven by the work carried out at Grave del Fumo and at the Grotta del Vento, respectively the active and inactive accesses to what is nowadays one of the most remarkable cave systems in the massif. These recent discoveries have been accompanied by tracing tests performed in selected caves, aimed at identifying the main courses of the underground rivers. ■

Passage through breakdown deposits in the recently explored branches at the Grava d'Inverno Cave (Cp 672), during the explorations carried out in 2006-2008. (Photo F. Maurano)

References

Bellucci F., Giulivo I., Pelella L., Santo A. (1995): Monti Alburni: ricerche speleologiche. De Angelis, Avellino: 302 p.

Boegan E., Anelli F. (1930): La Grotta di Castelcivita nel salernitano. Le Grotte d'Italia, s.I, v. 4, 215-233 p.

Russo N, Del Prete S, Giulivo I, Santo A, (a cura di) (2005): Grotte e speleologia della Campania. Elio Sellino, Avellino: 623 p.

Santangelo N., Santo A. (1997): Endokarst processes in the Alburni massif (Campania, Southern Italy): evolution of ponors and hydrogeological implications. Zeitschrift fur Geomorphologie, v. 41, n. 2, p. 229-246.

Vianello M. (1965): La terza campagna speleologica sull'Altopiano dell'Alburno della Commissione Grotte "E. Boegan". Rassegna Speleologica Italiana, n. 1-4, p. 27-36.

The Codula Ilune
Supramonte

Overview of the Codula Ilune. (Photo S. Arrica)

Where speleologists are decisive for reconstructing the underground water routes

Silvia Arrica, Gianluca Melis, Mario Pappacoda

The Codula Ilune is the most important fluvial karst canyon which crosses, from south-west to north-east, the entire carbonate structure of coastal Supramonte near Urzulei-Baunei-Dorgali, in the Centre-South of the wide Gulf of Orosei (Eastern Sardinia). From heights above 800 m, after about 20 km travel, it reaches the sea at the well-known beach of Cala Luna.

In the area, rocks having different natures and belonging to different geological eras crop out: the Palaeozoic basement is made up mainly of varis-can granitoids, often strongly arenised, over which lie, in stratigraphic unconformity, the Mesozoic sediments made up from the bottom towards the top of fluvial lacustral sediments followed by marls, dolostones and limestones of the Middle Cretaceous-Lower

SARDEGNA

Speleologia in Rete

Travel beneath the Codula Ilune
http://tinyurl.com/68-codula-ilune

Join the discoveries in Lovettecannas
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Above: The entrance, which has always been known to the inhabitants of Urzulei, became recognised in terms of its importance as an access to a large cave only at the end of the 1970s, when a group of Lombard speleologists belonging to the Gruppo Grotte Cai Milano Sem discovered the narrow passages which allowed reaching vast chamber the galleries, travelled by a large underground stream. In 1998, speleologists from Verona and Florence explored large spaces in which they found pieces of white line. It had been left by the French cave diver Patrick Penez who, entering the siphon lake of the Su Palu cave, re-emerged in a dry gallery which he explored for more than a kilometre. That find confirmed the fact that the two caves were connected, not only hydraulically. Penez had also built a cairn at the point of the gallery where he stopped. This cairn was reached in 1989 by a small group of Sardinian speleologists, further proof of the fact that it actually was one single cave. The gallery was called, in honour of the explorers from beyond the Alps, the Ramo dei Francesi (Branch of the Frenchmen). Its total length is around 43 kilometres. (Photo S. Fercia)

ID CARD

Name: Codula Ilune cave system
Location: Sardinia, Nuoro province, Supramonte of Urzulei, Baunei and Dorgali
Geographical area: Eastern Sardinia, in the centre of the Orosei Gulf
Exploration start date: '50s
Lenght: 43 km in two connected caves: Monte Longos and Su Palu; considering the hydrogeological cave system the total length exceeds 60 km
Altitude difference: Monte Longos-Su Palu system 332 m
Lithology: Palaeozoic basement of granitic rocks with big feldspar crystals, quartz, biotite and other minerals.
These rocks are overlain by the Mesozoic sequence composed of fluvio-lacustrine sediments first, dolostones and limestones of Middle Jurassic-Lower Cretaceous age.

It owes its name (Marine Ox) to the fact that it was the refuge of monk seals, whose call, probably further amplified by the vast spaces, sounded like the roar of an ox, and from here comes the Sardinian name BOE MARINU. The entrance opens to the sea with two majestic portals and the cave is made up of three branches: the north branch, the south branch and the middle branch, which was recently found and is completely submerged. Already known in ancient times, the first exploration took place in 1951. In 1954 the Gruppo Grotte Nuorese carried out the first mapping. That same year, the north branch was opened to tourists and remained visitable until the early 1980s, then it was closed and at the same time the South branch became touristic. From the early 1980s to beyond the mid-2000s, the cave has been remapped and explored, especially by cave divers, both Czech and Sardinian. Currently the total length is about 20 km. (Photo L. Fancello)

Above: The entrance of Su Palu cave was discovered in 1978 by French speleologists from the Speleo Club de Paris, following the indications of "ziu Marroccu", an ex-forestry worker who lived in Codula for years. Between 1980 and 1985 explorations were intense, carried out for the most part by Sardinian speleologists who ended up mapping more than 10 kms of cave. Between 1995 and 1997 many internal camps were made, during which new fossil branches were found, the rigging improved and a large part of the cave was remapped. In 1999 the "Sa Ciedda" siphon was explored, whose waters feed the siphon lake: the exploration turned out to be very complex because of the presence of another siphon and the instability of the surroundings. (Photo S. Arrica)

Jurassic. Alluvial conglomerates follow, often well cemented, which precede the Plio-Pleistocene basalt flows. The carbonate reliefs contain many faults, mainly going N-S, while the NE-SW and NW-SE directions appear to be subordinate.

From the time of their definitive emersion, which probably already took place in the Cretaceous era, and in particular, in the past 10 million years (from the mid-Miocene), these formations have undergone intense erosion and corrosion which have created the current landscape, strongly influenced by the structural and lithologic characteristics of the rocky masses.

Codula Ilune contains the most important underground karst system of Sardinia, which partially develops along the granite-dolomite contact and contains, from top to bottom on the hydrological right, the following caves: Su Palu (entrance elevation 185 m a.s.l.), Monte Longos, (120 m a.s.l.) also known as Su Spiria, the only two connected to each other not only hydraulically but also "physically", the Carcaragone Swallowhole (45 m a.s.l.), the Grotta di Su Molente (35 m a.s.l.), Cala Luna's Underwater Resurgence, located 100 m south of the homonymous beach and is the current outpour of the system's waters. The Grotta del Bue Marino is also included, whose entrance opens about 2.71 km further north of the canyon's mouth: it's southern branch, until 500,000 years ago, functioned as the complex's resurgence, but the geomorphologic evolution which the limestone massif underwent divided it into two parts. Currently the South branch is only active during strong rainfall, acting as an overflow of the cave system which phreatic level is 9 m below; the waters are in fact drained by the Cala Luna resurgence, whose meandering shape testifies to its recent formation.

Su Palu: Still in 1999, Sardinian cave divers made the first repetition of the siphon lake immersion, which until that moment had only been travelled by Patrick Penez, remapping it and revising its length to "only" 135 m instead of the 180 m the French cave diver came up with. (Photo L. Sgualdini)

Finally, a dye test carried out in February 2011 has proven the hydrologic connection between the Lovettecannas cave and the Codula Karst system.

The entrance, at 930 m a.s.l., opens in area called Serra Pirisi, on the left bank of the head of the Codula Ilune canyon.

The explorations cover a period of time from the 1950s and continue today, with alternating phases. They have been carried out by Sardinian speleologists as well as speleologists coming from all over Italy and abroad.

In this article we will go through the various steps in chronological order along the photo captions. ■

Right: Carcaragone entrance, this large swallowhole, explored for the first time by speleologists from Imperia, has an entrance which opens on the right of the Rio at 45 m a.s.l. It occasionally activates during periods of strong rain and absorbs a large part of the floodwaters which reach this section, so far down from the Codula Ilune. This cave is made up of a dense network of small conduits, which converge in a main gallery which ends in a siphon after several hundred metres. The water level of this siphon is at 2 m a.s.l. It has been explored by Czech cave divers to a depth of 40 m and a length of 180 m. It's connected with the galleries further down from the Codula Karst system, as revealed by dye tests. (Photo S. Fercia)

Left: Su Molente, discovered in April, 2007, and still being explored by the Gruppo Speleologico Sassarese, who entered it after some impressive deobstruction work. Its name comes from a local toponym. The strategic importance of the cave became clear as the explorations went on: its entrance is only 60 metres away from the end of the Bue Marino's south branch and in its interior, 4 branches allow contact with extraordinary submerged areas which head upwards, towards Su Palu - Su Spiria (as proven by dye tests) and the Carcaragone Swallowhole. Downstream, instead, it heads towards the Cala Luna resurgence and the Codula. While the junction with the Su Palu - Su Spiria system is probably only a matter of a few immersions, the junction with Bue Marino will probably be more difficult, despite the hydrologic connection as proven by dye tests. (Photo S. Arrica)

References

De Waele J.(1997): Il complesso sotterraneo di Codula Ilune, Sardinia, Italy. *International Caver*, n. 20, p. 3-10.

De Waele J. (2004): Geomorphologic evolution of a coastal karst: the Gulf of Orosei (Central-East Sardinia, Italy). *Acta Carsologica*, n. 33(2), p. 37-54.

De Waele J., Pappacoda M. (1996): Il fantastico universo sotterraneo della Codula Ilune. *Speleologia*, n. 35, p. 13-24.

Fancello L. (2009): La Grotta del Bue Marino. *Sardegna Speleologica*, n. 24, p.59-71.

Pappacoda M. (2009): Il Complesso Carsico della Codula Ilune. *Sardegna Speleologica*, n.24, p. 17-29.

Fancello L., Loru R., Murgia A. (2009): Su Molente, l'anello mancante del primato. *Speleologia*, n.61, p 16-25.

Arrica S., Melis G., Pani D. (2011): Lovettecannas, una nuova stagione esplorativa. *Speleologia*, n.65, p. 40-47.

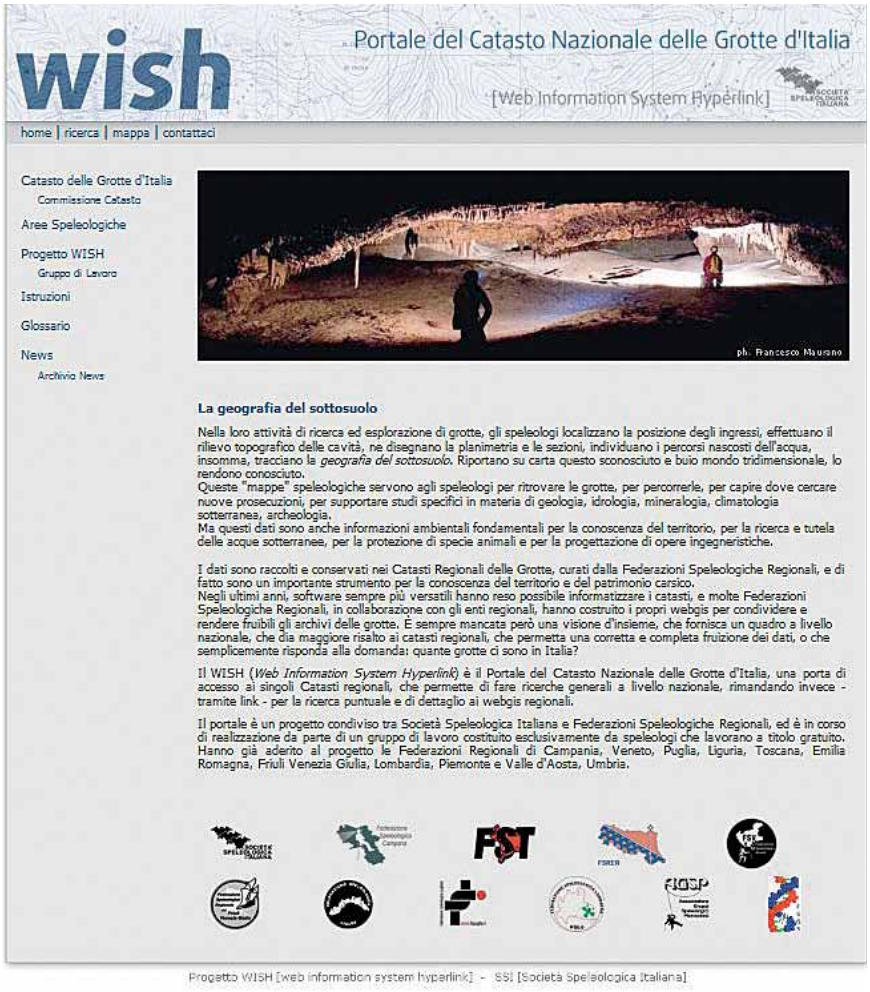
Right: Lovettecannas, it also owes its name to a local toponym. Discovered by speleologists belonging to the Groupe Ulysse Spéléo Lyon, the Unione Speleologica Cagliaritana and the Gruppo Speleo-Archeologico Giovanni Spano in 2001, it has been explored in an on and off fashion until 2012, resulting in a length of over 6 km and a depth of almost 600 metres. Its pseudo-horizontal configuration means than it can be travelled without the help of rope equipment. A dye test has shown the hydrologic connection between Lovettecannas and the Codula Ilune Karst System and has opened up exciting explorative scenarios in a cave which, up to that moment, didn't seem to have much to offer in that sense. (Photo S. Arrica)

WISH - The portal to the caves of Italy

An advanced network for getting to know karst hypogean phenomena in Italy better

Giorgia Bonini, Umberto Del Vecchio, Vincenzo Martimucci, Vito Meuli, Andrea Moretti, Maria Luisa Perissinotto, Alberto Riva, Rossella Tedesco

In Italy, several regions have independently developed web-GIS or computerized databases of various types for managing geographic, topographic, photographic and bibliographic information referring to caves within their own territory. However, at the national level, there was no portal which allowed searching, querying and spreading this information throughout Italy. Since this information was collected in different ways by the different regions, creating a national portal was difficult.
The WISH project (WISH being Web Information System Hyperlink), presented to the permanent forum between the Italian Speleological Society (SSI) and the various regional speleological federations (FSR) in 2008, was created with the goal of making the Italian Cave Register usable and searchable online

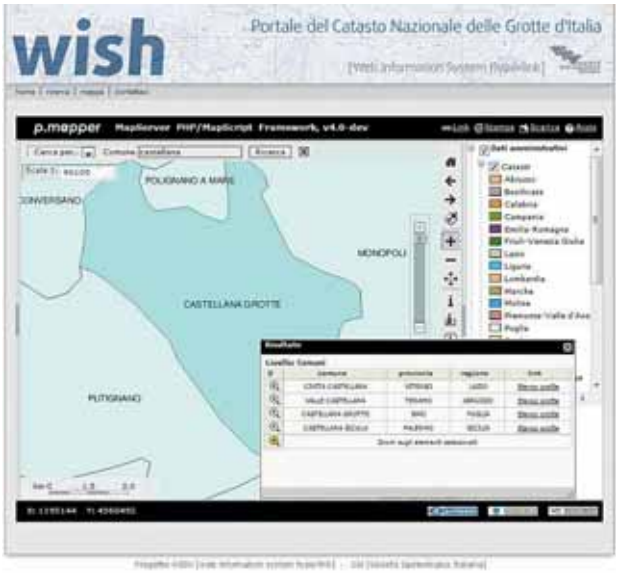


Homepage of the accessible online version at: http://catastogrotte.speleo.it. Started in 2008 the WISH project aims to bring together in one list all data of natural caves present in Italy.

List of caves surveyed in the municipality of Castellana Grotte (http://catastogrotte.speleo.it).

by the speleological community and anyone else who may be interested.
WISH is based on a very simple idea: to create a portal, that is a means of access, to the various regional databases, which would allow consulting data at a national level, while referring back to the regional sites for more detailed and specific queries.
This idea involves a change of approach towards creating a national database: the idea is no longer a centralized national database which contains all the data, but rather an access gate to national information with a continuous connection with the regional federations, who remain the only database administrators. All this created on an internet platform and therefore easily spread around the world.
WISH is based on computer systems which combine the potentials of geographic databases and Geographic Information Systems (GIS) with those of the Web. Searches and queries are possible by navigating maps or by accessing a data interrogation module. Tabular searches are made possible by and intuitive graphical interface where one can insert the search pa-

Interface for research on tabular data (http://catastogrotte.speleo.it). The portal hosts generic data of 24000 caves surveyed by Regional Federations.



Geographic research for the municipality of Castellana (http://catastogrotte.speleo.it).

rameters, while the geographic search is possible through an immediate geographic navigation over the entire national territory. Results can be displayed as lists of data or on the map using a few simple steps.

Several different types of general searches can be carried out at the National level (for example, those which involve a comparison between all the caves in the nation: the deepest cave, the most extended caves, etc.) or at a regional level down to a scale referring to the administrative level of towns. For more in depth searches, which go beyond the township level and could, for example, show the detailed maps of an area, the photos of entrances, the cave's map and its entrance's coordinates, then regional databases and web-GIS' are referred to, if they exist.

Another important goal of WISH is that of exporting the experiences and "best practices" from one federation to another, bringing the various databases up to the same level.

WISH is an ambitious project which aims at completing the data over the entire national territory. It's continuously evolving and is an opportunity for giving the regional databases a uniform structure, as well as being a stimulus for the FSRs to make the databases work and "network" with other federations.

The work group ("Gruppo di Lavoro" – GdL) is composed of speleologists who volunteer their time free of charge and use open source programmes which don't require licensing fees. ■

Map for geographic data search (http://catastogrotte.speleo.it). Currently connected to the "WISH" website there are the cave registers of 11 Italian regions: Campania, Emilia-Romagna, Friuli Venezia Giulia, Liguria, Piedmont, Puglia, Sicilia, Tuscany, Umbria, Veneto and Valle d'Aosta.

References

Bonini G., Del Vecchio U., Martimucci V., Meuli V., Moretti A., Perissinotto M., Riva A., Tedesco R. (2010): "WISH: Un progetto per il portale delle grotte d'Italia". In: Atti II Convegno Regionale di Speleologia "Campania Speleologica 2010", Caselle in Pittari, 3-6 giugno 2010. p. 243-249.

Speleological Italy, a travelling exhibition created by the Regional Speleological Federations and the SSI National Cave Register Commission

An original and concise presentation of the National Cave Register and of speleological organisations in Italy

SSI National Cave Register Commission

Areas having speleological interest cover approximately one sixth of Italy's entire surface. Natural caves of karst origin are present in every region, albeit with large differences in extension and typology. Emilia Romagna, with about 1% of its surface covered, is the region with the smallest percentage of karst territory, while in Puglia these outcrops cover almost 50% of the region's surface. Currently, there are over 40,000 natural cavities marked in the registers as a result of slightly over a century of explorations: most of these lie within carbonate rocks (limestones and dolostones), but there are also many in evaporitic rocks, in basaltic lavas and in other types of rock.

Speleologia in Rete

See the poster of the "Speleological Italy" exhibition
http://tinyurl.com/68-italia-speleologica

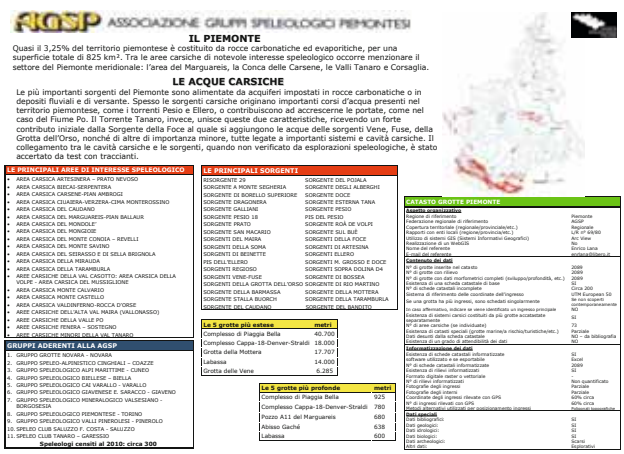
With the 1928 establishment of the National Register of the Caves of Italy, an offspring of the Istituto Italiano di Speleologia in Postumia, the collection of exploratory data began. This was furnished to the Institute by the first cave groups and led to a first large card index of topographies and physical data pertaining to the studied caves.

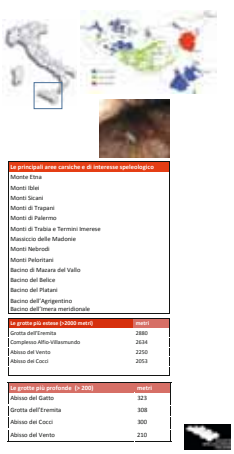
As a result of two National Speleology Congresses (Sardinia 1955 and Lombardy 1957), the management of the Cave Cadastre was handed over from the cave groups to the Italian Speleological Society (SSI), which had been constituted in Verona in 1950. Through the National Cave Register Commission, over the years the SSI furnished itself with specific regulations and data input forms.

In the 1970s, the cadastre was decentred to a regional level, because, usually, the Cave Register was recognised and made official by specific regional laws. Also, the regional speleological federations, which in that decade began to grow in almost all regions, became the favoured interlocutors of the regional administrations for the planning and administration of karst areas.

The cooperation between the regional speleological federations and the SSI's National Cave Register Commission, led in 2008 to the WISH Project, the Portal of Italian Caves (Portale delle Grotte in Italia) (pag. 38-39). In 2010, 20 posters were made, one for each Italian region, which gives an immediate picture of the speleological situation in Italy.

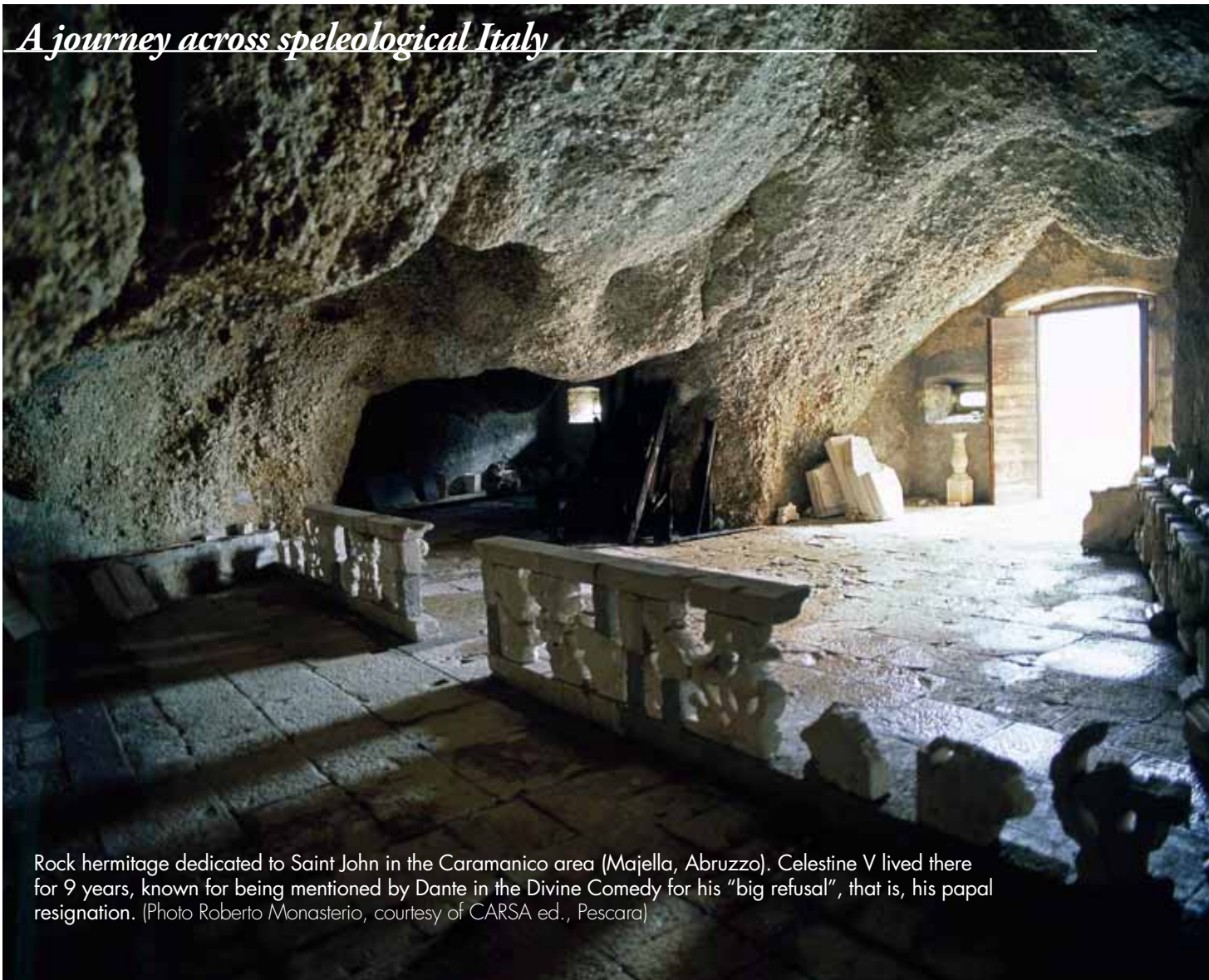
The project, called "Italia Speleologica", gives data on the total number





caves in the register, on the speleological groups, concise information on the organisational aspects of the speleological world, describes the cataloguing methodologies used and highlights the particular karst phenomena of every single region.
"Italia Speleologica" became a travelling exhibition; the continuing requests for it from museums and other bodies in Italy are proof of its interesting content and usefulness.
The balance of these first years of publishing gives us one fact: underground geography, as drawn by speleologists, arouses interest and curiosity, even from outside the speleological world.
This highlights the role of regional federations and the work carried out by speleologists in spreading environmental data, necessary for the correct and sustainable use of territory as well as for the safeguarding of the water reserves, which are precious and abundant in many of the immense Italian karst areas. ■

A journey across speleological Italy



Rock hermitage dedicated to Saint John in the Caramanico area (Majella, Abruzzo). Celestine V lived there for 9 years, known for being mentioned by Dante in the Divine Comedy for his "big refusal", that is, his papal resignation. (Photo Roberto Monasterio, courtesy of CARSA ed., Pescara)

A topographic and systematic catalogue of the fauna collected in Italian caves

The animal taxa of caves collected and ordered in a reference work for enthusiasts and researchers

Luigi Boscolo Folegana

After a long period of meticulous and careful annotations, a work is almost ready which faithfully collects the knowledge pertaining to fauna found in natural and artificial cavities in Italy, both terrestrial and marine.

As a synthesis of the data contained in over 3800 different publications (of which about 3000 are articles contained in periodicals and over 800 are from monographic publications), it offers scholars the results of the fauna research carried out in our country's caves published between 1776 and 2012.

It should be noted that of the 216 periodical titles reviewed, less than 25% are of speleological derivation, while the rest come from other specialist publications.

The oldest publication consulted is the entomological monograph by Johann Heinrich Sulzer *Abgekürzte Geschichten der Insekten nach dem Linnéischen System* (1776, H. Steiner, Winterthur).

The catalogue is divided into parts. In the first, for each cave there is a chronological list of authors who have dealt with the fauna of the cave and a systematic list of the animals that live there. The second is a list of species with indications of the caves in which each lives.

The number of investigated cavities is over 6000. Of these, 85% are natural cavities while the remaining 15% are artificial ones. To all these, needs to be added the many cavities which are unidentifiable because of inadequate or mistaken name or topographic data used in the source publications. All the regions of Italy are represented.

Speleologia in Rete
The cave inhabitants
http://tinyurl.com/68-speleofauna

Leptodirus hochenwartii, Schmidt 1832, Karst of Trieste. (Photo E. Lana)

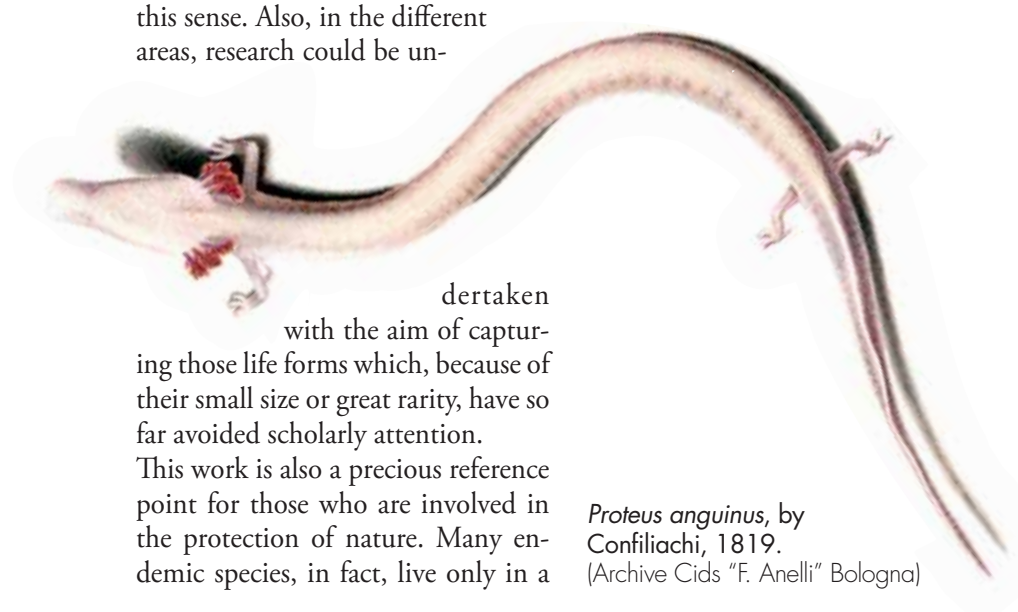
Ixodes vespertilionis, Adult male on the left and female nymph on the right in a sandstone cave. (Phjoto F. Grazioli)

Those in which the greatest number of caves have been explored from a fauna point of view are: Lombardy (854), Veneto (668) Friuli-Venezia Giulia (666), Piedmont (646), Liguria (590) and Sardinia (536). The provinces having the greatest number of explorations as of now are: Brescia (Lombardy) 366, Cuneo (Piedmont) 349 and Bergamo (Lombardy) 316.

The listed animal taxa are 5,638. The Classes with the largest number of taxa are: Pterigota (2,144), Arachnids (1,130), Crustaceans (951), Gastropods (411) and Diplopods (348). The Orders having the largest number of taxa are: beetles (1,519), isopods (363), mites (271), diptera (210) and amphipods (210). There are many endemic species (881), especially among the beetles (330), the diplopods (106), the isopods (93), the pseudoscorpions (87) and spi-

ders (64). The region with the largest number of taxa is Sardinia.
Among the most surprising discoveries made in the last 60 years, we can mention, concerning terrestrial cave fauna, the Sciarid fly troglobitic *Allopnyxia patrizii* Freeman, 1952, the Carabidae beetle *Italaphaenops dimaioi* Ghidini, 1964, some Trichoniscid Isopods *Catalauniscus hirundinella* Argano, 1973, *Catalauniscus puddui* Argano, 1973, *Scotoniscus janas* Argano, 1973 and *Scotoniscus baccettii* Manicastri & Argano, 1989 and the Vespertilionid bat *Plecotus sardus* Mucedda, Kiefer, Pidinchedda & Veith, 2002. Representing the fauna discovered in Marine caves are the Desmoxyid Demosponge *Higginsia ciccaresei* Pansini & Pesce, 1998 and the Onisciden Isopod *Utopioniscus kuehni* Schmalfuss 2005.
In the catalogue, taxa are generally ordered according to the original plan of the *Checklist delle specie della fauna italiana* by A. Minelli, S. Ruffo, S. La Posta (1995, Edizioni Calderini, Bologna), taking later updates into account.
The types catalogued are given the currently valid name, with any changes which have occurred being noted in the text.
This synthesis is very important reference point for researchers. Knowing which caves are well studied from a fauna point of view, will allow them to collect fauna from others which are still untouched, or little explored, in this sense. Also, in the different areas, research could be undertaken with the aim of capturing those life forms which, because of their small size or great rarity, have so far avoided scholarly attention.
This work is also a precious reference point for those who are involved in the protection of nature. Many endemic species, in fact, live only in a few caves close to each other or even in one single cave, which makes it necessary to organise the protection of their natural habitat.
It is certainly a useful instrument for those who aspire to become specialists of a zoological group: thanks to this catalogue, they won't have any difficulty finding places where they can collect samples belonging to particular species.
With such a structure and advantages, it is reasonable to believe that this work could be a valuable tool for anyone who wants to keep up-to-date on the current state of knowledge concerning cave fauna in Italy.

Duvalius bianchii cycnus, rare endemism of the Bologna Appennines. (Photo F. Grazioli)



Proteus anguinus, by Confiliachi, 1819. (Archive Cids "F. Anelli" Bologna)

Additional Information

Some of the papers we examined while making the catalogue contain some astonishing descriptions, among which the following are particularly worthy of note:

Freemann P. (1952): A new genus and species of *Mycetophilidae* (*Diptera*), allied to *Pnyxia* Johannsen, from a cave of Italy. *Bollettino Società entomologica italiana*, v. 82, n. 3-4, p. 20-23.

Allopnyxia patrizii Freeman, 1952: Sciarid troglobitic, characterized by a noticeable sexual dimorphism: e.g the male with shorten wings and simplified nervation and female depleted of wings and evident physogastria; found in the Cave.

Ghidini G.M. (1964): Un nuovo eccezionale Trechino cavernicolo: *Italaphaenops dimaioi* n. gen., n. sp. (*Coleoptera: Trechidae*). *Bollettino Società entomologica italiana*, v. 94, n. 1-2, p. 32-36.

Italaphaenops dimaioi Ghidini, 1964: Extremely big beetle Carabid among the known Trechinidae, found in the Spluga della Preta (Vr).

Argano R. (1973): *Trichoniscidae* of su Mannau cave, SW Sardinia

(*Crustacea, Isopoda*). *International Journal of Speleology*, v. 5, n. 2, p. 153-162.

Catalauniscus hirundinella Argano, 1973 and Catalauniscus *puddui* Argano, 1973: Isopod Trichoniscid, important proxy of the moving of the Sardinian-Corse micro-plate from the N-E coast of the Iberic Peninsula, found in the Su Mannau Cave and in other neighboring caves

Mucedda M., Kiefer A., Pidinchedda E., Veith M. (2002): A new species of long-eared bat (Chiroptera, Vespertilionidae) from Sardinia (Italy). *Acta chiropterologica*, v. 4, n.2, p. 121-135.

Plecotus sardus Mucedda, Kiefer, Pidinchedda & Veith, 2002: Chiropter Vespertilionid; sigle endemic mammal of Sardinia and single endemic bat of Italy. It flies during nights within the woodlands of the Central Sardinia. It has been found in caves of Supramone of Oliena and Baunei.

Below: *Oxychilus* draparnaudi mating. Right: *Arrhopalites* sp., Springtail *Symphypleona* endemic of Vena del Gesso romagnola. (Photo F. Grazioli)

Sardaphaenops supramontanus supramontanus, Cerruti & Henrot 1956 in the Sa Rutta 'e S'Edera caves in Sardinia. (Photo E. Lana)

Schmalfuss H. (2005): *Utopioniscus kuehni* n. gen., n. sp. (Isopoda: Oniscidea: Synocheta) from submarine caves in Sardinia. *Stuttgarter Beiträge zur Naturkunde*, (A), n. 677, p. 1-21.

Utopioniscus kuehni Schmalfuss 2005: Isopod stygobite, regarded as the oldest of the Trichoniscids (thus a true living fossil), found in the Utopia cave and in the Bel Torrente cave (Nu).

Pansini A., Pesce G.L. (1998): *Higginsia ciccaresei* sp. nov. (Porifera: *Demospongiae*) from a marine cave on the Apulian coast (Mediterranean Sea). *Journal of the Marine Biological Association of the United Kingdom*, n.78, p. 1083-1091.

Higginsia ciccaresei Pansini & Pesce, 1998: Demospongia Desmoxyide found at a depth of 12m in the brackish waters in the complete darkness of the Zinzulusa cave (LE) some 250 m from the cave entrance.

The following is the oldest looked up printed paper in the realization of the present cathalog:

Sulzer J.H. (1776): Abgekürzte Geschichten der Insekten nach dem Linnéischen System. Winterthur, H. Steiner (2 parti) – I, XXVII + 274 p.; II, 71 p.

Didactic resources for speleology and karst

The Italian Speleological Society's Powerpoint lectures

Jo De Waele

Studies on caves and karsts are becoming more and more important for the scientific community in many disciplines. However, the publications which deal with these topics are usually only known within specialist circles and are therefore hard to access, even for speleologists themselves. The result is that such publications are rarely used for didactic purposes, not least of all because they usually only written in English.

In order to spread the scientific knowledge concerning speleology to the public at large, in 2006 the Italian Speleological Society (SSI) launched the "Progetto Powerpoint" (Powerpoint Project). After three years of work and with the support of the International Union of Speleology, this idea led to the creation of a DVD and an Internet site: *http://document.speleo.it/*.

Speleologia in Rete

Here are the shortcuts to the PPT project
http://tinyurl.com/68-progetto-powerpoint

There are more than 50 lectures in the form of Powerpoint presentations, created by experts in various sectors of technical and scientific speleology. More than 100 speleologists and other collaborators have contributed to the creation of the scientific texts, while the photographs were furnished by over 300 people. All the lectures have been translated into English, French and Spanish. The impressive numbers concerning the Project are shown in Table below.

The entire package of the Powerpoint Project has been named "*Teaching resources in Speleology and Karst 2009*" and the DVD was presented at the XIX International Speleological Congress in Kerrville, thanks to the financial backing of the *National Cave and Karst Research Institute* of Carlsbad.

The Powerpoint Project is freely available and is also and especially designed to meet the needs of speleological groups when they give courses for beginners. Anyone can download the desired lectures from *http://document.speleo.it/* and even adapt it, if need be, to the specific needs of the group, as long as the original source is cited.

The lectures cover the different multidisciplinary branches of speleology, from the classic introduction to speleogenisis, to biology, archaeology and even the communication techniques used in didactics.

The Powerpoint Project should in any case be considered as a project in constant evolution, also because many subjects can be further expanded or treated in more detail. ■

Principal characteristics of the Project

Lectures	58
Slides	>3600
Slides per Lecture	~ 62 (19-147)
Authors	120
Photographers	330
Illustrators	57
Reviewers	10
Typesetters	9
Final Typesetters	4
English Translators	8
English Reviewers	5
French Translators	20
Spanish Translators	4

Let's Clean Up the Dark: an environmental strategy of the Italian Speleological Society

Cave reclamation as an opportunity for knowledge and new sensibilites

Carlo Germani, Francesco Maurano

Since 2005, the Italian Speleological Society (SSI) has been organising and coordinating "Puliamo il Buio" (PiB - Let's Clean Up the Dark): days which are dedicated to cleaning up underground spaces (*www.puliamoilbuio.it*) and for informing local communities through shows, thematic meetings, didactic activities in schools and publications. These activities are connected to the international *Clean up the World* event (*www.cleanuptheworld.org*) which, in Italy, is coordinated by the *Legambiente* association (*www.puliamoilmondo.it*), of which SSI is a partner for this occasion.

The dumping of waste underground, when it isn't due to criminal activity, is largely a result of ignorance (real or pretended) of the possible consequences on karst aquifers. These make up a considerable part of the drinking water reserves in Italy. They suffer from human pressures more than other types of aquifers, because of the ease of hiding offered by caves and the very low self-cleaning capacity which characterises them. For these reasons, the contribution of speleological organisations can't be limited to simply pointing out the presence of pollutants and reporting offences. Instead, we believe that we need to create a common strategy in order to control the phenomena and to recover, where possible, the damaged karst environments.

In the period from 2005 to 2012 speleological organisations, mostly using volunteer work and through a series of underground operations which were sometimes very complex, have taken out and sent to authorised dumps about 131 tonnes of solid refuse, thus removing them from the underground water cycle. This is obviously only a small fraction of the garbage present underground and it was only possible to extract it thanks to the work of many dozens of speleologists. Speleologists have the necessary technical knowledge and experience for moving safely within the underground world: they can point out and sometimes solve cases of pollution and degradation in caves which would otherwise remain unknown.

Another important SSI initiative has been connected to the PiB events: the Survey of Cavities Environmentally at Risk (CRA), where the term "environmentally at risk" is understood as the presence of substances or situations which are able

Muriaturo shaft, Cusano Mutri (Campania). (Photo Archivio GSNE)

Neviera del Barone, Locorotondo (Puglia). (Photo N. Marinosci, Alto Salento Speleological Center)

Waste oil garbage dump in a cave in Karst of Trieste. (Photo A. Danieli)

to alter or pollute the underground waters. The CRA project has been active several years and the up-to-date results are always available on the site *www.puliamoilbuio.it*.
As can be seen from the data published in the aforementioned internet site, the pollution in most cases so far has to do with the so-called "solid urban waste", whose presence inside caves or artificial cavities is largely due to a lack of civility by those who visit a karst area, whether local inhabitant, excursionist, tourist or speleologist. Also "toxic waste" can be largely attributed to the same cause, as they are often used oils, car batteries, entire automobiles and hospital refuse.
Unfortunately, with the current state of the Regional Databases, is not always possible to establish a precise relationship between springs or water tables and particular caves. It's not even possible to exclude from the total number of cavities, those which are protected by law or by their situation (SIC areas, parks or reserves, high altitude), which would isolate them from human activities. In any case, even if incomplete and not exhaustive, the CRA gives accurate geographic indications, reliable numeric data and precious indications on how to guide the actions of speleological organisations, because it's not enough to count the risks but also coherent actions have to be undertaken to eliminate them, or at least reduce their effects. Unfortunately a damaged underground environment is unlikely to be successfully fully recovered, while in most cases speleological organisations have to limit themselves to reporting situations of risk or degradation, as they don't have the necessary resources for recovery work. Initiatives like PiB can, however, start important synergies between volunteers and public bodies, which, in some cases, can turn into true environmental reclamation operations. Cooperation with public bodies is also indispensable for obtaining protected statuses for areas, with the aim of avoiding repetitions of the degradations. ■

Busa Fonda (Asiago Plateau, Veneto). (Photo A. Danieli)

The map of ancient underground aqueducts

In between natural and artificial. The speleological research in the water paths built by men

Mario Parise, Sossio Del Prete, Carla Galeazzi, Carlo Germani, Mariangela Sammarco

The activity of cavers in the search and documentation of artificial cavities began in Italy several decades ago, when the first multi-disciplinary studies on the topic were carried out. They highlighted the remarkable presence and distribution of man-made cavities that have characterized the history of Italy in different epochs and for different purposes: rupestrian settlements, hydraulic works, religious and worship sites, underground mines and quarries, as well as other types of man-made cavities characterise the entire country.

In 1981 the Italian Speleological Society established the National Commission for Artificial Cavities, in order to encourage local and international studies, and to create a dedicated National Register, complementary to the one dealing with the natural caves.

Furthermore, the journal "Opera Ipogea" has been published since 1999 and is entirely dedicated to artificial cavities.

Beginning with the first congresses and workshops organized on the issue during the early 1980s, the significant role played by underground hydraulic works soon became apparent, strongly related to past history and civilization.

Without the availability of water, the development of settlements and villages, and the establishment of geographically stable inhabited areas were not possible.

This resulted in the 2003 National Commission on Artificial Cavities project "The Map of Ancient Under-

Above: in Naples' undergrounds, ancient caves get in contact with the flow of archaic aqueducts creating small pools. (Photo F. Ardito).
Below: ancient aqueduct, re-adapted during 1600 by the Monks of the Camaldoli Hermitage in Mount Tuscolo (Rome, Latium). (Photo archive Egeria Centro Ricerche Sotterranee)

ground Aqueducts in Italy", entirely dedicated to research, exploration, survey and analysis of underground aqueducts.
Italy contains a huge amount of hydraulic works on its territory, with long underground stretches, that constitute a valuable documentation of the skill and engineering techniques of the ancient communities. Due to their mostly underground development, aqueducts have often been preserved intact for millennia.
During these years of work, we have been able to collect a large amount of material and information about underground aqueducts, both through direct caving explorations and through analysis of the available documentation.
A detailed register of ancient underground aqueducts in Italy has been thus created, by filling in a dedicated form containing all the main information on the hydraulic structure (location, name, age, length, geology, instability problems, and so on), aimed at safeguarding these unique works of historical and hydraulic engineering importance.
So far, more than 140 underground aqueducts, distributed all over Italy, have been identified and studied, with the majority of them located in the Latium region (over 40 aqueducts).
Many other regions are also strongly represented in the database: for instance, Marche, Campania and Apulia are present with more than 10 aqueducts each.
The majority of the underground aqueducts date back to Greco-Roman age; even the many aqueducts of byzantine and medieval periods seem to follow, at least in part, more ancient courses of roman origin.
As concerns the length of the hydraulic works, most of the identified aqueducts range between 1000 and 5000 m, but the presence of hydraulic works with lengths of over 30 km is also significant (at least 15 cases).
The uses of the underground hydraulic works are quite varied: most of them were used to tap and transport water resources for towns, settlements and spas, but in some cases aqueducts were created to provide drinkable water for individual domus' or villae, military settlements, or for agricultural purposes.

Acquedotto della Formina (Narni, Umbria). (Photo C. Ranieri - Gruppo Speleo Archeologico Vespertilio)

Water supply gallery of the Fountain at Villa Grazioli. (Frascati, Latium; photo: archive Egeria Centro Ricerche Sotterranee)

Further activities have included the study of other types of hydraulic works, namely reclamation works and drainage tunnels.
The Project has been advertised through presentation in several Italian and international conferences, and with a number of publications, including special issues of the journal "Opera Ipogea" in 2007 and 2012. ■

References

Castellani V. (1999): La civiltà dell'acqua. Editorial Service System, Roma: 256 p.

Galeazzi C., Germani C., Parise M. (2012): Gli antichi emissari artificiali dei bacini endoreici. *Opera Ipogea,* n. 1, p. 3-10.

Parise M. (2009): Distribution and characteristics of ancient underground aqueducts in Italy. In: Proc. Int. Water Association Specialty Conference. 2nd International Symposium on "Water and wastewater technologies in ancient civilizations", Bari, 28-30 May 2009.

Parise M., Bixio R., Burri E., Caloi V., Del Prete S., Galeazzi C., Germani C., Guglia P., Meneghini M., Sammarco M. (2009): The map of ancient underground aqueducts: a nation-wide project by the Italian Speleological Society. In: Proceedings 15th International Congress of Speleology, Kerrville (Texas, USA), 19-26 July 2009, v. 3, p. 2027-2032.

Parise M. (2012): Underground aqueducts: a first preliminary bibliography around the world. In: Proceedings 3rd IWA Special Conference on "Water and Wastewater Technologies in Ancient Civilizations", Istanbul, 22-24 March 2012, p. 65-72.

Glacial Speleology Project

A fascinating research in a changing "freezing" underground world

Andrea Ferrario, Mauro Inglese, Paolo Testa, Paola Tognini

Beginning in the second half of the 19th Century, caves formed inside glaciers have been attracting the attention of explorers and researchers, but only at the end of the 1970s have new techniques and equipment, together with the increasing ease in reaching glaciers, brought a renewed interest in this kind of exploration: modern glacial speleology was born in this period. From the beginning Italian speleologists have been pioneers in the study and exploration of glacier caves, both in Alpine glaciers and abroad, and their activity began early in the 1980s. Big explorative expeditions on Patagonian or Asian glaciers sometimes gathered together a great number of cavers and speleologists, but, on the other hand, research on Alpine glaciers was limited for many years to very few people and small groups. Because of the intrinsic logistical and technical difficulties, glacial speleology in Italy has therefore always been carried out by small groups, working autonomously and independently from each other and with very few reciprocal exchanges of information. For over 20 years, small groups have thus been carrying out research and explorations inside the larger Alpine glaciers, but only in few cases are these activities coordinated and concentrated on a single glacier, monitoring and collecting data on its evolution through the years. This happened, for instance, on the Gorner (Swiss) and Forni (Lombardia) glaciers, which have been being studied and monitored, respectively, since the second half of the 1980s and 1990s. From this situation arose the need to create a contact between the different groups working on Alpine glaciers, in order to merge the collected data and information into one single database, to promote discussion and mutual exchange on technical and scientific experiences and to join forces for common projects. In 2008 some cavers and speleologists of the G. S. CAI Varallo, G. G. Milano CAI SEM and G. G. CAI Saronno caving groups had the idea of creating the Glacial Speleology Project (Progetto Speleologia Glaciale - PSG). The aim is to encourage exploration, documentation, data collection and monitoring of glacier caves. Within the PSG each group keeps its autonomy regarding targets, purposes and operating methods, but with the possibility of joining forces and experience for common activities and especially to put all the data into one common database. Over 50 cavers and speleologists are currently members of the PSG, from a dozen different caving associations in various Italian regions (Piedmont, Lombardy, Liguria, Tuscany Emilia Romagna, Veneto and Calabria). In the last few years, researches and explorations have been carried out on the Lombard glaciers of Forni, Ventina and Scalino (Valtellina, Northern Italy), and on the Gorner, Aletsch, Morteratsch and Pers glaciers in Switzerland. Two national-level exploration expeditions have been organized on the latter two glaciers: this allowed not only the collection of a large amount of data, cave surveys and videos and pictures, but also helped create moments of intense technical and scientific debate and exchange of personal experiences. In September 2012 a dye tracing test was organized, in cooperation with SUPSI (Professional University School of Italian Switzerland, in Lugano), with the purpose of investigating the presence of en- and sub glacial lakes in the Pers and Mortertasch glaciers. The cooperation of all the speleologist members of the PSG laid the basis for creating and organizing an inventory of glacial caves. This is a very important instrument for understanding how these caves change and evolve through time and allow the formulation, based on an objective data base, of theories and hypotheses on the genesis and evolution of these caves and on their relation to the glacier containing them. A code was developed which could give, for each cave, not only the basic information identifying the cave, but also information on when the cave was found, its morphology and its hydraulic activity. The next step will be to put all the collected data into a GIS database, which will allow a dynamic view of the caves through time. For spreading information, the PSG organized two glacial speleology courses, in cooperation with the National School for Speleology of the Italian Alpine Club, on the Forni glacier in 2009 and 2010, and a glacial speleology meeting in February 2012, during which lecturers from different Italian caving associations spoke about the results of their research and explorations. To promote information exchange, discussion about projects and results and to organize common activities, a mailing list was created, which presently includes over 90 speleologists and cavers. The PSG has the support of the Società Speleologica Italiana (Italian Speleological Society), the Commissione Centrale per la Speleologia del CAI (Central Commission for Speleology of the Italian Alpine Club) and the Federazione Speleologica Lombarda (Lombard Speleological Federation). In 2012 it began cooperating with the Servizio Glaciologico Lombardo (Lombard Glaciological Survey): a very good example of the "transversal way" of speleology, which is presently at the root of many recent Italian exploration successes. ■

Above: descent in a moulin on Morterasch Glacier (Switzerland). (Photo M. Inglese), facing page: contact cave on the Forni Glacier (Lombardy). (Photo C. Mangiagalli)

Palaeoclimatic research on speleothems in Italy

The search for time preserved in natural hourglasses

Ilaria Isola, Leonardo Piccini, Eleonora Regattieri, Giovanni Zanchetta

The word speleothem has now become commonly used in speleological literature for describing secondary deposits of chemical origin formed in a cave, such as limestone concretions (stalactites, stalagmites, flows, eccentrics, etc.) and other secondary minerals.

The mineralogical study of these formations goes back many years, but only since a few decades have researchers discovered the incredible scientific importance of speleothems as recorders of the climatic and environmental changes which have affected our planet in the past few millions of years.

The great incentive for research has come from the possibility of dating the limestone concretions with a high degree of accuracy, thanks to techniques based on isotopes of the uranium decay series (U/Th, U/Pb), to the fine-tuning of trace element analysis and the isotopic ratios of carbon and oxygen, which require ever decreasing amounts of sample material (by now reduced to only a few milligrams), permitting an ever greater temporal resolution.

In Italy, the palaeoclimatic study of speleothems started a bit later compared to other European countries and North America, but has quickly reached results having international relevance, thanks also to the participation of an always greater number of Italian and foreign researchers.

The caves of Monte Corchia (Lucca) are not especially rich in speleothems, at least compared to other Italian caves, but the fact that they go down very deep means that the percolation waters contain very little detritus and in general a low content of Ca^{2+}, which results in the growth of the speleothems being slow but without "background noise" and very sensitive to environmental changes. The particular structural organisation, with large parts of the karst system being underneath Palaeozoic crystalline rocks, resulted in the water being contaminated with high levels of uranium, making dating highly reliable and with a small margin of error. In the photograph, collecting samples in the "Galleria delle Stalattiti", which has resulted in an almost continuous record of the past million years. (Photo L. De Cesari)

Speleologia in Rete

An example: La Buca Onyx
http://tinyurl.com/68-paleoclimi

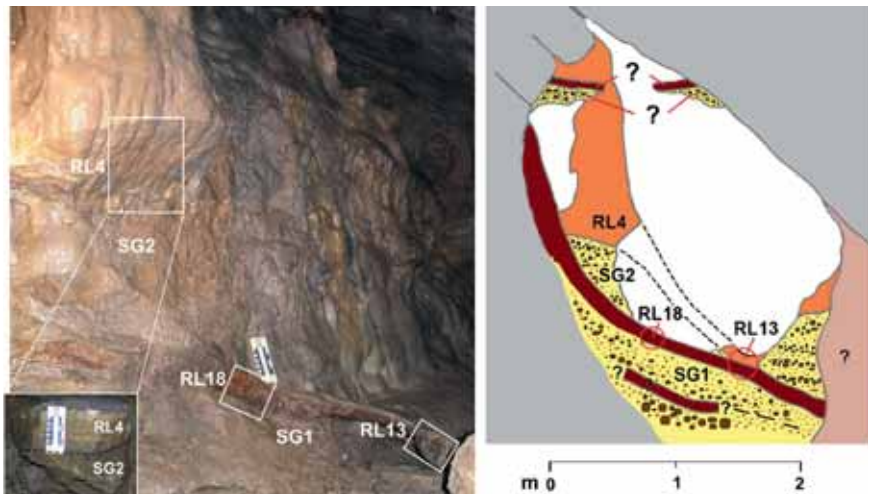
It's interesting, however, to remember that one of the first studies to use isotopic analysis techniques on speleothems dates back to 1968 and was carried out by the Laboratory of

Nuclear Geology of the University of Pisa (Laboratorio di Geologia Nucleare dell'Università di Pisa).
After that pioneering work, in Italy studies on speleothems for palaeoclimatic reconstruction only started again 20 years later, thanks to some ENEA researchers who sampled the concretions of submerged caves. These researches give important data for precisely reconstructing the sea level variations during the last glacial phases.
Around the same time, a group of researchers, first from the University of Milan, then from the Trieste Museum of Natural Sciences (Museo Tridentino di Scienze Naturali), collected samples from caves in the Central-Eastern sector of the Alps, among them the Grotta di Ernesto in Trentino, studying the environmental effects of the last glaciations in the Alpine area.
In 1998, following an initiative by some Tuscan speleologists and with the support of the Tuscan Speleological Federation (Federazione Speleologica Toscana), an informal research group was formed which carried out the first samplings in the Apuan Alps.
Over the years, the group became more recognized and receives interest and support from several research bodies, including the University of Pisa, the National Centre for Research (C.N.R.), the National Institute of Geophysics and Volcanology (Istituto Nazionale di Geofisica e Vulcanologia), the University of Florence and, successively, the cooperation of foreign bodies including

Position of the main caves where speleothems have been sampled for palaeoclimatic studies in Italy.

Limestone concretions, along with their aesthetic value, are exceptionally interesting from a scientific point of view thanks to the fact that they "record" the environmental and, especially, climatic changes in great detail.
(Photo M. Vattano)

Newcastle University in Australia and the SUERC of Glasgow (UK).
This group of researchers, after carrying out exploratory samplings in various caves in the Apuan Alps, found that the Monte Corchia Karst Systems was a study subject of exceptional scientific value, thanks to the continuity of its concretions which cover almost 2 million years. Other caves which have given interesting results in the Apuan Alps are the Buca della Renella and the Tana che Urla, the latter mentioned by the famous naturalist Antonio Vallisnieri in 1723, which have permitted the reconstruction of recurring extreme precipitation events and/or particularly dry phases during the Upper Pleistocene and the Holocene.
Following the first encouraging results, in 2001 a national project took off, financed with ministerial funds, it had the aim of comparing the responses of speleothems distributed all along the Italian peninsula



Stratigraphy of the flowstone deposit studied in the Grotta Renella (Massa). The speleothems are mainly post glacial and give a detailed record of the main hydrologic events of this cave, which has experienced periodic flooding in the past.

to climatic changes in Late Glacial-Holocene periods.
This project, which ended in 2003, witnessed the participation of research institutes belonging to universities of Padua, Florence, Rome III, Palermo, Trieste and the Trieste Museum of Natural Sciences.
In the last few years, palaeoclimatic studies on speleothems have been extended to other regions, among which are Piedmont, Emilia Romagna and Sardinia.
The Italian peninsula, despite not being very wide, has become particularly interesting for palaeoclimatic studies, especially thanks to its longitudinal extension and to its position in the centre of the Mediterranean, straddling the European and African continents. Thanks to the variety of climatic situations, which go from the Alpine arc which was heavily glaciated doing the Quaternary and tied to the climatic dynamics of Central Europe, to Sicily which is already in the area influenced by the tropics and is tied to the climatic dynamics of the Northern Sahara, the peninsula is proving to be an excellent laboratory for palaeoclimatic knowledge of the Quaternary.
The distribution of karst areas and the extent of knowledge about them, allow researchers to have real access to speleothems distributed all over the country, which had formed in morpho-climatic conditions very different from one another and in a timeframe which embraces at least 3 million years (from the Upper Pliocene to today). ■

Note: an exhaustive list of the scientific publications concerning palaeoclimatic research on speleothems carried out in Italy can be found at: *http://tinyurl.com/68-paleoclimi*

The impressive speleothems of the Grotta di Santa Barbara (Iglesias), one of the most important cavities in Italy for the variety and beauty of its speleothems. (Photo A. Naseddu)

References

Bard E., Antonioli F., Silenzi S. (2002): Sea-level during the penultimate interglacial period based on submerged stalagmite from Argentarola Cave (Italy). *Earth and Planetary Science Letters*, n. 196, p. 135–146.
Fornaca-Rinaldi G., Panichi C., Tongiorgi R. (1968): Some causes of the variations of the isotopic composition of carbon and oxygen in cave concretions. *Earth Planetary Science Letters*, n. 4, p.321-324.
Frisia S., Borsato A., Preto N., McDermott F. (2003): Late Holocene annual growth in three Alpine stalagmites records the influence of solar activity and the North Atlantic oscillation on winter climate. *Earth and Planetary Science Letter*, n. 216, p. 411–424.
Frisia, S.; Borsato, A.; Spötl, C.; Villa, I.; Cucchi, F.; (2005): Climate variability in the SE Alps of Italy over the past 17 000 years reconstructed from a stalagmite record. *Boreas*, n. 34, p. 445– 455.
Frisia S., Borsato A., Mangini A., Spötl C., Madonia G., Sauro U. (2006): Holocene climate variability in Sicily from a discontinuous stalagmite record and the Mesolithic to Neolithic transition. *Quaternary Researches*, n. 66, p. 388–400.
Zanchetta G., Drysdale R.N., Hellstrom J.C., Fallick A.E., Isola I., Gagan M., Pareschi M.T. (2007): Enhanced rainfall in the western Mediterranean during deposition of Sapropel S1: stalagmite evidence from Corchia Cave (Central Italy). *Quaternary Science Review*, n. 26, p. 279-286.
Zhornyak. L.V., Zanchetta G., Drysdale R.N., Hellstrom J.C., Isola I., Regattieri E., Piccini L., Baneschi I. (2011): Stratigraphic evidence for a "pluvial phase" between ca. 8200-7100 ka from Renella Cave (Central Italy). *Quaternary Science Review*, n. 30, p. 409-417.

The Speleoteca Project

A unified catalogue of the Italian caving libraries

Michele Sivelli

If you search the Internet for "speleoteca", you will immediately find the *www.speleoteca.it* OPAC, which allows the free consultation of more than 30,000 bibliographic records of caving publications from all over the world.

The Speleoteca Project started in 2007 as a natural evolution of the previous catalog of the Italian Speleological Society's "Franco Anelli Library".

When the Anelli Library was officially founded 30 years earlier, its goal was to provide the same, or at least a similar "cultural service" to that offered by any other public library.

At the beginning a simple database (Db3) working on a local workstation was the only available service. Later it was implemented as an Access database and finally all the old data was recoded into the current cataloging software with online access, meeting all the requirements of the standard bibliographic description (ISBD rules).

This new program also theoretically allows a direct connection with other caving group's libraries which are willing to use the same software. This option provides the advantage of a synergy, moving towards creating a truly unified catalog of the Italian caving libraries.

Currently Speleoteca, is a work-in-progress project which is continuously expanding and improving its bibliographic database. But it is should be remembered that that many of the original records are still incomplete or inaccurate, because, as previously mentioned, they are the result of several recoding operations. Additionally, the original descriptions were applied by different operators over the years.

Speleologia in Rete
Want to know more?
http://tinyurl.com/68-speleoteca

Centro Italiano di Documentazione Speleologica **Franco Anelli**
www.cds.speleo.it

To date, the Associations joining the Speleoteca project are spread throughout Italy and their number is constantly rising: the "choose library" field in the "simple search" function of the OPAC shows the current list of linked libraries.

The possible queries are quite simply the ones typical of all OPACs: from simple Author/Title searches, to multiple criteria (Author/title, series, classifications, subject, year, standard number, etc...). It must be stressed that the Dewey Decimal Classification was not adopted, because of its poor applicability to caving. Instead, we decided to use the UIS code of the Bulletin Bibliographique Spéléologique/ Speleological Abstracts in its more extensive adaptation created by Aleksander Klimchouk.

Currently, the search by "subject" is aimed not only at finding the conceptual content of the cataloged documents, but also to list the Nations or States in which the scientific research or exploration were carried out: this because we know how important is for cavers to know what has been done in a given geographical area.

Moreover "keywords" can easily incorporate the complex search for subjects with other names of geographic interest (i.e.: names of karst areas, names of caves, mountain ranges, provinces, departments, etc.).

As a recent development, Speleoteca is now also accessible in English, with a tutorial, and all search fields have been translated.

Many challenges await the Speleoteca Project in the future. First of all, it needs to be made as contemporary as possible, allowing online access to the original documents. In most cases, this will make physical visit to the libraries unnecessary, which is an advantage since they are often scarcely accessible mainly because they are almost entirely managed by volunteers.

Over time, Speleoteca will probably become a combination of hybrid libraries, partly digital and partly classical. In fact, an authors' consent is needed to digitalize their work and, even when the copyright problem is solved, financial resources must be available for digitalizing.

To date many covers of the cataloged documents are already visible as well as some tables of content.

Our dream is that, in the future, the Speleoteca's OPAC will become a Meta OPAC of the European Speleological Associations. To reach this goal, a feasibility study was recently made in co-operation with the French (FFS), Belgian (UBS) and Swiss (SSS/SHG) colleagues, though some technical and economic difficulties still hinder its practical implementation. ■

Spatial Speleology - The CAVES Project of the European Space Agency

Caves as a real and metaphoric Martian speleology

Loredana Bessone, Jo De Waele, Francesco Sauro

Exploring the depths of space is an activity accessible to few people, in a hostile, dark, and unknown environment with limited resources. The operations are complicated by many tasks: tests and installation or fine-tuning of on-board systems, scientific experiments, protocols to be followed rigorously. Each activity requires full attention and technical abilities, many of the tasks need high level motor abilities and most duties are based on team work requiring clear communication and perfect coordination. For their training, astronauts need simulators and terrestrial environments as similar as possible to that of space: modules built on the ocean floor, bases in Antarctica and in hot deserts. One of the terrestrial environments which best mimics a planetary world, such as the one on Mars, is without any doubt the cave: darkness, constant temperature, limited visibility, physical obstacles, strict safety rules, isolation, loss of temporal cognition, difficulty in supplying materials and food, the necessity of working in a team. If exploration and documentation tasks and scientific sampling and experiments are added to these stress factors, the similarity of a cave mission to an extraterrestrial one becomes even more striking.

For all these reasons, since a couple of years, experts of the European Space Agency (ESA) have chosen some natural caves in Sardinia as their playground for the simulation of a space mission. This ESA Project, called CAVES, has the aim of training astronaut teams, supported by expert cavers in various disciplines coming from different Italian Universities. These astronauts will end up working in multicultural teams, efficiently and safely, in critical operational environments during long missions. During the CAVES course, the group dynamics and the individual performance of the astronauts will be analysed. Similar training courses are held by Russians and Americans in survival or submarine contexts. These courses are based on behavioural models derived from the analysis of activities carried out in critical environments, originally developed by NASA and later applied to civil aviation, now also being extended towards the training of traffic control personnel operating in flight control towers and train stations, nuclear power stations, petroleum platforms and, in the last few years, medical personnel in operating rooms.

The many teaching modules of the Course occupy 11 days, of which 5 are dedicated to technical and scientific training, and 6 days are spent in a subterranean camp site located at over half a kilometre from the entrance of the cave. The astronauts have the task of exploring and documenting the cave, also carrying out a series of programmed experiments, accord-


Foto V. Crobu, Progetto CAVES ESA


Foto V. Crobu, Progetto CAVES ESA

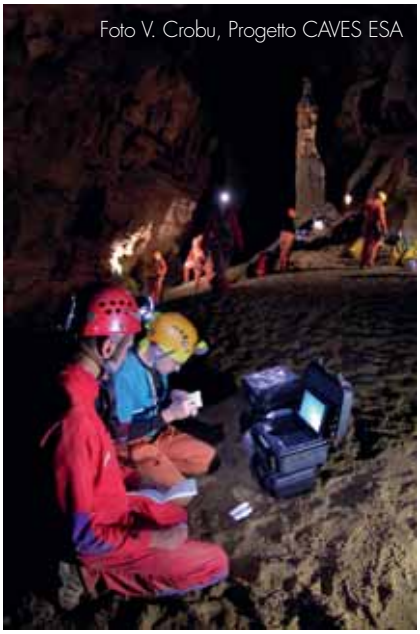
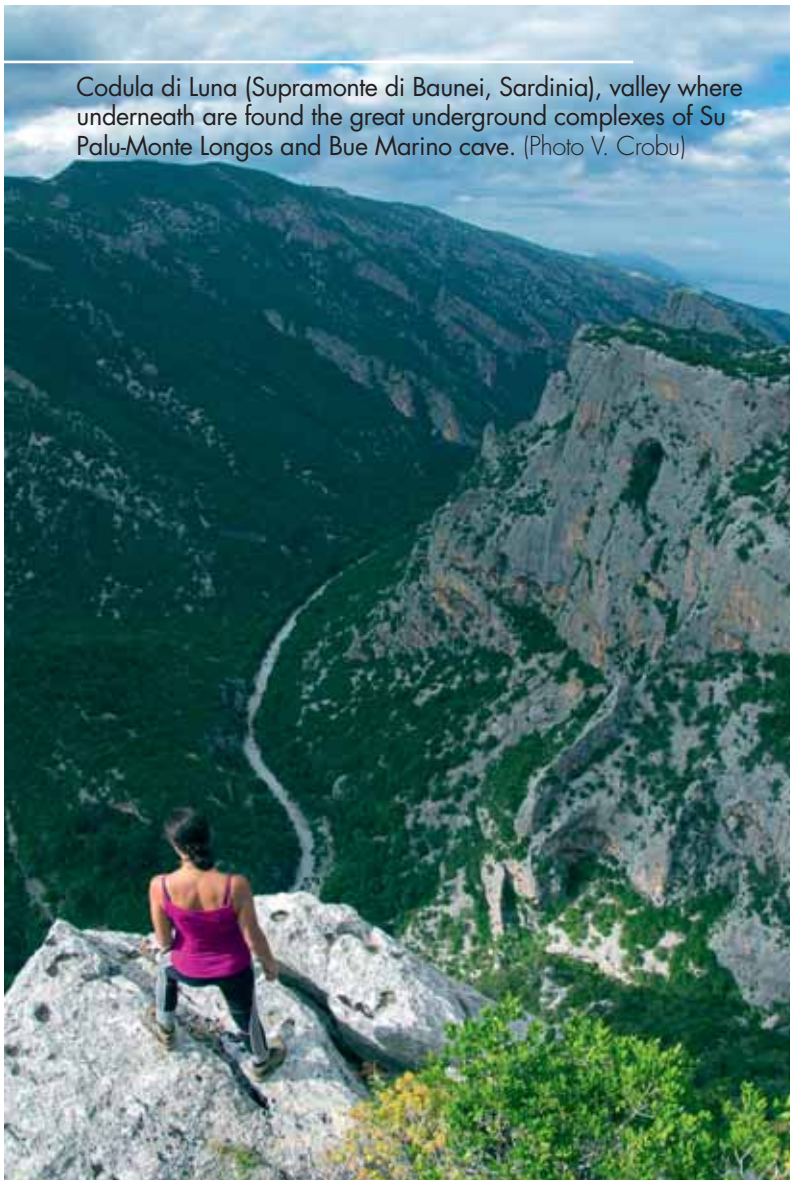


Foto V. Crobu, Progetto CAVES ESA

ing to a daily time schedule similar to the one used on the International Space Station. The scientific program comprises sampling of waters, microbiological and biological sampling, measurements of CO_2, drip rate, radioactivity and the management of a micrometeorological station that measures temperature, relative humidity and the wind speed and direction in a narrow cave passage. The data retrieved during the missions in 2011 and 2012 have shown great promise, confirming that some of the scientific experiments are not only meant for the training of astronauts, but can also lead to new scientific speleological breakthroughs in this area of Sardinia. For example the biological researches, based also on the DNA analysis of the sampled troglobites, have led to the discovery of a new species of Isopod Crustacean.
The astronauts also perform experiments with new generation technical equipment, like the TEDRA^{tm}-S1 subterranean communication system (Through Earth Digital Radio Appliance), that could be very useful for cave rescue operations in the near future, or the advanced digital cave surveying system called CaveSniper, produced by Polish cavers and engineers.
At the end of the mission the astronauts compile a report on the activities they carried out, interpreting the scientific data obtained during their stay underground. All this material is then passed on to the next team of "astronaut-explorers".
In other words, the CAVES Project is also an opportunity for Speleology, an activity that is often poorly considered and that, at least in this case, is taken seriously by large Space Exploration organisations as a potential resource for preparing for missions beyond the boundaries of our planet. Speleological explorations often carried out in the darkness and near secrecy of our own caving world, are now showing their importance for the entire human race. ■

A journey across speleological Italy


Su Gologone (Oliena, Sardinia), spring of the vast Supramonte di Oliena and Orgosolo karst system, areas where the CAVES Project experiments are carried out. (Photo V. Crobu)


Codula di Luna (Supramonte di Baunei, Sardinia), valley where underneath are found the great underground complexes of Su Palu-Monte Longos and Bue Marino cave. (Photo V. Crobu)

Winds, clouds, rains in the dark: the quest for the imperceivable meteorological events in the Reign of the Dark

When slight variations of temperature indicate great, continuosly acting processes

Giovanni Badino

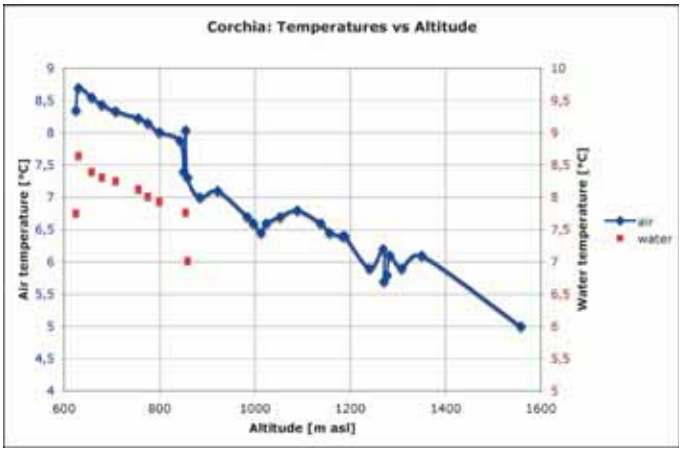
In Italy the interest in the microclimatic processes in caves has always had a certain attention, especially for its applied character in the field of environmental protection; it is enough to remember the many papers that have brought Arrigo Cigna to become the scientific inspirator of the International Show Cave Association (ISCA), the international organisation that, more than anyone else, studies these aspects. Personally I have started studying these processes from the mid 80s, trying to give a physical explanation on one hand – something that had not been done before – and on the other to realise a series of measurements in several important and big caves. The main questions that were challenged were two: i) what makes temperature to become relatively stable in caves on a certain end well-defined value, and ii) what causes the underground air mass movements.

The temperature of a cave is an interesting concept. For the external meteorology the idea itself of "temperature" is conventional and imprecise, but in caves it assumes a precise significance since it is close to equilibrium. It is possible to make measurements precise up to a thousanth of centigrade, an accuracy level that outside would have absolutely no physical meaning. This is how the micro-variations are revealed: clouds, thermal sedimentation, condensation, mixing of air currents. In practice the invisible subterranean meteorology is unveiled…

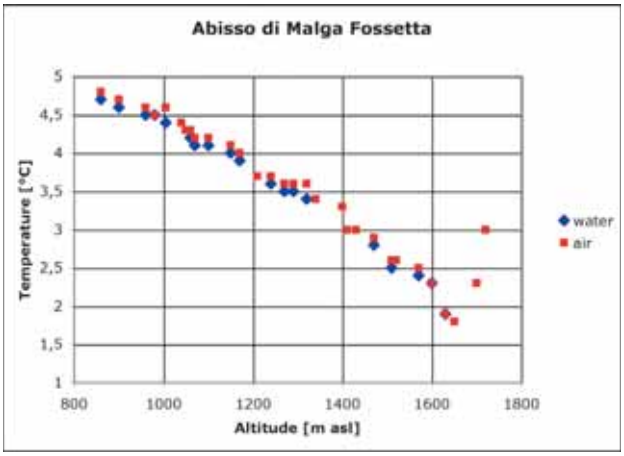
Simultaneous wind measurements in different entrances of a great cave system. Installation of the sonic anemometer at the entrance Eolo of the Mt. Corchia cave system. (Photo G. Badino)

The "vapor" column – in reality a mixing cloud – coming out of the Fummifere Acque entrance, Auyan Tepui, Venezuela. The air masses that move in the underground undergo special thermodynamic transformations that make them become unstable respect to the outside climate. Many physical effects are thus generated, many of these are invisible, but sometimes they can be spectacular, as in this case. (Photo G. Badino)

These measurements have allowed us to discover unexpected results. The various areas of the world show annual thermal variations comprised between values of 5 and almost 40 °C in continental environments (Ulan Bator) and 8 °C in oceanic settings (Ushuaia). Furthermore, between the areas with greatest solar irradiation (central Sahara, 320 Wm^{-2}) and those in shadow (North Atlantic, 50 Wm^{-2}) there is only a difference of factor 6. Underground, on the other hand, the annual thermal excursions in certain caves can be around 1-2 °C, to descend at values 100 times less in others, or even in certain areas of the same cave. The energy fluxes



Tempareture variation relative to altitude changes in the Mt. Corchia Cave system (LU). The external topography allows air and water to enter at different altitudes, creating temperature variations and internal clouds to form by mixing phenomena. The most regular part of the curve corresponds to the cave passages in which the river flows, since these waters are able to buffer the variations thanks to the great heat capacity of water.



Temperature variations relative to altitude changes in the Malga Fossetta abyss, Asiago Plateau (VI). The impressive uniformity is due to the extremely regular surface topography, causing air and water to enter at more or less the same altitudes. The slight slope variation in this curve at lower altitudes has revealed a small topographical error in the cave survey of the deepest areas…

have even greater variations: caves like the Underground River of Palawan (Philippines) have mean energy fluxes around 10-20 MW, while other caves – especially those with rock art – are crossed by energy fluxes of around 1 W.

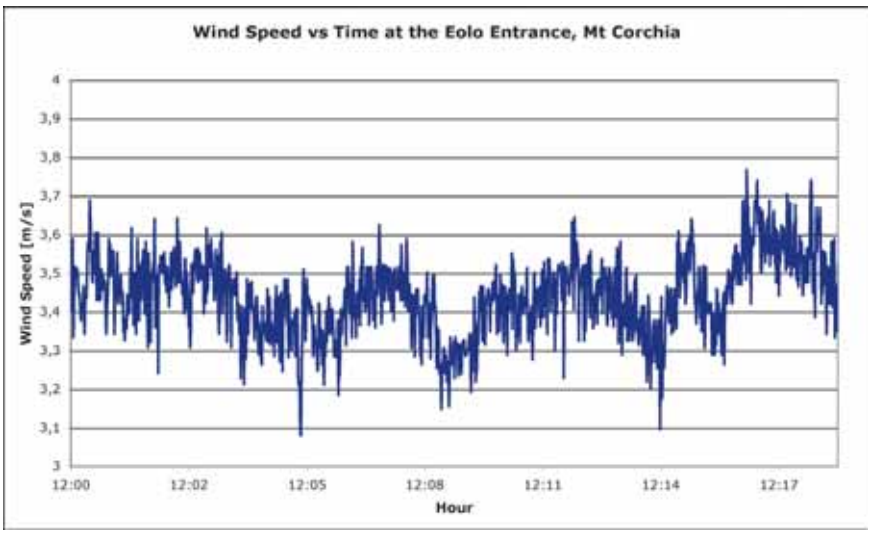
All of this indicates that the physical characteristics of a cave, and thus its "sensibility", is a much more complex problem than previously thought, but probably it can explain also the complexity and variability of the underground morphologies. On the other hand, if we were to observe the Earth with a thermometer with a resolution of 100 °C it would be difficult to explain the presence of deserts and forests, or glaciers and steppe.

A topic that has been the subject of a big research campaign has been the temperature variations according to the altitude in deep cave systems.

Subterranean Laboratory of Rio Martino (CN). In this cave the techniques to measure temperature accurately up to thousanths of a centigrade have been developed. (Photo P. Barcellari)

Outside the temperature changes by 6.5 °C/km. This value is given by the natural cooling down of an ascending air mass (adiabatic expansion of variously wet air), but the situation in caves is much more complex, since the air is in thermal contact with the flowing waters that have a different thermal natural gradient, since they warm up by 2.34 °C for each km of descend. A series of measures in very deep caves has allowed us to demonstrate that the gradient in a deep karst massif is intermediate, between 2.8 and 4 °C/km, with deviations toward the adiabatic gradient of the dominant fluid (air or water). This brings with it a series of very important consequences. To begin with, in great cave systems air and water are never in complete thermal equilibrium, thus creating condensation, corrosion, deposition. Also these instabilities are periodical, bringing seasons also underground where nothing appears to change at all. Finally, the water that has crossed the mountain flows out of the spring with a much higher temperature respect to that gained by falling down, meaning it substracts thermal energy from the internal air masses. So, if there is no question about the fact that water is the chisel that excavates the caves, from these simple thermometric con-

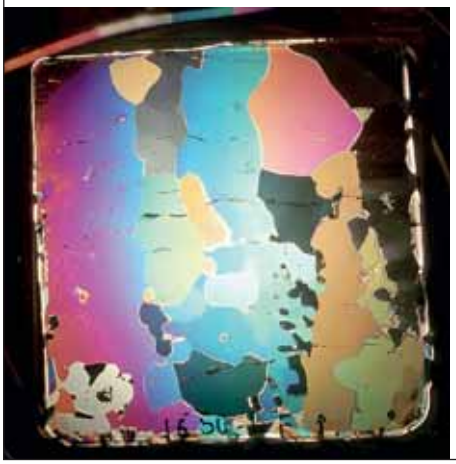
siderations it becomes obvious that the hammer that hits the chisel is nothing else than the air flow…
More recently we started analysing air flow in caves, connecting it to the external meteorology to try and extrapolate information on the underground world. The most ambitious part of this research is the part regarding infrasounds. Caves can be considered as resonating networks of interconnected voids. The sonic changes – obviously not hearable but detectable using instruments like anemometers – wherever these are measured contain informations on the structure of the entire subterranean network. The analysis of these harmonic waves coming out of caves (a sort of sonic "fingerprint") should allow to get some morphological information. But this is not easy… ■



Wind speed variations measured at the Eolo entrance, Mt. Corchia cave system (LU), 20 minutes of monitoring at 1 Hz frequency. The wind measured with a sonic anemometer, appears to be very regular, but in reality is very complex. This behavior is linked to the extreme complex nature of the cave system, composed of different connected cave branches with different entrances. This behavior can be seen at all scales, up to several hours, but the spectra show the presence of some main frequencies related to resonance.

Ice in caves

Italian cavers and speleologists are also quite active in studying ice deposits in caves and some of them (associated with the Science, Environment, Territory and Earth Science Department of the Università degli Studi Milano Bicocca) took part in the establishment of an international research group: every two years the group organizes the IWIC International Workshop on Ice Caves, which last year was held in Italy, in Barzio (LC).
In Italy, ice deposits in caves are rare and small in volume, compared to other places all over the world, and they are generally limited to Alpine and Prealpine caves. Nevertheless, very special microclimate conditions allow their existence in unexpected places, such as on Mt. Etna or in the Apennines. Since they are formed and preserved thanks to special conditions, ice deposits in caves are a very important and precious data archive which allows the reconstruction of climate and environmental conditions back several thousand years. They are studied with the same methods used for ice cores from Alpine and polar glaciers. Right: Dobra Picka Cave: the terminal tongue of the inner ice deposit. (Photo S. Sedran)



In the LO LC 1650 Cave, in Moncodeno (Northern Grigna, LC), at a depth of – 80 m, an ice core was sampled in 2002 from a perennial ice deposit. From the core a thin section was cut, which was photographed under cross polarized light with a petrographic microscope, to show the particular texture of the single ice crystals. The sampled cores were studied both from a crystallographic point of view, to reconstruct the environment in which the ice was formed (probably a lake), and with physical, chemical and isotopic analysis. (Photo S. Turri)

Paola Tognini

The underground karst Laboratory of Bossea

A constant monitoring of the cave environment and hypogean biology

Bartolomeo Vigna

The Bossea cave is one of the oldest show caves in Italy. In the cartoon, a1891 picture of the "Grande Cascata". (Archive Cids Bologna)

The basic structure of the laboratory was built between 1969 and 1972, by a team of volunteers from the CAI Alpi Marittime of Cuneo Speleological Group. That is how the Scientific Station of Bossea got started, structured since its beginning into a Biological and a Hydrogeological Section.
The laboratory has seen a gradual growth of the basic installations and equipment, as well as a parallel growth of research activities, thanks to the continual financial contributions granted by some public institutions.
The original scientific station is now the *Underground karst laboratory of Bossea,* managed by the Scientific Station of CAI Cuneo, the DIATI Department of the Politecnico di Torino and the Central Scientific Committee of CAI.
This structure now leads the field of underground karst laboratories in Italy, in terms of instrumentation and research activities carried out.
The underground laboratory is placed within the Bossea Cave, an important cave partially equipped for tourist activities, located in Valle Corsaglia (Frabosa Soprana, CN). A large stream flows through this cave, which on the way is increased by a series of small water supplies characterized by a very low flow rates, but reflecting the circulation in the network of fissures that feed the main catchment basin.
The karst aquifer is characterized by the presence of Mesozoic carbonate layers which are laterally confined by a basement of Permo-Triassic rocks (metavolcanic rocks and quartzites) through a series of sub-vertical faults.
This structural layout highly influences the surficial and underground water circulation.
The hydrographical reticulate is characterized by the presence of a series of small streams that flow in valleys deeply embedded in rocks the metamorphic basement having low permeability of which are then absorbed by a series of swallow holes located close to the main tectonic contacts.
Today the laboratory is organized into a main station installed in the lower part of the cavity, in a cutting-edge station located in the upper part and in a number of peripheral stations scattered in different sectors of the cave.
There are four main research areas: karst hydrogeology, cave meteorology, natural radioactivity of the underground environment and biospeleology.

Speleologia in Rete
Virtual visit to the Cave of Bossea
http://tinyurl.com/68-bossea

Constant monitoring of the secondary water supplies for the study of hydrochemical and chemical-physical parameters. (Photo B. Vigna)

The hydrogeological research

The study mainly focuses on the hydrodynamics and geochemistry of the waters of the main catchment basin and the multiple secondary inputs fed by the networks of fissures of the carbonate massif.
The monitoring of the main catchment basin began with the continuous gathering of data in 1982, through the construction of a weir located in the final sector of the cavity.
Then a impressive amount of data was gathered, also regarding very particular hydrogeological situations like long periods of drought or exceptional flooding events.
The research concerning the secondary inputs started in 1983, with occasional measurements of some seepages but only in the last decade has the study been extended to various locations with continuous monitoring of the main hydrodynamic and chemical-physical parameters of the waters.
A series of sampling of the waters flowing in the cavity in different hydrodynamic conditions, followed by chemical analyses carried out in the Hydrogeological Research Laboratory of the DIATI, allowed a more detailed characterization of the chemical typologies of the flowing waters and a better understanding of the flow behaviour in the networks. The chemical analysis of the waters was carried out by testing for the main elements with the addition of the rare earth (lanthanides) and metal content. Through numerous tests with dye tracers and continual analyses of the dye return curve, it was possible to gather more information regarding the underground circulation in the different zones which constitute the aquifer system of Bossea.

The meteorological research

The meteorological study regards a series of measurements concerning the underground environment and the behaviour of seepage supplies linked to rainfalls and snow melt in the area above the cave. In Bossea, data is gathered concerning the weather condition and air circulation linked mainly to the regime of the underground stream. Temperature and airspeed, relative humidity, evapo-condensation and carbon dioxide concentrations are measured in a continuous, or sometimes localized, way in different zones of the cave. The availability of this data allowed the examination in detail of the impact the visitors have on the underground environment.

The study of natural radioactivity in the underground environment

The study of natural radioactivity found conditions of particular interest in this cave environment, as the entire karst system is confined in Permian metavolcanic rocks, locally fractured or cataclastic, which show a substantial amount of radioactive activity due to a significant content of radioisotopes. From the radioactive decay process of the Uranium 238 series derives the Radon 222 gas which propagates in the waters and the atmosphere of the cavity. To this end an advanced research project was launched, for analyzing the exchange dynamics of the gas with the rock matrix, waters and atmosphere.
This study is carried out through occasional or continual collaborations with various scientific entities operating in this specific sector: the Radiation Section of ARPA Valle D'Aosta, the Radiation Section of the Ivrea Department of ARPA in Piedmont, the Research Centre for Marine Environment of ENEA in Lerici - S. Terenzo, the Faculty of Nuclear Sciences and Engineering Physics of the Czech Technical University in Prague. The fieldwork was possible thanks to the availability of completely innovative instrumentation for the continuous measurement of radon in waters, which allowed measurements that were not feasible before. This research recently led to obtaining interesting information concerning the existing relationships between the underground flow rate and the increase of the release of radon from the rocks.

The biospeleological research

The biospeleological research resumed with great vigour a few years ago, after a long period of stasis. A series of research campaigns, carried out in the Bossea Cave, led to the discovery of many new organisms which greatly increased the wealth of knowledge on animal biology of the Bossea underground environment. In the cavity, 75 different species of wildlife have been discovered so far. It is now time to resume the ethological studies on the different life forms, to be carried out in the terrariums and aquariums of the biological laboratory. ■

Peripheral monitoring station.
(Photo B. Vigna)

The Grotta Gigante's geodetic laboratory

Refined instruments for a study centred on the "Earth in movement"

Franco Cucchi

The Grotta Gigante ("Giant Cave") lies in the classic Trieste Carso (Karst) and is, since 1908, one of the most famous and spectacular show caves in Italy. It is made up of a main branch with a large chamber (167 m long, 98 m high, 76 m wide, with a volume of about 365,000 m^3) and several side branches which go down to a depth of 252 m for a total length of 719 metres.

Thanks to its size, to its particular morphology and to the presence around Trieste of important institutions involved in research in the karst-speleological field, this cave has become a scientific laboratory in which, since 1959, multidisciplinary research has been carried out.

The "cave-laboratory" project is run by the Department of Mathematics and Geosciences of the University of Trieste (Dipartimento di Matematica e Geoscienze dell'Università di Trieste - DMG_UniTs) and by the Commissione Grotte Eugenio Boegan of the Società Alpina delle Giulie di Trieste (CGEB) and takes place in and in the immediate vicinity of the Grotta Gigante.

The horizontal pendulums and the inclinometers

In the middle of the cave's large chamber is a pair of horizontal pendulums placed.

This instrument, installed by Antonio Marussi in 1959, observes the deviation from the vertical, the rotations and the deformations of this singular "underground box" (and therefore the Carso's entire limestone platform).

Speleologia in Rete

A Guided tour of the Grotta Gigante ... free!
http://tinyurl.com/68-grotta-gigante

The large size of the pendulums, which have a length from the upper to the lower attachment points of 95 metres, give them a very large amplification factor, high stability, high sensitivity and eliminates the sources of noise typical of smaller instruments.

The pendulum's shaft is suspended horizontally from 2 nickel-chrome steel wires having a diameter of 0.6 mm, in their turn attached to the cave's vault and floor.

Each pendulum's shaft rotates in the horizontal plane around a virtual rotation axis formed by the link of the two points. In 1997 a pair of traditional inclinometers with Zöllner suspensions of 0.5 metres diameter were installed. The registered movements are aperiodic or of regular repetition.

The crust responds to lunar and solar attraction (like tides), with ascents on the order of tens of centimetres which results in inclinations from the vertical of a few billionths of a radian.

The study of the pendulums' movements also allows the identification of: the free oscillations of the earth, the centuries-long tilting of the Carso towards Northwest (probable effect of the Adria plate's movement), some thermo elastic effects, the loading effect of the Adriatic Sea's tides,

The big chamber in Grotta Gigante.
(Photo Archive Grotta Gigante)

the deformations induced by the passage of the Timavo's flood waters and the aperiodic oscillations due to large earthquakes.

The meteorological station

On the outside adjoining the cave, a meteorological station has been active since 1968. It keeps traditional mechanical instruments operating alongside the automatic recording units. It is run by the *CGEB* with the *Osservatorio Meteorologico del Friuli Venezia Giulia* (www.meteo.fvg.it), the *Consiglio Nazionale delle Ricerche* (www.ts.ismar.cnr.it) and the *Servizio idraulica* (www.regione.fvg.it). Since 2007 the station has been part of the European transborder monitoring network for *Local Severe Weather*. The site has an average annual temperature of 12.3° C (over the 1971-2000 period) and 1342 mm of precipitation distributed on average over 131 days, 7 of which are snow; 60 days have temperatures below zero, with an absolute minimum of -14.9° C measured on January 14, 1968. The absolute maximum measured so far is 37.8° C. measured on August 12, 1998.

The station for the measurement of karst dissolution

In 1979, the CGEB along with the DMG_TS, installed an experimental station for the measurement of the surface dissolution of carbonate rocks near the cave. The measurements are obtained using a Micro Erosion Meter, which is able to read reductions with a resolution of 1/1000th of a millimetre. Each measurement point (there are about 20 positioned on the karst rocks around the cave) consists of 3 hardened stainless steel screws cemented into the rock. The particular combination of the screw's shapes and the instrument's resting surfaces guarantees self-centering on the order of a micrometre. The readings are timed so as to show the relationship between rain and the lowering of the rock.

The measuring station is expanded by exposing an additional 24 samples of limestones, dolostones and chalks originating from different Italian karst areas (Trentino Alto Adige, Venetia, Tuscany, Marche, Abruzzi, Puglia, Sicilia, Sardinia and Friuli Venezia Giulia).

The average consumption of the carbonate rocks, from 1980 to today, is about 0.02-0.03 mm/year, which means a real lowering in 30 years of measurements of nearly one millimetre.

Inner rooms and showcases of Grotta Gigante Speleological Museum. (Photo Archive Grotta Gigante)

The visitors' reception Centre and the Grotta Gigante Speleological Museum. (Photo Archive Grotta Gigante)

The water monitoring network

In a side shaft of the cave, special instruments allow the continuous measurement of the waters which fill the cave during and after precipitations. These measures, carried out with instruments which belong to a monitoring network of the Timavo's waters, allow the understanding of the entire dynamics of the Carso's water table, starting from the Škocjanske jame sinkhole 30 km to the southeast in Slovenia, to the springs near San Giovanni di Duino in Italy, about 10 kilometres northeast of the Grotta Gigante. From these measurements, it has been possible to determine that these waters, whose underground course in only known in a few specific points (three cavities in Slovenia, around 10 in Italy), move very slowly in normal conditions, but reach speeds of 23 cm/sec during flood events. ■

The Cave Laboratory-Museum in Monte Cucco

Didactics centred on the relationship between people and the karst environment

Francesco Salvatori

The limestone Apennine, which acts as a border between Umbria and Marche, has many large caves. Among them are the cavities of the Frasassi Gorges (Gole di Frasassi), of Monte Nerone and of Monte Cucco. They were created mainly by highly acidified fluids rising from below (hypogenic speleogenisis) and are the underground skeletons of the hydrogeological basins which gather large amounts of meteoric water. At the base of these large basins, a large part of the waters which are collected deep down go to feed a very large number of springs, large and small, which have furnished the aqueducts of large cities (such as Perugia, Ancona and Fabriano) and of many other smaller towns for a very long time. The strong connection between karsts and human activities is especially evident in the Monte Cucco Massif (now a Regional Natural Park), where the underground system of the Grotta del Monte Cucco feeds the Scirca Spring.

The laboratory-museum of the Monte Cucco Park Caves (Grotte del Parco del Monte Cucco) was born with the aim of showing, both to experts and to the public at large, the importance of the relationship between Apennine karsts and human activities, as well as the particular environmental characteristics of this imposing karst system, not least its extraordinary hypogenic origin. The creation of the laboratory-museum is also tied to the creation of a more complex education and knowledge structure, where it is integrated with the Scirca Spring and the Grotta di Monte Cucco. The visit to the spring, which follows that to the cave and is concluded in the laboratory-museum, is a highly effective way to explain the origin of karst waters.

These structures have also been planned to meet the didactic needs of the Centro Nazionale di Speleologia (a didactic and guest structure which is right at the foot of Monte Cucco), aimed at primary and secondary school pupils. The project, which each year involves over 1500 teachers and pupils in residence, was created for providing schools a highly effective and impressive on the spot activity for naturalistic education, specifically centred on karsts. In practice, the school groups stay a few days at Monte Cucco to follow some real speleology courses, including the visit to the cave.

Scale model on underground hydrology of the Mount Cucco massif. (Photo F. Salvatori)

Museum – Paleontology in Mount Cucco caves. (Photo F. Salvatori)

The project which led to the creation of the current Cave Laboratory-Museum, situated in the ex-church of S. Marco in the centre of Costacciaro, took its first steps in 1980 with the creation of the Centro Nazionale di Speleologia "Monte Cucco" (CNS) by the town of Costacciaro, the Region of Umbria and members of the current CENS (Centro Escursionistico Naturalistico Speleologico).

The most important didactic activities of the National Speleology School of the Italian Alpine Club (Scuola Nazionale di Speleologia del Club Alpino Italiano) became concentrat-

ed around this structure. Since then, the first equipped lecture rooms and first exhibits of finds were created inside the CNS. Successively, the laboratory-museum has undergone several modifications and merges until reaching its current form with the last big works in 2008. In 2009 the laboratory-museum was further expanded with new rooms, where the exhibits specifically dedicated to the evolution of life and of humans were placed. The project, the managing and the creation of the laboratory-museum, as well as the visits to M. Cucco's cave is the responsibility of CENS and the necessary funds carrying out the activities come from the European Community and the town of Costacciaro. The visits to the Scirca Spring, a fundamental step of the didactic route on the Monte Cucco Massif karst phenomena, are guided by the workers of Umbra Acque, the society which manages the regional aqueduct system.

The laboratory-museum is divided into sections as follows: the sedimentary origin of limestone rocks, the birth of the umbro-marchigiano Apennine, the action of meteoric waters and the origin of caves, hypogenic speleogenisis, palaeontology, cave fauna and Monte Cucco's hydrogeological systems.

Each sector is furnished with teaching aids, from traditional images to computer animations. There are three-dimensional models which can be activated by the visitors in various ways (especially innovative are the animations on the origins of rocks and mountains, and the small scale models which show the underground paths of the karst waters are very effective). Inside the laboratory-museum there are some rooms in which the Speleological Cadastre of Umbria is kept, in a single up-to-date and computerised version. Included with all this, is documentation on the most important karst cavities in Italy and well-furnished library which is focused on karst phenomena in the Apennines. ■

Museum – Human evolution: Australopithecus room. (Photo F. Salvatori)

The Research Centre for Mountaineering Caving and Canyoning Equipment

The scientific and instrumental approach for guaranteeing safety during progression

Francesco Salvatori

Among its other activities, the National Speleology Centre (Centro Nazionale di Speleologia) carries out research on the characteristics and strength of speleological, alpinist and canyoning equipment.

The laboratory, created in 1982 in cooperation with the National Speleology School of the Italian Alpine Club (Scuola Nazionale di Speleologia del Club Alpino Italiano), has carried out systematic theoretical and empirical research on all speleological equipment, as well as some used in alpinism and free climbing, with enlightening results. Its research, unique in the field of speleology, have resulted in the publication of several books, manuals and leaflets which have led to a sharp increase and a wider dissemination of technical knowledge concerning the different types of progression.

Free-fall tower. (Photo M. Menichetti)

The test instruments include a slow traction bench dynamometer (its speed can be varied in steps of about 0.0015 m/s) and a wall for fall tests (80 kg rigid weight and maximum fall of 5 m). Most of the tests are carried out using slow traction, that means in conditions which are different from those really existing during progression or as a result of a hypothetical fall (in these cases, the applied forces are much more dynamic and capable of generating forces much greater than the average weight of a human body). Also, it should be mentioned that the available instruments have only allowed the measurement of the force variations as a function of time, without any indication of the degree of the deformations produced. In every sector the research has been significant, but in some the results have been extraordinary, as in the case of the bolts used for rock anchors. For this purpose, an innovative test methodology has been developed which has given clear and valid results in a field where no one had previously ventured.

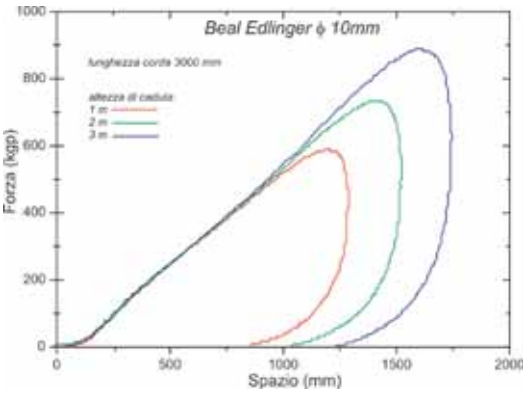
Since 2010 the laboratory has changed significantly and, thanks also to the relative ease of acquiring instruments for measuring stretching and deformation, has built a new wall for fall tests. This wall (maximum height 10m, 140 kg weight) is the first in the fields of speleology and mountaineering: it allows the correlation of time, force and deformations, thus allowing the measurement, among others, of the energy content of events and the effects of the visco-elastic nature of the polymers used in ropes. Only in this way has it been possible to measure, in a rope fall test, the time difference between the maximum force reached and the maximum amount of stretching. For the first time in November 2011 the Costacciaro laboratory measured (in few milliseconds) a delay that was previously only foreseen in mere theoretical considerations. This measurement provides quantitative evidence to the evaluation of the processes that lead to the deterioration of a rope, both in terms of resistance to break and in changing its capability of deforming under strain (and therefore absorb energy).

The wall also allows varying the impact speed of the weight on the test sample and therefore its "deformation speed", which is a crucial parameter when one wants to experimentally test the behaviour of equipment under the effect of impulsive forces.

Now a systematic experimental research programme is being carried out along the lines of what was previously done in the 1980s and 1990s using slow traction measurements. As far as it is possible, the same elements of the safety chain, starting with karabiners, cords, auto blockers and lanyards, will be tested and analysed in dynamic conditions.

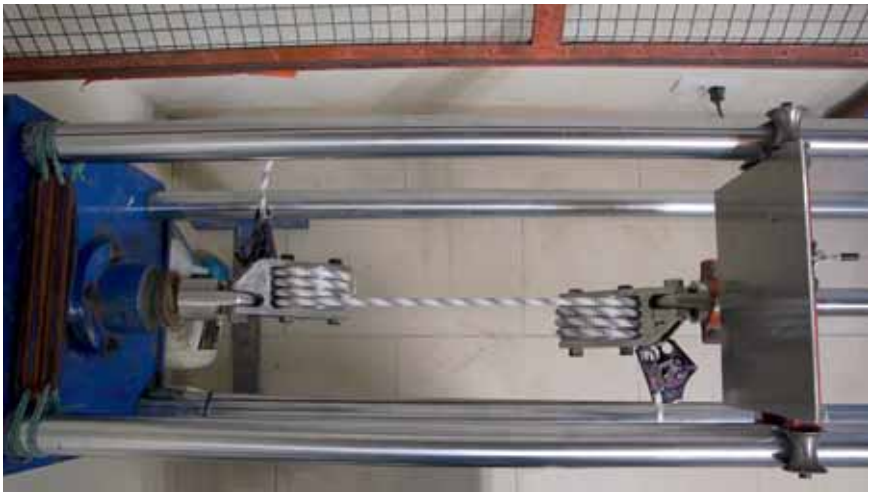
Another field of research holding great promise uses thermographic measurements on ropes tensioned until they reach their breaking point (which always happens at the knot). This seems to indicate that that the failure is a result of the rope overheating in the knot. The first experimental results do indeed show that the failure of a rope at the knot (knot effect) is caused by heating due to friction of the rope itself when stretched by the hydraulic dynamometer (or by a falling weight). This heating is concentrated mainly in the short section of rope which exits the knot and where temperatures are reached (around 60°C) which are capable of changing the fibre's polymers from a "glaseous" state to a "rubbery-viscous" one which is less able to resist tension. Other research is measuring the effects produced by water on the bonds which connect the polymer chains together, bonds which are responsible for the strength of a rope. Some tests have already determined that the presence of water in wet ropes causes a progressive reduction of its ability to resist breaks and deformations.

CRASC is still administered by CENS and its laboratories are situated in the National Speleology Centre at Costacciaro (Centro Nazionale di Speleologia di Costacciaro). It works in cooperation with the National Speleology School of the Italian Alpine Club (Scuola Nazionale di Speleologia del Club Alpino Italiano) and the National Canyoning Association (Associazione Nazionale Canyoning). ■



Charts of free fall tests.

Test to measure the breaking load of a rope. (Photo F. Salvatori)



The biospeleological research centres in Italy

Cave life be brought closer and made less secret

Domenico Zanon

Springtail *Arthropleona*. (Photo F. Grazioli)

In Italy there are very many examples of underground laboratories, which were created with the aim of promoting research and education in the field of biospeleology. This article, while not claiming to be exhaustive, gives a general overview on the main structures in Italy, each of which has specific goals and distinctive peculiarities. This gives a varied and complex character to the whole.

Within the national panorama, the most distinguished for the number and for the activities carried out, are the underground laboratories in the north-east (the regions of Veneto e Friuli Venezia Giulia).

In 1978, based on tried and tested French models, the ***Büs della Genziana Biospeleological Laboratory*** was founded on the Cansiglio plateau (TV). This can be considered the first of its kind in Italy, both for its location and its equipment. With the cave's temperature reaching a maximum of 2 - 2.5° C, it mainly researches the biological characteristics of low-temperature troglobite organisms.

With that example in mind, in the following years many other biospeleological centres of research and education, adapted within natural caves, made their appearance. Among these the ***Laboratorio didattico di biospeleologia "A. Saccardo"*** is particularly active. It is located inside Tavaran Longo, a resurgent cave dug in the Montello conglomerates and equipped mainly for educational purposes by the Gruppo Naturalistico Montelliano.

Also in Veneto is the ***Grotta di Monte Capriolo*** (*http://www.speleolessinia.it/grotte/grotta-di-monte-capriolo*) at Roveré Veronese, a cavity which is self managed by speleologists and carries out both biospeleological and geological research and is also the subject of guided tours.

At Trieste, the Società Adriatica di Speleologia set up a ***Speleovivarium*** (*http://www.sastrieste.it/SitoSAS/Viva.html)* in a World War II air raid shelter, which is particularly suitable for the purpose as it is easily accessible and has physical parameters similar to those of natural cavities. The main goal of this initiative is to raise the proteus (olm) in captivity, in order then returned to where they came from; others pause naturally in the laboratory cave, enticed by special niches built for that purpose.

The observation of the endemisms present on Montello has priority over other species.

The size of the example is also a characteristic which is considered, as

The pilot experience of the didactic biospeleological laboratory "A. Saccardo" on Montello

For several decades now, the Gruppo Naturalistico Montelliano (GNM) has organised guided tours which include various themes, especially historical and naturalistic ones.

The growing interest on the part of visitors in the mysterious underground world has spurred GNM to open a biospeleological laboratory, in order to tutor visitors about the life present in the subsoil.

For the execution of the project, the choice fell on Tavaran Longo, a resurgence cavity in the Montello conglomerates which, with just a few adaptations, was well suited for this purpose, thanks to its particular conformation and ease of access.

As a matter of fact, in various parts of the cave a ledge is present which made it easy to place aquariums and terrariums so that they can easily be observed.

The laboratory isn't a perennial cave fauna "zoo", but a place where the fauna only stays for the limited time that visits are carried out in. Some fauna is in fact collected from neighbouring cavities and

Speleologia in Rete

Make a virtual visit to the laboratory of Montello
http://tinyurl.com/68-montello

Acquariums cleaning in Tavaran Longo cave. Educational biospeleologic laboratory "A. Saccardo". (Photo M. Pellegrini, Archive GNM).

der to study its biology and create a reintroduction into nature for its.
The ***Villa Papadopoli underground laboratory*** of the GS CAI di Vittorio Veneto is also adapted inside a shelter, this time from the Great War, and is where experimental masters thesis' on cave fauna and karst waters are prepared.
Currently, one of the Italian centres in the forefront of biospeleological research is the ***Laboratorio di Biologia Sotterranea di Verona*** *(http://www.rcvr.org/cittaepr/biolsott/)*, managed by the Gruppo Attività Speleologica Veronese. There the ideal environmental conditions for raising underground organisms have been recreated; the organisms are thus studied by direct observation.
The laboratory also, in cooperation with local bodies, promotes research in the field, carrying out projects and programmes for environmental protection.
Among the many other examples present in Italy, we need to mention the ***Laboratorio della Grotta Novella*** in the Parco dei Gessi Bolognesi, created by the Unione Speleologica Bolognese, one of the first to be created in Italy, the ***Laboratorio Carsologico Sotterraneo di Bossea*** (pag. 61-62), where 75 new species have been discovered, and the ***Laboratorio ipogeo di Forra Lucia*** on the Monti della Calvana (PO), run by the Unione Speleologica Pratese (*www.speleologiapratese.it/new/* > articles). ■

Guided tour at the Educational laboratory "A. Saccardo". (Photo P. Gasparetto, Archive GNM)

a 2 mm long insect will be very hard to see inside a terrarium.
Among the Millipedes, one can observe *Typhloiulus montellensis* which walks freely on the bark of old branches placed outside the terrariums on purpose, among the Coleoptera are *Orotrechus targionii montellensis, Or. messai, and Orostygia doderoi* and among Spiders *Troglohyphantes fatalis*, which was first discovered in a cave not far from the laboratory.
As far as aquatic fauna is concerned, *Niphargus montellianus* occupies an entire aquarium, while another aquarium has a biodiversity theme and contains a collection of larvae of the various insects which visit the area's resurgences.
A terrarium reserved for amphibians is especially interesting for schoolchildren, as it contains salamanders, frogs, tritons and toads.
Normally a visit to Tavaran Longo starts from a request by a school, an association, a group or other interested persons or bodies.
At the entrance, each visitor is given a hard hat having a LED light.
As far as schools are concerned, the topics covered are underground ecology, the food chain, predators, nutritional resources, exogenous input, parasites, biological pollution, areals, the basic fauna subdivisions, metamorphosis and a hundred other things that the children's questions may bring up.
Obviously, for secondary school pupils and beyond, the topics become far more scientific.
The main purpose is, in practice, that of getting the underground ecosystem known, working in the most natural possible way and meeting the visitor's expectations.
In light of the success of the experiences so far, the impression is that we've succeeded.

Domenico Zanon

Speleologia in Rete

Want to see more pictures? On the wings of darkness
http://tinyurl.com/68-progetto-life

Innovative techniques in bat research

Francesco Grazioli

The use of more and more electronics, combined with widespread practices by engineers, researchers or even interested non professionals, make it now possible to create technologies capable of handling a number of quite different applications. The resulting benefits are increasingly affecting fauna research as well, with the analysis of details seeming to show no limits, except maybe creativity.
Worth mentioning is the specific case of "Life + GYPSUM", a five year project co financed by the EU, focusing on the protection of the fauna, vegetation and environmental features of the Emilia Romagna Gypsum areas. This involves 6 natural sites, 2000 so-called SIC and ZPS, including Regional and National Parks and Reserves, and a significant number of researchers, universities and speleological groups members of the Regional Speleological Federation of Emilia Romagna (Federazione Speleologica Regionale dell'Emilia Romagna - FSRER). Much space within the project has been given to the study of the bat populations present in a representative sample of caves. The animals were first monitored for two years, in 2010 and 2011,

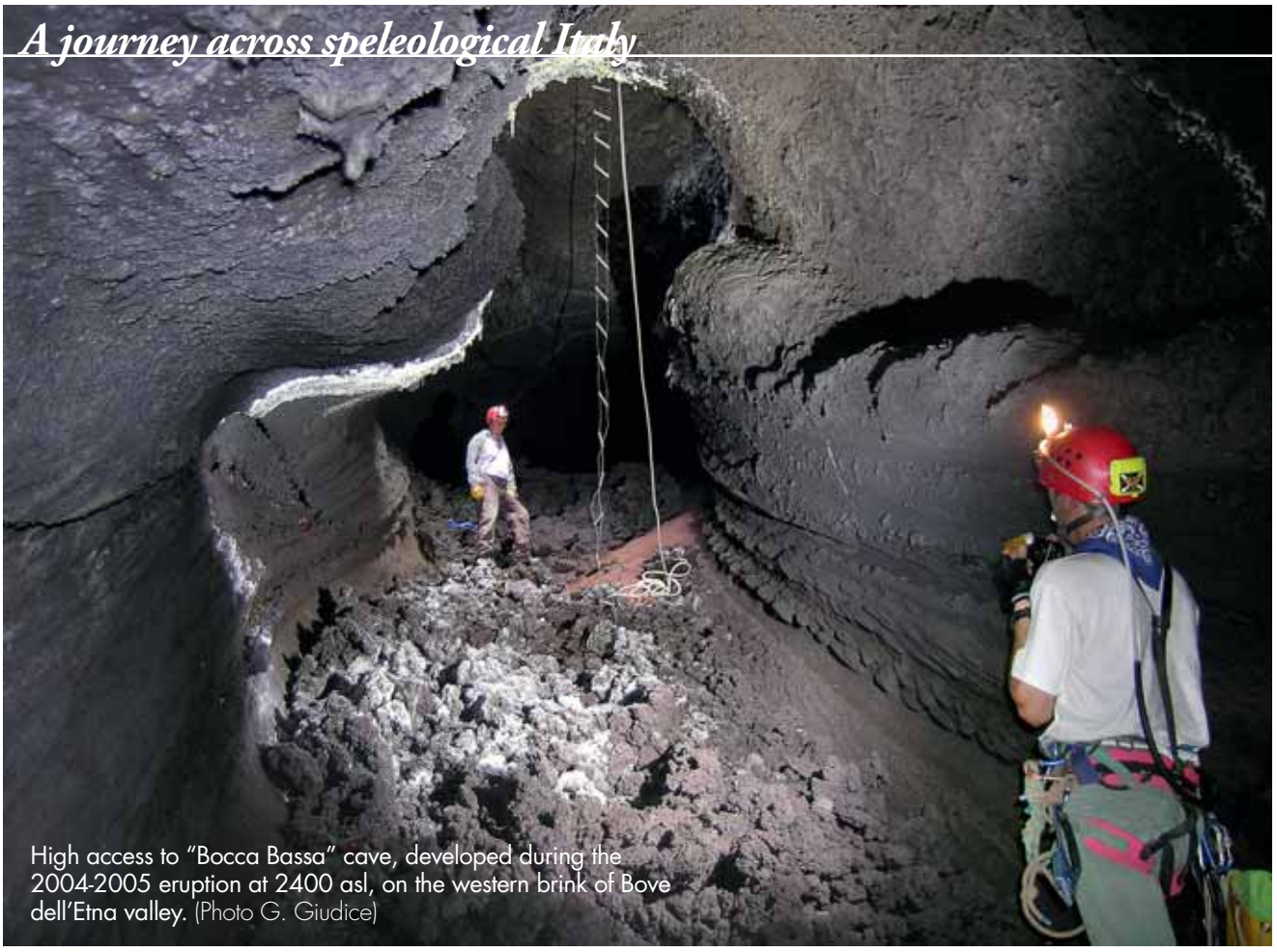
Data download of the data-logger in Acquafredda System (S. Lazzaro di Savena, Bologna). (Photo F. Grazioli)

Female *Myotis* in nursing period – IR technology photo.
(Photo F. Grazioli - Project Life Gypsum)

during their reproduction and hibernation, with the aim of improving the knowledge of this cryptic species, as well as to carry out ad hoc works in order to regulate cave access by humans.For this purpose, in addition to the techniques being currently used for bat studies (Agnelli et al., 2004), monitoring equipment and application models were designed to enable objective data and transit flow collection on site (Grazioli, 2011).
As a result, a special data logger was set up in order to trace bat transits on an electronic data sheet for further computer processing. In particular, a sophisticated bat photo-trap system was created: a non resounding device based on high definition IR technology, which records many more details and information about the animals entering/exiting the caves, thus eliminating potential disturbances connected with traditional photographic reporting or even more invasive capture activities.
The results achieved, thanks to the flexibility of these systems, contributed to highlight both bat ecology - especially discovering some unknown features of it - and the role of Emilia Romagna's karst environment over varying seasons of the year. By giving the research group valuable data and information, it was an extremely important step for supporting the preservation programmes being implemented at present.

Agnelli P., Martinoli A., Patriarca E., Russo D., Scaravelli D., Genovesi P. (a cura di) (2004): Linee guida per il monitoraggio dei Chirotteri: indicazioni metodologiche per lo studio e la conservazione dei pipistrelli in Italia. *Quaderni di Conservazione della Natura*, n. 19.
Grazioli G., Biasioli, M. (2011): Sorvegliati speciali, tecnologia e innovazione al servizio della ricerca sui Chirotteri. *Piemonte Parchi*, n. 5, p. 6-9.

A journey across speleological Italy



High access to "Bocca Bassa" cave, developed during the 2004-2005 eruption at 2400 asl, on the western brink of Bove dell'Etna valley. (Photo G. Giudice)

Collections and rare items of the "Franco Anelli" Italian Speleological Documentation Centre

A unique and outstanding collection of speleological publications and iconography

Paolo Forti

The "Franco Anelli" Centre of the SSI (Italian Speleological Society) was founded in 1976, when the libraries of the SSI and the IIS (Italian Institute of Speleology) decided to become a single entity. Since 1988 it is located in the University of Bologna.
Currently about 70.000 items (books, manuscripts and journals) are available for direct consultation.
Its historic section, in which publications from 16th to 19th centuries are stored, is one of the largest and perhaps the most interesting.
The "F. Anelli" library is included in the "Documentation Centres" network of the UIS (International Union of Speleology).
But today the "F. Anelli" Documentation Centre is much more than its extremely important library: over time, it has expanded its interests toward different printed items, which in all cases are directly related to karsts and caves.
The following are the five most important "side collections" of the Centre, which still have to be inserted in its database.

Speleologia in Rete
Visit the SSI Library archives
http://tinyurl.com/68-archivi-cids

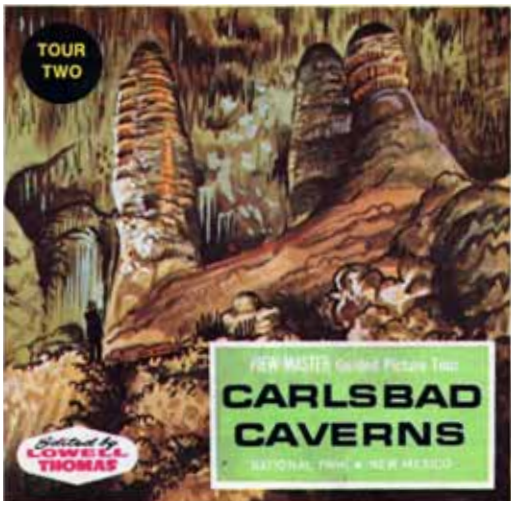
The "Emeroteca"

Articles and news related to karsts and caves, printed in any kind of newspaper or journal in Italy and abroad, are collected here. Currently this section consists of over 5500 items dating from 1877 to the present.
This section is fundamental for people interested in studying and documenting how the perception of speleology by normal people has changed over time: focusing, in turn, on the danger, the mystery, the scientific interest, on friendship and heroism…
All of these aspects are magnificently depicted in the colourful covers of some weekly magazines (a special mention must be made of the "Domenica del Corriere") dedicated to speleological events globally perceived as "fundamental".

The show caves documentation

Organized cave tourism can be dated back to the 18th century, even if a few cavities, like Postojna in the "classical" Karst, were already being visited for several centuries by then.

The transformation of a natural cave into a show cave simultaneously induced most of the cave owners to print descriptive materials which could be sold to visitors. Sometimes these were true cave guide-books, but often just booklets or folders and leaflets.



Cover of the booklet "Les splendeurs de la Grotte de Han (Belgique), guide-album et description", 1901. (Archive Cids Bologna)

The Predjama castle (Slovenia), from an illustration of "Die Grotten und Hohlen von Adelsberg, Lueg, Planina und Laas" by Adolf Schmidl, Vienna, 1854. (Archive Cids Bologna)

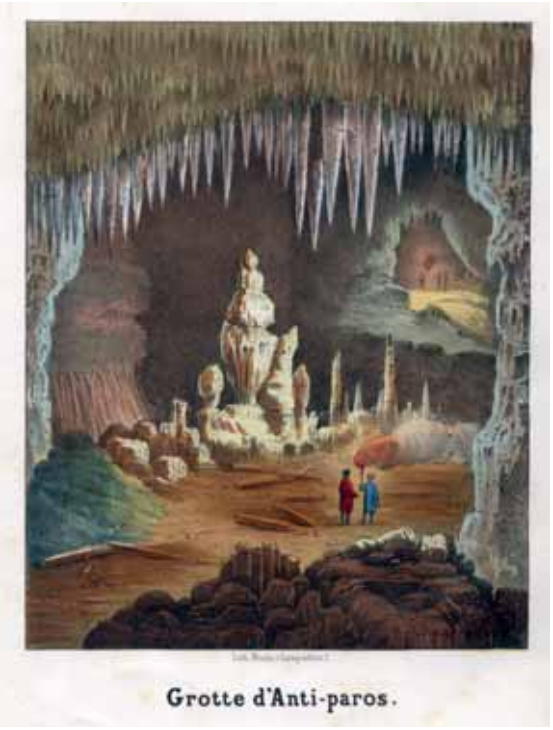
Some of these publications, especially the oldest ones, are true masterpieces of printing technique and of engraving quality.
In many of these materials, sometimes written by worldwide renowned cavers, interesting and important material may be found related to the transformation over time of the methods and materials utilized to plan, implement and manage a show cave. But, even more important, it is also possible to follow the evolution of all the side activities which currently characterise cave tourism.
The materials in this section refer to a few hundred show caves located in four different continents and cover a time interval of 250 years.
Beside Italy, the best documented countries are France, Germany, United States and Great Britain.

Illustration from "The Grotto of Neptune ("Antro di Nettuno"), Sardinia; a poem illustrative of three views of this interesting cavern" by Alfred Miles, 1864. (Archive Cids Bologna)

The old engravings

Since ancient times, caves have awakened curiosity and interest far beyond the small communities of scientists and explorers. So, immediately after the development of printing techniques, cave engravings were often present in naturalistic, scientific and travel books (the peak occurring between the middle of the 18th and the end of the 19th Century).
The scarcity of space, as well as budgetary limitations, have lead to avoiding adding to the library all those books concerning other subjects, even if they do actually contain cave engravings.
But this precious visual documentation is too important from the his-

torical-documentary point of view, thus, since its first years, the "F. Anelli" Centre collected just the engravings in an "*ad hoc*" section.
There are many documented caves, most of which from Europe, but several images are also present from North America, India, Japan and Australia.
Among them the map of the Santa Rosalia cave in Palermo is worth mentioning because, being printed in the middle of the 16th Century, it is the first cave map ever printed in the world.
The collection of engravings depicting the Fingal Cave (Hebrides Islands) is also very large: it is perhaps the most illustrated cave in the world.



Vintage print of the Antiparos cave.
(Archive Cids Bologna)

There are also images of speleothems, bats and paleontological remains (mainly cave bear bones). Some curious images are also present, such as the advertising leaflet of a whisky produced, once upon a time, inside a Scottish cave in order to prevent paying English taxes…
Today the Centre hosts about 1500 engravings and other kinds of illustrations (among which some daguerreotypes from the second half of 19th century are worth mentioning).

The postcards

Collecting postcards is a very common hobby, also among cavers, who often collect only karst and cave images of their own (local, regional, national) "territory".
The postcards devoted to some of the most renowned show caves often cover a time span largely exceeding a century. Thus they represent a fundamental tool to reconstruct the evolution of such caves, which are often influenced by human interventions aimed at enhancing tourism, but are sometimes also caused by tragic events such as wars.
Additionally, in many cases, such as in developing Countries, postcards are the only existing objective documentation of natural caves in remote regions.
Even if this section is one of the youngest of the "Anelli" Centre, it is probably now one of the most important: over 7000 postcards document hundreds of show and natural caves, in all five Continents. Among them an ice cave in Antarctica is worth mentioning.
A large majority of the Italian show caves are represented together with some of the most important natural caves: some of these postcards were specifically printed to celebrate speleological expeditions and/or Symposia and Congresses.
A curiosity: in this section the most represented Nation is France (with over 2500 items), and not Italy. This is because the "Chabert archive" hosted a huge collection of postcards, the majority of which were from France.
The most documented cave with over 200 postcards is Castellana cave (Italy) followed by Postojna (Slovenia) and Padirac (France).

The posters

There are two main categories of speleological posters related to two different activities: the first one advertises show caves and cave tourism, while the second is related to public events organised by Caving Associations.

Postcard showing the external area of the Han sur Lesse cave (Belgium).
(Archive Cids Bologna)

Even large or very large posters (up to 2 square meters and more) belong to the first category, which started to be printed in the second half of the 19th Century: the most famous and very artistic ones were made in France and Belgium during the "Belle époque" and "Floral" periods.
Posters printed by Caving Clubs are normally smaller and more recent: they started to be made after the Second World War.
They are mostly aimed at advertising activities of the Club, such as basic courses on speleology, symposia and congresses or any kind of activity directly related to caves and karsts.
More recently, posters stressing the protection and safeguard of caves and the karst environment have started to be printed and therefore added to the collection.
To date, the "F. Anelli" Centre's collection comprises about 600 posters, among which a dozen with historic and artistic relevance. ■

Grotta della Monaca, a prehistoric mine

Archaeological evidence for a travel in the time of humankind

Supervised by Felice Larocca and Maria De Falco

Grotta della Monaca is a karstic cave located in the upper Esaro River Valley in northern Calabria, not far from the Tyrrhenian Sea. Almost half a kilometre long, it develops with a sub-horizontal conformation through spaces with differing morphology: an impressive entrance leads to a passage partly filled with massive collapsed boulders; it heads to a vast chamber (60x30 metres), crowded with thousands of bats; in its innermost part the cavity ends in a series of narrow passages, some considerably long and accessible only with great effort.

Speleologia in Rete

Photo gallery of the excavations in the Grotta della Monaca
http://tinyurl.com/68-grotta-monaca

The cave's main feature is the presence of rich deposits of iron and copper minerals: the first being visible everywhere within the cave, while the second occurs only in the deepest underground sectors.
The most widespread iron minerals are *goethite* and *lepidocrocite*, two hydroxides varying in colour from pale yellow to dark orange. Among the main copper minerals documented, two carbonates stand out: *malachite* and *azurite*, characterized by bright green and light blue colours, respectively.
These mining resources and probably their bright colours caught the attention of prehistoric men, who used the cavity as a proper "natural mine".
The earliest archaeological findings date back to 1997, when the Centro Regionale di Speleologia "Enzo dei Medici" discovered several stone axes within the cave.
The axes, closely connected to the mineral deposits, were immediately recognised as ancient digging tools. In 2000, the close partnership between CRS "Enzo dei Medici" and the University of Bari paved the way to some speleo-archaeological research which is still underway.
They thoroughly investigated the archaeological deposit, recognizing it as one of the most ancient and important from the archaeo-mining point of view.

Grotta della Monaca location within Calabrian territory. (Drawing F. Breglia)

The cavity is huge entrance seen from the inside and archaeologists at work during a recent excavation. (Photo F. Larocca)

Rich iron hydroxide vein (goethite) within a fracture of the calcareous rock. (Photo F. Larocca)

Copper carbonate (malachite) smearing on a calcareous boulder. (Photo F. Larocca)

The constant support of the Soprintendenza per i Beni Archeologici della Calabria and the financial backing of the Local Authorities (Comune di Sant'Agata di Esaro, Provincia di Cosenza, Parco Nazionale del Pollino and Regione Calabria) have contributed to the present achievements. Studies which have been conducted show that the exploitation of the cave already started in the Upper Palaeolithic, around 20,000 years ago. It concerned the iron minerals at first and reached its peak in a Neolithic final phase, between 6,500 and 6,000 years ago.

The most remarkable evidence of extractive activities is represented by thousands of digging traces perfectly preserved on the mineralized veins, which are soft as a consequence of the high level of hydration.

These imprints are ascribable to implements such as picks, hoes and shovels made not only of deer antlers, but also out of other animal bones and horns.

Above: on the left, stroke imprints on goethite due to a deer antler pick; on the right, reconstruction of a pick derived from a deer antler. (Photo F. Larocca)

Plentiful charcoal remains, that underwent archaeo-botanical analysis, revealed that mining activities took place in darkness with torches made of Scotch pine branches; thanks to these charcoals, which were subjected to several radiocarbon dating procedures, it has been possible to precisely determine the period of prehistoric mining exploitations.

Between 6,000 and 5,500 years ago, the prehistoric miners became interested in the copper carbonates (malachite and azurite) as well.

This broader interest in new minerals is reflected in a shift in the range of digging instruments: great stone picks, mallets and hammer-axes were employed to smash calcitic flowstones and shatter blocks of hardened sediments enclosing precious copper mineral. It is not known where the minerals extracted from Grotta della Monaca were brought, nor the use they were put to.

However, researches carried out in the surrounding area have found the locations of other ancient mines, such as the so called "Grotta del Tesauro", another karstic cave containing equally rich minerals, especially iron.

Thus, the main characteristic of these ancient mining activities is the use of natural cavities, containing plentiful of minerals, as proper mines.

In 2013 the significant scientific interest of the Grotta della Monaca gave birth to safeguarding and enhancement programmes that aimed for the realization of a triple target in the next few years: 1) the protection of the archaeological site and underground areas through appropriate measures; 2) the establishment in Sant'Agata di Esaro of a speleo-archaeological museum and of a research centre specialized in mining archaeology; 3) the site opening to the general public, with didactic and touring services provided exclusively by experts (speleologists and archaeologists). ■

Learn more: *www.grottadellamonaca.it*

Right: on the left, selection of stone digging tools found within the cave; on the right, experimental reconstruction of the same tools as they appeared with the wooden haft. (Photo F. Larocca)

The Stoves of San Calogero, a millennial challenge

A unique natural laboratory for its environmental characteristics and anthropological memories in Sicily

Commissione Grotte "E. Boegan", Associazione Geografica La Venta

Mount Kronio is a small relief (385 m above sea level) located on the Southern Sicilian coast close to the town of Sciacca (AG). On its top a monastery and a temple dedicated to the cult of Saint Calogero are located. The lithology of the mountain is composed of Dolomia Principale (upper Triassic). The Southern side is affected by some faults which gave origin to steep slopes where several cavities are present. At the foot of the mountain the slope debris meets the less permeable coating of marls and clays, while the northern side descends down to the Portolana valley to then climb up again to the 901 m of Rocca Ficuzza. From the group of caves close to the top and other inaccessible blowholes come drafts of hot and humid air that condense into water vapour columns. The entire subjacent plain contains a thermo mineral aquifer having a temperature ranging between 32-56° Celsius; some of those waters are taken for therapeutic use in the Sciacca Thermal baths.

Speleologia in Rete

Take a historical exploration tour in Mount Kronio
http://tinyurl.com/68-monte-kronio

Historical Highlights

The Stufe are part of a thermal bath establishment that incorporates the entrances, channelling the hot air coming from the depths of the mountain. There is an access to a vestibule which was divided in ancient times into several rooms separated by masonry works, and was previously inhabited in prehistoric times for a few thousand years, from the early Sicilian Neolithic (end of 6th millennium BC) until the end of Eneolithic (approx. 2000 BC). Burial remains have been found in the far end galleries. Other traces of human passage, attributable to Greek and Roman populations for cultural reasons, date back to around 4th -5th century BC.

The karst and thermal phenomena, well visible from the underlying town of Sciacca, inspired the folk imagination and led to the weaving of a few legends; from those narrated by Diodorus Siculus (the caves were said to have been dug by Daedalus) to those regarding the fight of Saint Calogero against the Devil.

Descriptive Highlights

The higher part of the underground complex of the Stufe di San Calogero begins with the Grotta del Santo *(Saint's Cave,)* a chamber where legend says the Saint lived, followed by the

Since 2008 the Cave Commission G. Boegan experiments together with La Venta Association the technologies used for the exploration of Naica caves in Mexico. (Photo Archive Boegan/La Venta)

The hotel on Mount Kronio, an architectural monstrosity built in the '50s that incorporates the Stoves of San Calogero. (Photo Archive Boegan/La Venta)

"Stufa degli Animali" *(Animals' Stove)* because it was anciently used to cure animals. Then there is the "Antro di Dedalo" *(Daedalus' Cavern),* a chamber paved with stones and a series of ancient masonry seats to where most of the hot air is channelled. A low passage leads to the "Galleria del Fico" *(Fig gallery)* and then to shaft that reach the lower galleries.

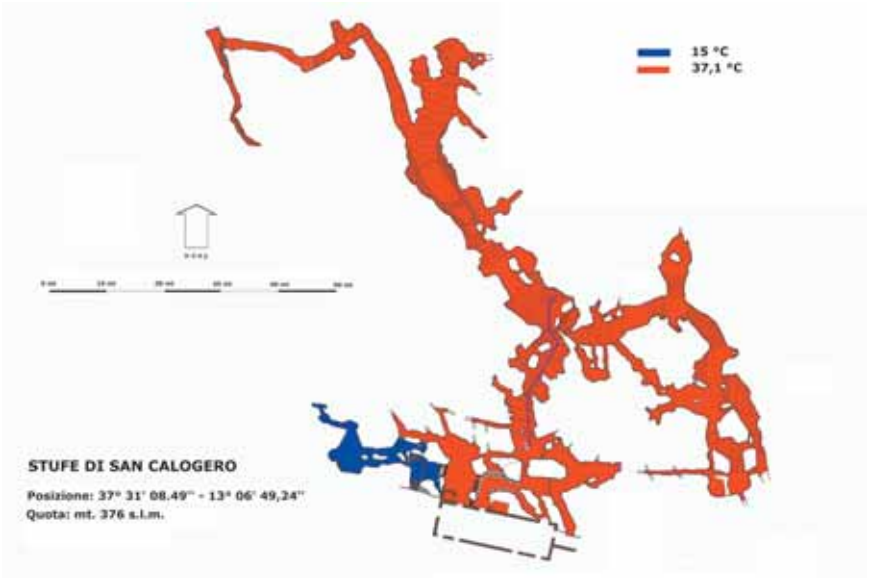
On the Southern side of Mount Kronio around thirty cavities were surveyed, of those, four have a significant amount of air circulation: two of them - Stufe and Grotta del Lebbroso *(The Stoves and The Leper's Cave)* blow hot air while the other two - Grotta del Gallo and Grotta Cucchiara *(The Rooster's Cave and the Cucchiara's Cave)* draw in cold air. Hot air blows, even if to a lesser extent, from fissures (Fumaroles) at the side of the mountain.

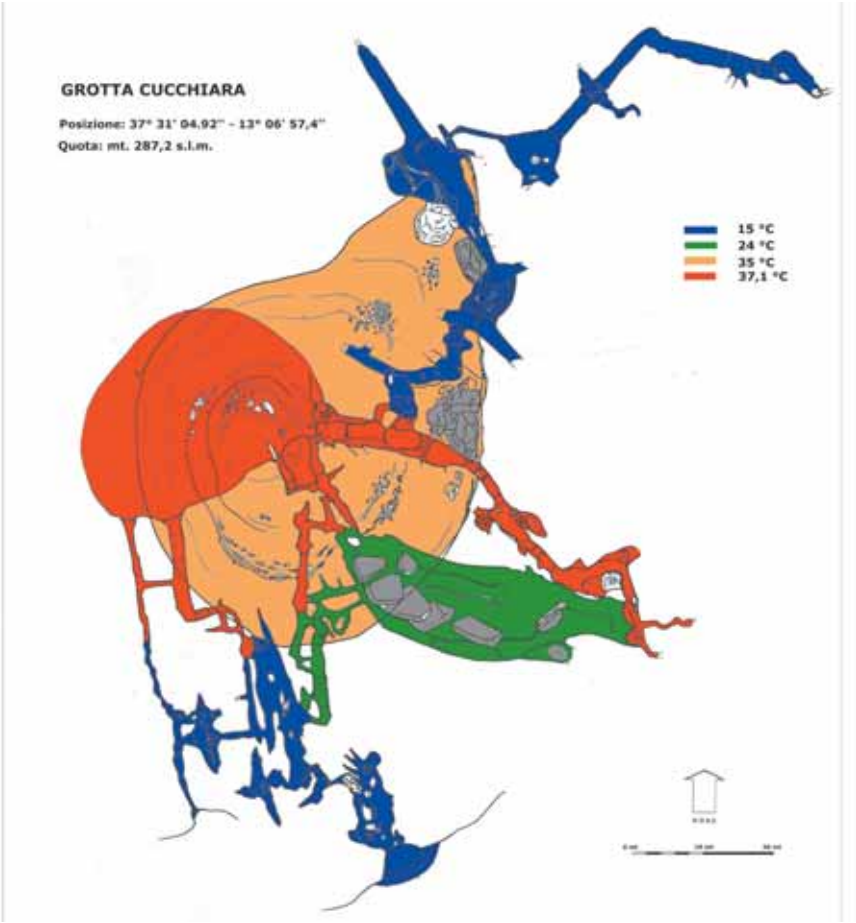
The Stufe are formed by a series of small pits and two wide chambers which are mostly horizontal; the SE ramification ends with a vertical pit - il Pozzacchione - at the bottom of which a human skeleton was found.

The second cavity of this complex is the Grotta Cucchiara, located one hundred metres below the Stufe.

A series of narrow passages lead to Pozzo Trieste (Trieste Pit), an abyss of more than one hundred meters that ends in a wide cave with no visible continuation. Hot air, coming from some windows, goes up to the Stufe, through the wide chimney that overlooks the pit.

An integral part of this system is the Grotta del Lebbroso, a hundred meters of tunnels that can be accessed through two entrances and that lead to a thirty metre pit ending in a gallery where a significant mass of hot air blows. Some old vases of unknown age were found there.





The climate

The Kronio caves wouldn't present any technical problems for their exploration, if it wasn't for the presence of hot vapours (36.8° C at the exit, a few degrees higher inside) that sweep through the three main cavities, bringing the humidity close to 100% and preventing the evaporation of sweat, and, therefore, the skin's thermoregulatory effect on the body. During the recent explorations the problem was partially solved by using special suits which blew dry air, together with other technologies previously used at "Naica" in Mexico by the La Venta Association.

The Explorations

After visits to the innermost parts of the Stufe is prehistoric times, in 1669 a Sciacca shoemaker, entered the inner rooms by falling down the first pit and thus finding his death. One hundred years later, the physician Antonio Bellitti visited and described the cave down to the inner pit; soon afterwards the cavity was visited by the French painter Jean Houel, who made a map of the upper part, and by Giuseppe Taurominna, who was lowered by rope to the base of the first pit. In the first years of the 20th century, the cave was explored by Raffaele Di Milia, who

provided a good description of it.
In September 1942, in the midst of the Second World War, the cavity's modern exploration began, led by Boegan and Medeot of the S.A.G. Cave Commission. They descended the cavity until the brink of the inner pit, surveying the upper part and drawing up a detailed report. In January 1957, a smaller team form the E. Boegan Cave Commission reached the bottom of the pit and explored a gallery discovering the vases and the burial remains. This expedition was followed by several others between 1958 and 1998, which resulted in the surveying of new cavities and the discovery of other ramifications of the Stufe, giving a more precise idea of the karst phenomena of this area.
Since 2008, studies have been carried out by a team composed of E. Boegan Cave Commission and La Venta Geographical Association members. This "Kronio Project" includes a wide program of scientific and explorative researches, which will be described further on.

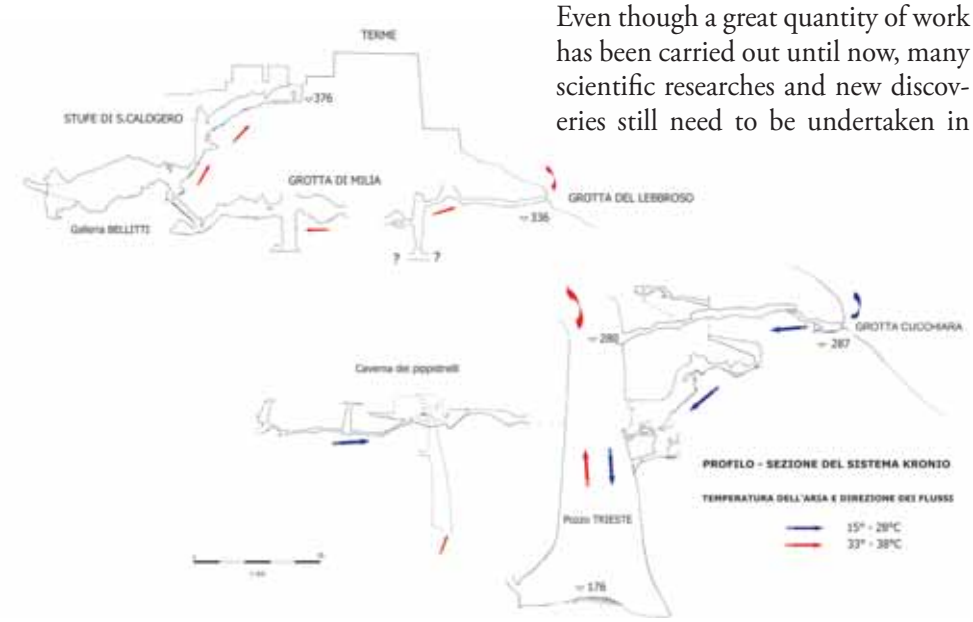
Archeology, physiology, climatology

The Stufe di San Calogero are of significant archaeological interest, for its initial cave deposits and for the presence of several large pithoi and burial remains. The hostile environment prevented archaeologists from carrying out detailed expeditions in the innermost galleries, while in the initial caves the excavations of the 1960s and 1980s documented a human presence from the Sicilian Neolithic (6th millennium BC) until the end of the Eneolithic (2nd millennium BC).
Thanks to new technologies, during the December 2012 expedition it was possible to bring an expert to the archaeological finds, thus allowing a first study and the sampling of sediments. The preparation of several reconstructive models will then be necessary in order to make an outline of the ancient presence inside the Stufe. On that same occasion they continued monitoring the air circulation in the Stufe - Cucchiara system, with sensors placed in key spots in the two caves, and made a geo-structural analysis of the system.

Archeological findings found in Galleria Bellitti. (Photo Archive Boegan/La Venta)

The near future

Even though a great quantity of work has been carried out until now, many scientific researches and new discoveries still need to be undertaken in the underground complex of Mount Kronio. As already mentioned, in the next years the "Kronio Project" foresees, apart from the continuation of the speleological exploration of the complex and connecting the Stufe to the Grotta del Lebbroso and the Grotta Cucchiara, the identification of the source of the endogenous phenomena. Scientifically, the following aspects are planned: along with the geo-structural studies of the karst complex, archaeological studies on the findings in Stufe and Lebbroso, entomological studies on the biotic content of the site, human physiological studies and the investigation of the hot air movements, their chemical composition and their influence on the development of the underground karst.
Special attention will also be given to a thorough folklore research to define what the impact of the thermal karst phenomenon has been on the local populations.
All this also involves the Superintendence of the Archaeological Heritage of Sicily, the Universities of Trieste, Turin and Catania, the Department of Medicine of the A.O.U. Laboratory of the United Hospitals of Trieste and the Thermal bath complex of Sciacca. ■



Caves and cave bears

Vital information from an extinct species

Roberto Zorzin

There are many caves in Italy which contain the remains of *Ursus spelaeus*. Most of them are in the Alpine arc, where there are over 80 known sites.

This plantigrade was distributed in Europe and also partly in Asia, from southern England to central Italy (Cassino) while to the East it reached the Caspian Sea and to the West, Northern Spain.

The cave bear originated from the *Ursus etruscus* species, which was distributed over a large part of Eurasia during the Middle and Upper Villafranchian period.

From this ancestor, two lines evolved: one in Europe which led to *U. spelaeus* in the Middle Pleistocene (about 350,000 years ago), passing through the species *U. deningeri* (Lower and Middle Pleistocene), the other in Asia leading to *U. arctos* (the contemporary brown bear), which then spread out throughout the rest of Europe and in America.

Cave bears were very large, but of variable size: they could reach 3 m in length and 1.50 at the shoulder.

Males and females were also differently sized, with the males being larger.

A fundamental characteristic of these plantigrades was the specialisation of the teeth for an essentially vegetarian diet.

Cave bears lived in wooded plain and hilly environments during the ice ages, while during the interglacial periods they could climb to higher elevations or latitudes.

They sought refugee in caves during their winter hibernation.

In fact, many of the remains of *U. spelaeus* have been found inside these caves.

It is a curious fact that there were caves mainly used by females and their cubs and other caves mainly populated by males.

Also, in many caves *U. spelaeus* remains were found that were affected by mandibular pathologies, which, causing the bone to deform, could have resulted in undernourishment for the winter hibernation.

Among the most important cavities of the Italian Alpine arc which contain *U. spelaeus* remains, we can mention those in Liguria (Grotta delle Fate, Grotte di Toirano), Piedmont (Grotta del Bandito, Grotta delle Streghe, M.te Fenera), Lombardy (Fontana Marella, Grotta Generosa, Buco dell'Orso, Buco del Piombo), Veneto (Grotta del Cerè, Covoli di Velo, San Donato di Lamon, Veja, Grotta del

Speleologia in Rete

Want to see more? Log into the bear's jaws
http://tinyurl.com/68-Ursus-spelaeus

Fumane cave (VR). Excavation and surveying. (Photo R. Zorzin)

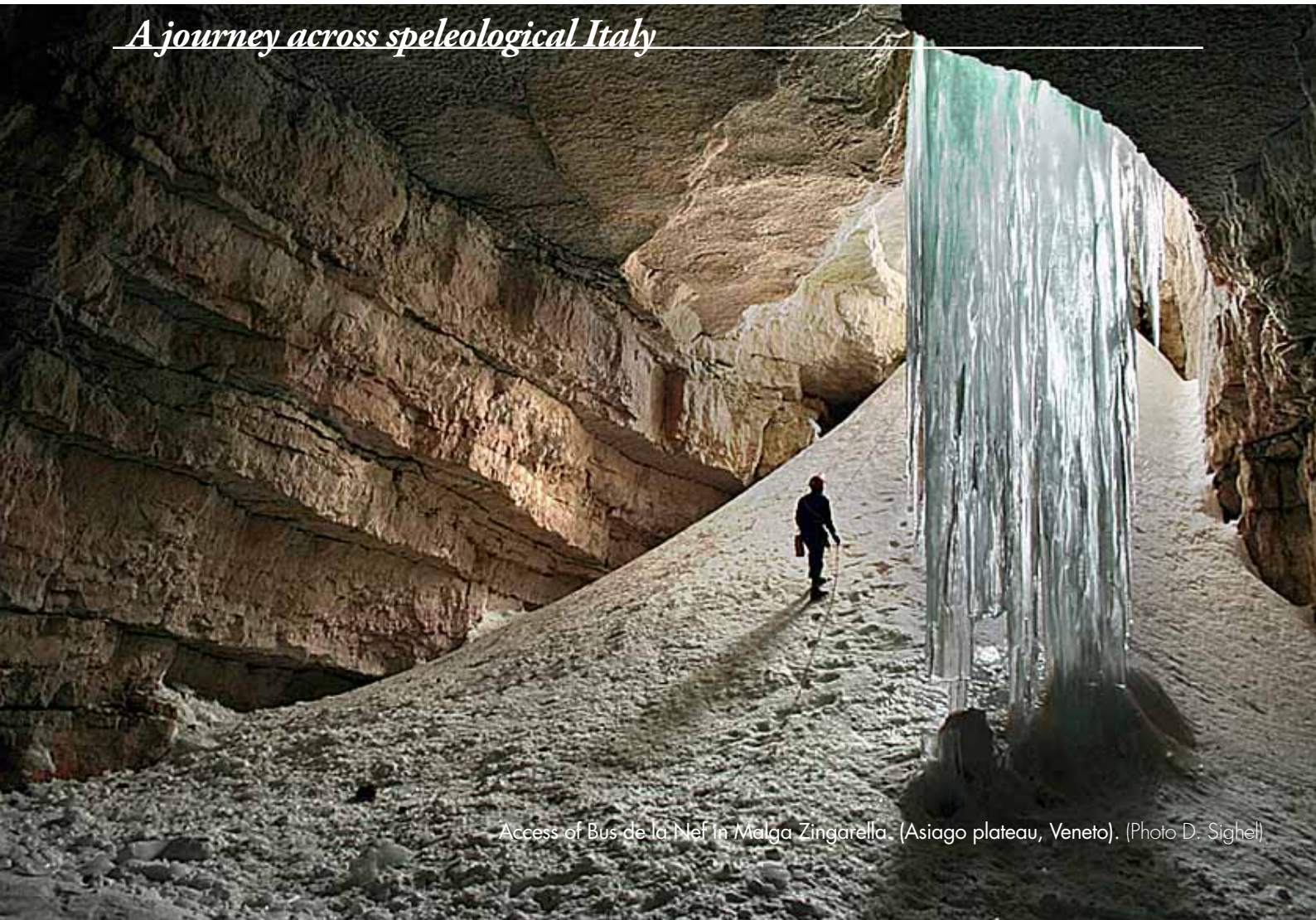
Ursus Spelaeus skeleton in the museum of Camposilvano (Lessini Mountains, Veneto). (Photo U. Sauro)

Covoli di Velo (VR), 2005 excavation campaign. Detail of the excavation surface n.5 with an *Ursus spelaeus* skull located on a sub-horizontal attitude. (Photo F. Bona)

Grotta di Cima Paradiso (VA). Fossil findings of *Ursus arctos* are frequent in the alpine caves. (Photo A. Ferrario)

Broion), Trentino Alto Adige (Buse di Bernardo, Conturines) and Friuli Venezia Giulia (Grotta Pocala).
In central Italy, the site at the Grotta di Equi (Tuscany) must be mentioned.
In Veneto, excavations at Covoli di Velo (VR) from 2001 to 2008, coordinated by the Civic Museum of Natural History of Verona (Museo Civico di Storia Naturale di Verona) and in cooperation with local speleologists, have led to the recovery of more than 3000 *U. spelaeus* remains, as well as a thousand bone fragments belonging to an extremely varied microfauna. Some of the *U. spelaeus* craniums have punctures created by the canine teeth of other bears.
Bones have been recovered belonging to foetuses, males and females of all ages, even if females are the majority.
Pollen analysis has shown the presence of herbaceous and woody plants, as well as small particles of carbon, which are compatible with a Pleistocene date around the Last Glacial Maximum (about 18,000 years ^{14}C B.P.). Also in the province of Verona, the remains of three species have been found in the Grotta del Cerè (S. Anna d'Alfaedo): *deningeri*, *spelaeus* and *arctos*.
The Cerè cave is the only Italian cavity containing remains of *U. deningeri*, of which the Verona Museum, based on the most recent studies, has three craniums and various bones.
In Lombardy, instead, the 1988 discovery of the Grotta Generosa by some Ticinese speleologists started a series of excavation campaigns led by the University of Milan.
Some radiocarbon dating resulted in dates between 50,000 and 40,000 years ago.
The interpretation of the data suggests that already doing the last Interpleniglacial, the local *U. spelaeus* population began its, slow descent which led to the species extinction on Monte Generoso.
In the Dolomites of Trentino Alto Adige, finally, the Grotta di Conturines must be mentioned as it contains over 60 skeletons in what can be defined as the site having the highest elevation (2750 m a.s.l). ■

A journey across speleological Italy



Access of Bus de la Nef in Malga Zingarella. (Asiago plateau, Veneto). (Photo D. Sighel)

Knowing the rules

The difficult balance between safeguarding karst phenomena and protecting speleology

Marguareis – Alta Valle Pesio and Tanaro Park, Piemont, Chiusetta, looking towards Punta Marguareis. (Photo B. Vigna)

Giuseppe Moro

Speleology is one of the last geographical explorative activities which are possible. Practised by thousands of adepts in every country, it is an interesting combination of sports and scientific activity, where the discovery of new underground spaces generates data on one of the least known environments in the world. This observation necessarily leads to speleologists taking responsibility, regarding both their capacity of furnishing information to the rest of society and the necessity to conserve the underground treasures. In Italy, caves are a recognised asset in a general sense for their landscape qualities, in principle covered by natural and cultural protection laws (*Codice dei Beni Culturali - D.L.vo 42/2004*). They are also specifically recognised as habitats of comunitary interest under *Allegato I* (*codice 8310 per le grotte*) and by the Habitat Directive (*92/43/CEE*), being therefore protected within the context of Italian environmental regulations according to *DPR 357/1997*. These important directives recognise the necessity of protecting underground assets, but also compel explorers as well to respect rules while using them. In Italy, most of the regions have by now enacted laws which protect karst and underground resources. Thus, the cave cadastres, originally systems for collecting and managing data administered by individual speleological groups, have been transformed into databases, officially recognised by local administrations and have become important instruments for planning and protecting the territory. In the same way, where karst areas are included in environments having special protection (Parks, Reserves etc), the need for acquiring ever more knowledge has become evident, resulting at the same time in a regulating code for speleological activities. The synergy between speleologists and local administrations ends up being very advantageous for both. Administrations have the duty of protecting objects they don't know and couldn't know if not through the activities of speleologists, on the other side speleologists are often able to be in the condition of reaching a mutual

agreement for a regulation of the accesses to protected areas. The awareness of these reciprocal advantages has led to the creation of very close relationships at the local level, but until now a national framework is missing. This is necessarily one of the goals that national speleological organisations have to aim for. Today, thanks to the incorporation of the WISH Project (see pag. 38-39) within the Italian Speleological Society (SSI), a national plan for the coordination of the collection of data concerning cave cadastres has been developed. At the same time, a Commission for Environmental Protection SSI has been created, cooperation with the association which groups together the governing bodies of protected areas (Federparchi) is being defined and the synergy with the Italian Alpine Club (CAI) has been made stronger. Furthermore, dialogue with trade associations such as the Italian Touristic Cave Association (Associazione Grotte Turistiche Italiane) has become possible. It's clear by now that the jealousy with which speleologists used to keep the data regarding the caves they explored is anachronistic, while ever more evident is the necessity of a mutual exchange of information and assistance between who collects the data (speleologists) and who has the responsibility of managing the territory (Nation, Regions, Municipalities). Speleological activity continuously modifies the data acquired from caves and it is for this reason that the cadastres will become ever more modern informative instruments of territorial management. Some very extended karst systems aren't limited to the territory of one Region, while others happily cross national borders (an example of this, the Timavo which unites Slovenia and Italy). It is especially the routes of the underground waters which have an interest which goes beyond pure geographical curiosity or the pleasure of discovery: karst waters are an essential part of Italy's drinking water resources. The studies carried out at a volunteer level by speleologists have pointed out problems which have remained unsolved for decades, revealing a vulnerability of the potable water supply sources which wasn't suspected until a few decades ago. ■

Regional park of Bologna gypsum, Emilia Romagna, Spipola doline. (Photo F. Grazioli)

Regional park of Mount Cucco, Umbria. Northern side of Mount Cucco, focus on Rio Freddo canyon. (Photo F. Salvatori)

The Karst Parks of Italy

Editorial Staff

Looking at a physical map of Italy, one can notice several geographical and morphological singularities. Even though it has a relatively small surface (301,000 km^2), Italy extends nearly 1900 km in length, from 35° N, very close to the coast of the African continent, to 47° N, practically in the heart of continental Europe. Additionally, 80% of the surface consists of mountainous areas, with peaks over 4000 metres in the Alps and nearly 3000 metres in the Apennines.
These conditions, together with the fact of Italy being a peninsula lying in the middle of the Mediterranean Sea, give the country a large degree of climatic variability, leading to the creation of landscapes having strongly heterogeneous and peculiar characteristics. These environmental characteristics have led to the institution, over the years, of a large

number of protected areas. Currently, about 10% of the country is subject to special environmental restrictions, distributed between more than 1170 protected areas which are administered in various ways. At least seventy of these are areas having a strong karst-speleological presence.
Practically all the most important National Parks created so far, that is Abruzzo-Molise-Lazio, Alta Murgia (*Puglia*), Val d'Agri (*Basilicata*), Appennino Tosco Emiliano (*Tuscany-Emilia Romagna*), Cilento - Vallo di Diano (*Campania*), Dolomiti Bellunesi (*Veneto*), Gran Sasso (*Abruzzi*), Sibillini (*Marche-Umbria*), Majella (*Abruzzi*) and Pollino (*Calabria-Basilicata*), contain surface and underground karst phenomena of great, or very great, significance.
It should be kept in mind that almost all the country's main cave complexes are contained within Regional Parks and Reserves. Among these are:
Piaggia Bella Complex (Parco del Marguareis Alta Valle Pesio e Tanaro, *Piedmont*); ***Alto Releccio Complex*** (Parco delle Grigne, *Lombardy*), ***Cima Paradiso-Schiapparelli Complex*** (Parco del Campo dei Fiori, *Lombardy*); ***Spluga della Preta*** (Parco della Lessinia, *Veneto*); ***Complesso del Foran del Mus*** e ***Complesso del Col delle Erbe*** (Parco delle Prealpi Giulie, *Friuli Venetia Giulia*); ***Complesso Spipola-Acquafredda*** (Parco dei Gessi Bolognesi, *Emilia Romagna*); ***Complesso del M. Corchia***, ***Abisso Roversi***, ***Complesso della Carcaraia*** (Parco delle Alpi Apuane, *Tuscany*); ***Grotta di Monte Cucco*** (Parco di Monte Cucco, *Umbria*) and many others.
It should be added that many minor reserves, minor for size but not for interest, have been created almost exclusively for their karst content. Among these are the ***Bric Tana*** (Liguria), ***Onferno*** (Emilia Romagna), ***Bussento-Morigerati*** (Campania), ***Entella*** e ***Monte Conca*** (Sicily), only to mention a few. ■

Active pothole in the natural park Fanes Sennes e Fosses (Trentino-Alto Adige). (Photo M. Vianelli)

Regional natural park of Lessinia, the Veja bridge (Veneto, VR). (Photo U. Sauro)

Show caves in Italy

The necessary search for equilibrium between resource exploitation and protection

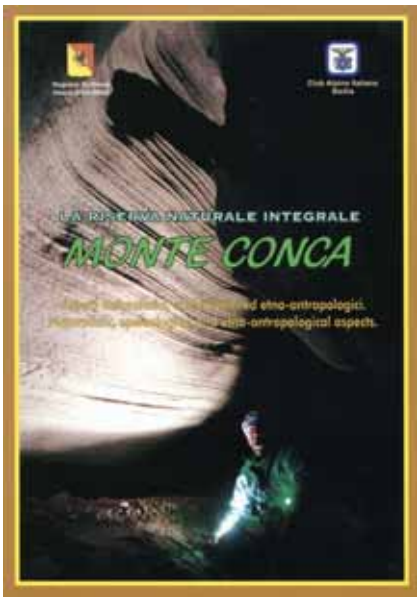
Editorial Staff

Hundreds of underground tourist sites exist in Italy. Among them there are natural caves, rock shelters, catacombs, old mines and aqueducts. The natural cavities transformed into show caves are over one hundred, but only about thirty of them can be visited by any kind of visitor. In many of the Italian caves open to tourism, in the last few years a new type of path has been created, which is more eco-compatible and, practically, able to supply even stronger emotions to interested tourists. In these cases, the tourist adaptations are kept to a minimum or even none; often there are no fixed lights and visitors must wear hard hats with a light, while the visit is always lead by expert guides.

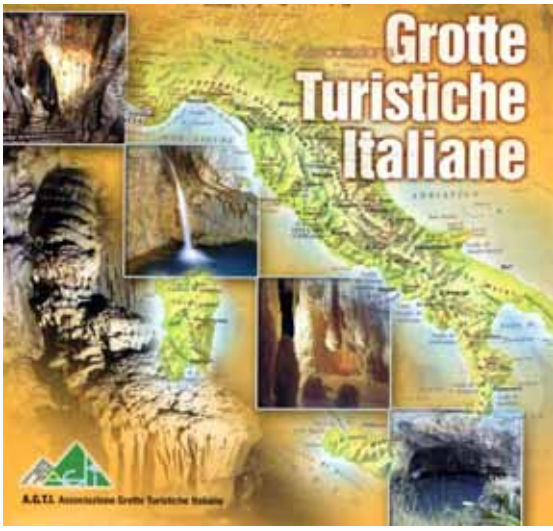
Speleologia in Rete

A journey through the show cave posters
http://tinyurl.com/68-grotte-turistiche

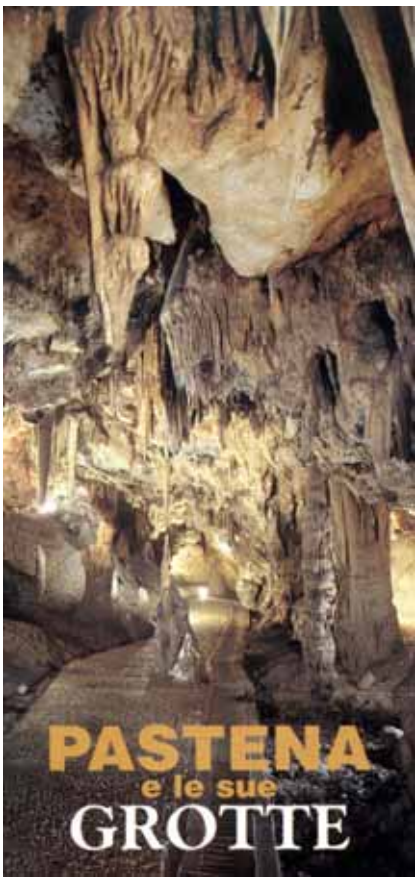
This type of visit is also offered by many of the Regional Natural Parks, where karst-speleological features are often the main reason for the existence of the park itself. In natural parks, the main target is normally schools, which, in co-operation with the park's administration, create specific didactic programs and/

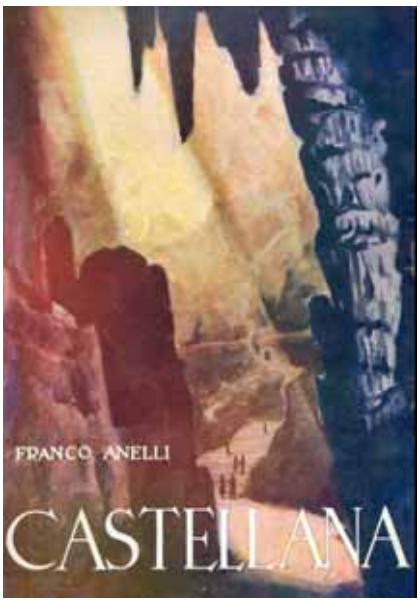


or nature trails. Practically every Region in Italy has karst parks and show caves equipped with these types of facilities. Often these didactic activities are organized directly by local caving organisations or by societies directly linked to them. From a historical point of view, it was in the middle of the 18th Century that a true cave tourism developed in Italy and in the surrounding areas: this occurred mainly in Friuli-Venezia Giulia thanks to the presence of the Classical Karst and the Postojna cave. Presently, beside Friuli and Venezia Giulia, where the



Grotta Gigante is the most important show cave, the other Regions having strong cave tourism activities are Apulia and Sardinia, which have huge and spectacular natural cavities, like the Grave di Castellana in Apulia and several caves in Sardinia (Bue Marino, Su Mannau, Ispinigoli, Is Zuddas, ecc..). Anyway, it is the Grotta Grande del Vento in the Marche Region which holds the Italian record of about 400,000 visitors per year. As in many other Countries, the relationship between





speleology and show caves managers are not easy and often conflicting, but at the same time they may result in an important resource for implementing a show cave. Currently there is no law in Italy which regulates protection, safeguarding and the interrelations between cavers, local Authorities, private bodies and the working and/or economical opportunities of a given area. Thus these are topics which must be faced daily due to the lack of a true national co-ordination of those areas. Only some Regional laws exist for the preservation of caves and a few more give some general guidelines for transforming a natural cavity into a show cave. The Italian Speleological Society, in agreement with the Regional Speleological Federations, suggests the correct ways to exploit show caves and often co-operate with the cave managers by supplying scientific studies and environmental impact analyses. Most of the major tourist caves in Italy are grouped together in the Association of the Italian Show Caves (AGTI) *http://www.grotteturistiche.it/it/agti* which currently numbers 24 Show cave members. The AGTI is member of the International Show Caves Association (ISCA) *http://www.showcaves.com/index.html*. Besides promoting the activities of its members, the main aims of the AGTI are: the study of the different problems related to the management of tourist caves, the preservation of their pristine conditions and other activities which support its members. A new Association in favour of caves and their surrounding areas was recently founded: the Associazione Nazionale Città delle Grotte (National Association of Cave Cities) *http://cittadellegrotte.it/*. This Association is made by local Institutions and Administrations which administer areas containing natural caves, which may possibly be transformed into show caves. The mission of this Association is to support its members in the preservation and in the touristic transformation of their territories, supplying knowledge and facilities in the fields related to safeguarding, tourist and environmental information. The Italian Speleological Society is currently actively discussing with these two entities ways to improve the co-operation between the speleological associations and the managers of the show caves, while furnishing didactic activities and enhancing the idea of an eco-compatible underground tourism which may be fully compatible with the required economic parameters of the show cave. ■

Some of the most important Italian show caves

Grotte di Bossea (Piemonte) *http://www.grottadibossea.com*
Grotte di Toirano (Liguria) *http://www.toiranogrotte.it/it/home*
Grotte di Borgio Verezzi (Liguria) *http://www.grottediborgio.it*
Grotta Gigante (Friuli Venezia Giulia) *www.grottagigante.it*
Grotta Nuova di Villanova (Friuli Venezia Giulia) *http://www.grottedivillanova.it*
Grotte di Oliero (Veneto) *http://www.grottedioliero.it*
Antro del Corchia (Toscana) *http://www.antrocorchia.it*
Grotta del Vento (Toscana) *http://www.grottadelvento.com/ITA/home.aspx*
Grotte di Frasassi (Marche) *www.frasassi.com*
Grotta di Monte Cucco (Umbria) *http://www.grottamontecucco.umbria.it*
Grotte del Cavallone (Abruzzo) *www.grottedelcavallone.it*
Grotte di Stiffe (Abruzzo) *http://www.grottestiffe.it*
Grotte di Pastena (Lazio) *http://www.grottepastena.it*
Grotte di Castelcivita (Campania) *www.grottedicastelcivita.com*
Grotte dell'Angelo a Pertosa (Campania) *www.grottedellangelo.sa.it*
Grotte di Castellana (Puglia) *www.grottedicastellana.it*
Grotta del Fico (Sardegna) *www.grottadelfico.it*
Grotta di Su Mannau (Sardegna) *http://web.tiscali.it/grottadisumannau*
Grotte Is Zuddas (Sardegna) *http://www.grotteiszuddas.com/montemeana/index.php*

Speleological publishing in Italy, between tradition and transition

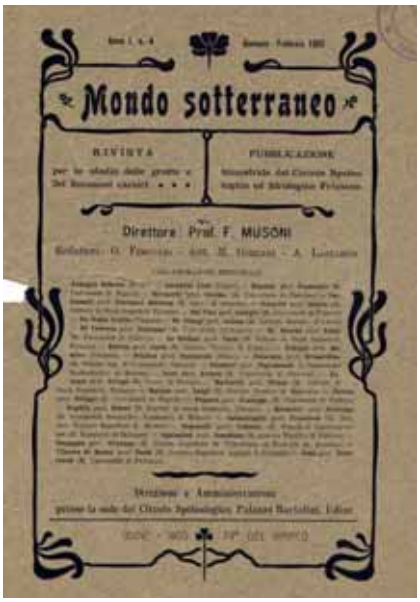
The depiction of speleology, in a constant balance between personal diary and mass distribution

Michele Sivelli

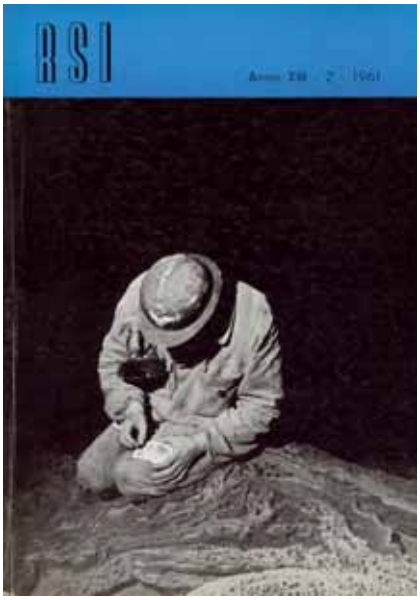
In Italy, there are many periodicals printed by Caving Clubs or Regional Federations, much as in any Country with a strong speleological tradition. Despite the recent worldwide development of digital publishing (PDF downloadable journals), a similar proliferation of digital publishing did not occur in the speleological field in the last decade. In fact, much of the information concerning caves and their exploration appear almost exclusively in social networks,

while scientific research or detailed exploration reports are still tied to classical paper publications. These publications are, mostly, proceedings, or monograph of local interest and serial publications printed by national Associations, although some of these journals also have a digital version.
Traditionally, in Italy, not only caving associations but also Universities and other scientific or sports organizations publish speleological articles or information. However most of these are linked to the serial media: in fact, nothing more than caving has such a temporary nature. From the historical point of view, *Alpi Giulie*

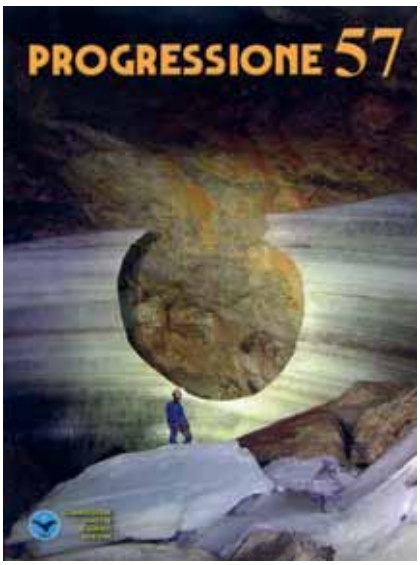
and *Il Tourista* in the late 19th century were the first magazines to continuously print speleological topics, with frequent articles on karsts and caves. Both these magazines were based in Trieste (at that time still part of the Austro-Hungarian Empire). The first magazine which was completely dedicated to speleological topics was founded in Bologna in 1903: the *Rivista Italiana di Speleologia* was created by four university students who were destined to become famous cavers (among these Michele Gortani, first



president of the Italian Speleological Institute) and were among the founders of the first Italian Speleological Society. Unfortunately this magazine survived only two years, as did the association behind it. This journal was substituted by *Proteus,* but also this magazine only survived one year.
Mondo Sotterraneo founded by the Circolo Speleologico Idrologico Friulano of Udine in 1904 is far more important. The first series of this magazine was published until 1923, and



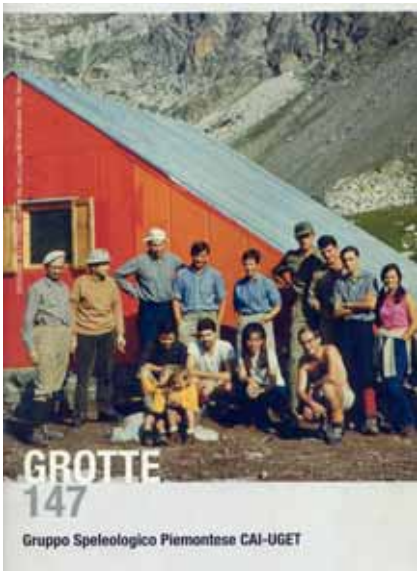
was mostly dedicated to the karsts of Northeast Italy, but also hosted different studies on karsts in other parts of Italy and of the world. Biospeleology, palaeontology and local history were also treated in this magazine. The second series started after the Second World War and *Mondo Sotterraneo* is still in print today, thus existing over 100 years, a unique record for a speleological magazine. The first and second series of *Le Grotte d'Italia* started slightly later (in 1927 and 1936). This magazine was born as an official State periodical, issued by the Royal Caves of Postumia, it eventu-



ally became the voice of the Italian Speleological Institute, the scientific branch of the Royal Caves. Undoubtedly this periodical is the real first national journal in Italian speleological history thanks to its descriptions of most of the main Italian karst phenomena known at that time.

Le Grotte d'Italia, after a period of quiescence due to the troubles within the Italian Speleological Institute, restarted with a third series in 1958, followed by other two series before finally closing down in 2004.

Only after the second part of the 1950s did caving club magazines start to be printed in every part of Italy. The highpoint for the appearance of new magazines was in the 1970s and 80s. Most of them didn't last long (usually only a few issues or years), however they were a real expression of the nation's speleological

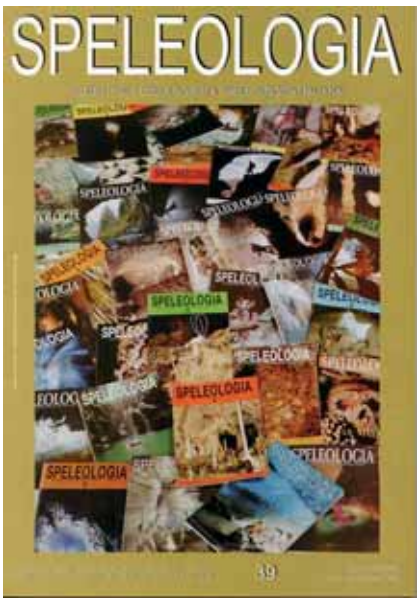


activities, collecting documents on explorations in Italy and beyond.

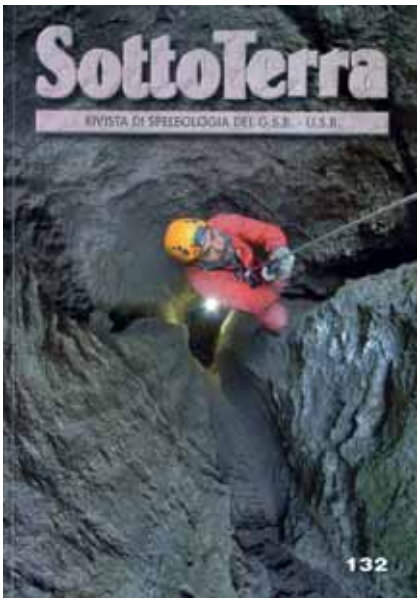
Almost 200 different caving magazines were printed in Italy from 1903 up to date, but only about fifteen have still been active for at least 10 years.

Those worth mentioning on the basis of their age and long-lasting tradition are: *Grotte*, the bulletin of the Gruppo Speleologico Piemontese of Turin and *Sottoterra,* of the Gruppo Speleologico Bolognese of Bologna, both with over 100 printed issues. Moreover, we must also mention the two bulletins printed by the same Club (Commissione Grotte E. Boegan of Trieste): *Atti e Memorie della Commissione "Eugenio Boegan"* and *Progressione*.

Among the Italian speleological publications, a place of absolute importance should be given to *Speleologia,* printed since 1979, in continuity with the previous *Atti e Notiziario of the SSI*, which were edited from 1965 until 1978. This magazine practically took the place of the *Rassegna Speleologica Italiana*, which represented the real junction between *Le Grotte d'Italia* (First and Second Series) and *Speleologia*. *Rassegna Speleologica Italiana* was a very important journal founded by Salvatore Dell'Oca: this magazine started in 1949 and it was printed up to 1977. Its subtitle contained the following: "*official journal of the Italian caving clubs and the Società Speleologica Italiana*". Among the many hiking and/or climbing magazines, which often deal with caves, the bulletin of the Italian Alpine Club, now named *Montagne 360°,* it worth mentioning because it has always given reasonable space to caving activities. Now, what about the future? It's difficult to say. To date in Italy we have less than ten regular magazines still in print, while the already existing online journals have their authors and their readers, but are frequently focused on specific geographic areas or items. A single exception is *Scintilena*, an open blog which functions as a kind of information agency about the world of caves. We are surely in a transitional stage, where, thanks to the new media,



some generations of cavers are "immigrants" in a new world. Currently, in the wide world of digital publishing there is a tendency to report news, in a style catering to *surfing,* which hardly ever goes into depth or detail. Also, the making of a safe backup is still an unsolved problem: a damaged file can often not be repaired. *Speleologia* is testing a web extension which supplies ideas but also shows some limits. However the variety and the richness of the "speleo-diversity" which we present in this issue make us confident that the ongoing revolution of ideas and media will have a positive impact on Italian Speleology. Whether on paper or in the web, Italian cavers will surely be able to keep broadcasting the memories of their results and the meaning of their work. ■

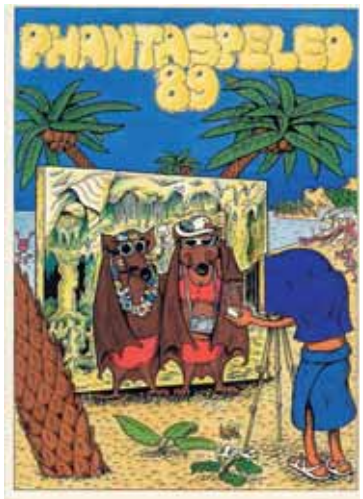


The national speleology meetings in Italy. The shared knowledge

Massimo Goldoni

National meetings are an important resource for every country's speleology. For long as they have existed, they have been a time for comparison and exchange. All this is

decisive, especially in a country such as Italy, where the cultural and environmental differences are not small. The meetings help dissolve regionalisms, transfer skills and open up new ideas and solutions for speleological activities. The meetings ("Rassemblement" in France, "Adunada" in Spain, "Hidden Earth" in the UK, "Convention" in the USA…) have the quality of putting speleologists and particularities of the places where they take place on centre stage. They don't have



the specialisation of congresses or conferences, or the focused didactic content of courses, but they have the great advantages of being "horizontal" and of being a crossroads of relationships. They are the time and the moment in which one shows oneself, proposals are made, things are bought and exhibited, one listens, stories are told or preparations are made. And, obviously, the chance for conviviality, an *agorà* in which the speleological community meets itself.

As the beginning of the 1980s, the Italian speleological meeting was *Pantaspeleo*, that is "the many spe-

leologies". It soon became *Phantaspeleo*, more closely related to the fantasy world. All this happened at Costacciaro, in Umbria, organised by the Centro Escursionistico e Speleologico. Undoubtedly, it was a great thing. It was an important event, which ended in 1991 when, unavoidably, a different vision of speleology emerged. It wasn't against Costacciaro, but simply felt uncomfortable in national memberships, in CAI and SSI, in official programmes. It knocked down personal conflicts and had a need for more centres: it became "transversal".

For the national meeting, speleologists

from Emilia Romagna chose Casola Valsenio in the province of Ravenna for its easily reachable position, the presence of a hospitable community open to discussion and the availability of equipped rooms. The Speleobar, the common space with stands from different regions, became the beating heart of the meetings, which had up to 3000 official attendees. Casola Valsenio, the location of seven meetings in 20 years, became the possible reference model.

Notes on 20 years of meetings

Casola 1993 - "Nebbia" is *by* and *for* all of speleology, to express the desire to leave divisions behind. The Banchi di Nebbia and flash lessons on themes conducted by experts are the highpoints of scientific and tech-

nical learning and discussion.

Casola 1995- "Le Speleologie". Explorations, research, studies in dry or submerged caves, in ice or in artificial cavities, historical and archaeological environments created by man… Diversity is thoroughly examined.

In ***1996*** we went to ***Fiume Veneto*** (Pordenone, North-East) A lot was centred on speleological visibility and iconography.

Casola 1997- "Speleopolis". The definition was by Tim Stratford, who noted that in Casola are there were no real differences between shops, shows, bars and the conference room.

Chiusa Pesio, in Piedmont in the Alpi marittime, In 1998 it was the meeting with Alpine speleology and at the same time the 18th National Congress.

Casola 1999- "Millennium" Also known as the millennium passage of the speleologists. The meeting was characterised by an avant-garde review of digital techniques used in documentation.

In the following years, the Casola model was repeated in Trieste, in Veneto, in Tuscany, Lombardy, Marche. Everywhere the ideal magic thread of the meetings was followed.

Almost always the local communities also became involved.

2000 "Bora", over 3000 people met in Trieste, in a holy place of world speleology. Bad weather, but many visits to historical caves.

2001 "Odissea nel Corchia" was Seravezza in Tuscany, in the shadow of Monte Corchia and its extraordinary complex.

2002 "Conglomeriamoci" in Veneto at Nervesa della Battaglia in Veneto, with peculiar caves in conglomerates and 2004 at Genga, near that extraordinary complex, partly touristic, of Frasassi.

Lombardy, with the ***Valle Imagna,*** was the host in ***2005***. Excellent reportages were on the menu.

Casola 2006-"Scarburo!" *"Scarburare"* is, was… the act of changing the carbide inside the acetylene generation canisters. The meeting was an ideal watershed between two lighting "epochs". There was a lot of talk about geography.

2007 is "Metamorfosi?" at Castelnuovo Garfagnana in Tuscany, with the Apuan Alps on centre stage.

2008, return to Val Imagna, at S. Omobono. Nice event affected by bad weather.

2009 is an atypical year. Spring meeting in Sardinia, ***"Icnussa"*** in Urzulei characterised by extraordinary places. Then, in November, a meeting - laboratory on "speleologists in movement" at Toirano (Savona).

Casola 2010- "Geografi del Vuoto". The entire meeting was an intense confrontation on the meaning of contemporary speleology

2011 is "Speleolessinia" at Negrar (Verona). A few logistical problems, but the Spluga della Preta (The Abyss!) is close by.

2012 at ***Borgo Celano*** (San Marco in Lamis, Gargano in southern Italy) alongside "Spelaion", the yearly appointment of speleology in Puglia,

turned international in cooperation with the Parco Nazionale del Gargano.

In ***2013*** back to Casola Valsenio for ***"Casola 2013-Underground"***, a meeting inserted within the transnational Julius project, centred on the wonders of the mountain from Slovenia to the Appennino Ravennate.

In 2010 the Italian Speleological Society, during the course of its 60th foundation celebration in Verona, gave Casola the title of" Speleopolis-Città amica degli speleologi" (Speleopolis-City friend of the cavers). In October of that year, that title became an official sign on the main entrances to Casola Valsenio. ■

A brief journey through the historical memory which guides us

Giampietro Marchesi - President of the Italian Speleological Society

Over 60 years ago, the Italian Speleological Society (Società Speleologica Italiana – SSI) was born as a channel for the existing speleological bodies. On June 25, 1950, 33 speleologists representing almost all the cave groups of Northern Italy met for a convention at the Museum of Natural History of Verona: after much discussion and the presentation of a statute, they unanimously decided to found the Italian Speleological Society.

Leonida Boldori was proclaimed its first president. This is where our story begins. The statue and the act of constitution, deposited by notary Rognoni in Pavia, are the foundations of the current SSI. And I like to remember that in the first years, 55 groups of the 60 active in Italy were members.

In April 1883, in Trieste (at that time still annexed to the Austro-Hungarian Empire), the Comitato alle Grotte della Società Alpina delle Giulie, the current Commissione Grotte "Eugenio Boegan", was born. In Northern Italy towards the end of the 1800s, other associations took shape. In October 1897, in Milano, the Speleological Section of CAI (Italian Alpine Club) was founded and still exists today as the Gruppo Grotte Milano. Still in 1897, more precisely on October 25, in Udine the Circolo Speleologico e Idrologico Friulano was cosituted and still exists and is active today. One year later, on October 12, 1899 it was the turn of Brescia, with the Circolo Speleologico Bresciano "La Maddalena". In Bologna in 1903, four students, Carlo Alzona, Ciro Barbieri, Michele Gortani and Giorgio Trebbi, encouraged by Professor Giovanni Capellini, founded a speleological society which in their intention would have been the nucleus of a future Italian Speleological Society, but in practice that remained an a noble dream. In 1904, the Circolo Speleologico Romano was founded. The end of the First World War (1915-1918) saw Italy annex the city of Trieste and its karst territories, including Postumia. And it's here that in 1927 the first issue of the publication "Le Grotte d'Italia" (The Caves of Italy) saw light. It was the official publication of the State Corporation for the Royal Postumia Caves (Azienda Autonoma di Stato delle Regie Grotte Demani-

The Museum dedicated to Giovanni Capellini, who inspired the first Speleological Society with national ambitions in 1903.

Descent into Buco del Laghetto of the Circolo Speleologico Bresciano "La Maddalena". (Photo L. Rubagotti 1899)

Caricature of the attendees of the founding meeting of the Italian Speleological Society, Verona, 25 June 1950.

Speleologist card released by the Italian Institute for Speleology in 1924.

From left to right: Luigi Fantini (founder of Gruppo Speleologico Bolognese in 1932), Giuseppe Loreta, Eugenio Boegan and Michele Gortani in Trieste, 11 June 1933 at the 1st National Speleology Congress. (Archive GSB-USB di *Sottoterra*)

ali di Postumia). Its aims were clearly described in the presentation to the readers by President Spezzotti "*the aim of the magazine is to gather, with a spirit of pure Italianess, around Postumia which is the incomparable site of the most interesting karst phenomenon known, all the speleological activities of Italy; to coordinate the work and the speleological studies which are being carried out in many places in the Peninsula, and to start the Cadastre of Italian Caves with methodical criteria.*"

Still in Postumia, on 26 November 1928, the Istituto Italiano di Speleologia was founded, presided by Michele Gortani and directed by Franco Anelli. At that time the number of associations increased to 27 and in 1933, the year in which the 1° National Congress of Speleology took place in Trieste, there were 58 groups.

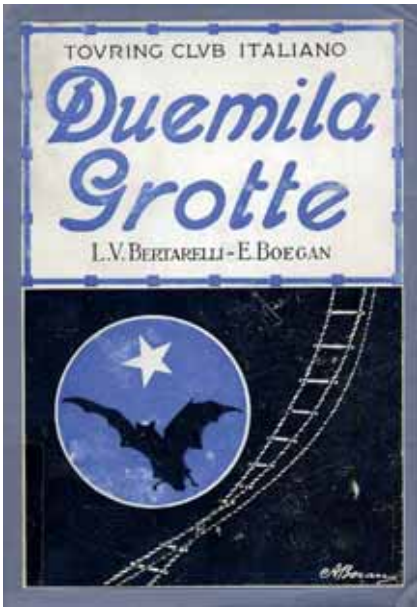
The events of the Second World War created huge problems also for Italian speleology. All the materials of the Istituto Italiano di Speleologia, including the cadastral archives, which at first had been transferred to Recoaro, was confiscated by the Germans and taken to Germany. At the end of the war, with incredible effort and with the wisdom and the great patience of Franco Anelli, only a part of the precious documentation was recovered.

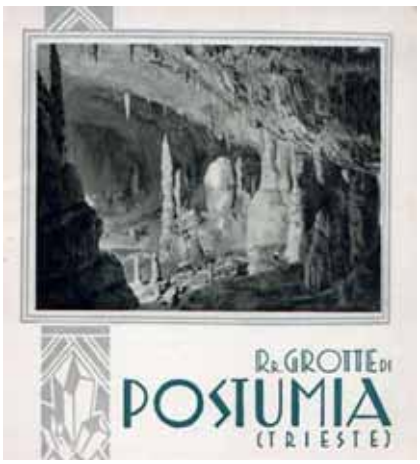
In Milan in 1945, in the offices of the Touring Club Italiano, the Centro Speleologico Italiano was constituted. In 1949, Salvatore Dall'Oca started, financing it himself, the *Rassegna Speleologica Italiana,* which quickly and until 1973 became the printed voice of Italian speleological groups.

Currently, the Italian Speleological Society has over 3500 individual members and counts more than 160 groups. The Society has juridical standing and is recognised by Italian law as an Association for Protection. SSI is articulated into the following commissions: Cadastre, Schools of Speleology, International Relations, Environmental Protection and Artificial Cavities. Furthermore, the Insurance Office matches up members with insurance companies, thus guaranteeing an indispensable instrument for field activities. Since 1979 it publishes *Speleologia* (this magazine!) and, since 1999, *Opera Ipogea - Journal of Speleology in Artificial Cavities*.

In Bologna the SSI coordinates and manages the Italian Centre for Speleological Documentation "F.Anelli" (Centro Italiano di Documentazione Speleologica "F.Anelli"), which has one of the most important libraries having a speleological theme in the world. ■

Cover of the renowned publication *Duemila Grotte* by Luigi Vittorio Bertarelli and Eugenio Boegan published in 1926 by the Italian Touring Club.





Advertisement leaflet of the '20s of the Royal Caves of Postumia.

Italian Speleological Rescue: brief history and organization

The evolution of a specialized and renowned structure

Roberto Carminucci

For over fifty years the National Mountain and Cave Rescue Corps (CNSAS) has carried out its duties of emergency rescue in the mountains, underground and in any inaccessible area of the country. It's operationally part of the Italian Alpine Club (CAI), with its own charter, statute and organizational rules approved by the CNSAS National Assembly, a sovereign self-governing body. The organization is divided into Regional Services, coordinated by a National Directorate, which also heads its national schools. Each Regional Service is divided into Alpine Delegations and Speleological Zones, which are composed of several stations (alpine or speleological). The more than 7000 CNSAS members are all climbers or cavers of proven experience and skills and all of them have a basic understanding of medical aid techniques. The specific training and constant updating are a guarantee of high expertise, which is necessary for emergency rescues in a difficult, hostile or inaccessible environment. The CNSAS is summoned for any accident which may occur during hiking or climbing activities (on mountain paths, cliffs, ice waterfalls, clefts etc..), caving (natural or artificial caves), cave diving (flooded caves, mountain lakes), canyoning (canyons, gorges), in case of natural disasters (avalanches, floods, earthquakes, etc..), in the event of ropeway incidents (chairlifts, cable cars etc..), but also for ordinary events which occur in environments that standard emergency teams are not able to reach or where they can't perform the required rescue activities within acceptable safety standards. The CNSAS constantly provides, through its National Schools, education, training and upgrading of its members, so that all the volunteers are able to operate with competence and professionalism, even in the most difficult environmental conditions.

Rescue maneuver with the tackle technique during an exercise. (Photo L. Sanna)

The Speleological Rescue

Officially born in 1966, over the years it has evolved from both the organizational and operational point of view. It covers the whole country with 16 Delegations, divided into 27 local operating units: the Stations. Several operative commissions, (Canyoning, Cave diving, Communication and Documentation, Obstacle removal, Medical) are part of the Speleological Rescue. Other commissions (Technical and Foreign Affairs), have the task of studying, developing and disseminating new, safer and smarter emergency evacuation techniques. A complete set of operational protocols have been developed with the goal of minimizing response time while guaranteeing the quickest possible and most professional medical assistance and evacuation. These standards allow the deployment of the most suitable technical and specialized resources for each particular emergency scenario from all over the country. The usual long duration of evacuations is the factor which most affects the organization of cave rescues. The strategic and winning choice, the result of years of experience in the field, has been to provide immediate medical assistance to the injured in the same place where the accident occurred, and only after the medical

Exercise in the Cuccuru Tiria cave, Sardinia. (Photo L. Sanna)

team rushed to the scene of the accident declares that the injured can be moved, the evacuation procedure takes place.

The National Schools

The CNSAS has 9 National Schools (National School of Cave Rescue Technicians, National School of Medical Emergency in high-risk underground environments; National School of Cave diving Rescue; National School of Canyoning Rescue; National School of Directors of Operations), which are recognized as the only training schools qualified for training specialists in mountain and cave rescue. The National Schools are responsible for training and updating all the volunteers, and to ensure the standardization of rescue techniques all over the country. All volunteers are required to attend a training program that provides different training levels and specialties, exams, periodic checks and formal certifications of all the acquired levels.

The commissions

In addition to the national schools, which often have corresponding regional schools, several commissions are in operation within CNSAS. Some provide specialist support during the rescue operations (Obstacle removal, Cave diving, Medical, Communication and Documentation). Others are thematic commissions which are involved in the development and study of various topics related to emergency techniques (Techniques, Foreign Affairs). ■

A journey across speleological Italy

Mount Conca cave, Messinian gypsum of Campofranco (Caltanissetta, Sicily). (Photo M. Vattano)

Gorgazzo, Luigi Casati at 212 meters depth

After decades of cave diving explorations, in 2008, at the Gorgazzo spring (Friuli Venezia Giulia), the cave diver Gigi Casati reached a new exploration limit of -212 m, which is still today the maximum depth reached in Italy

edited by Luana Aimar

One of the best chapters of cave diving exploration in Italy has been written in the Eaestern sector of the Alpine range, more precisely in the Venetian pre-Alps in Friuli Venezia Giulia.
The Gorgazzo spring lies at the south-eastern base of the Cansiglio plateau, a large karst area of which it is probably one of the main resurgences. It appears as a wide and deep shaft, partially hidden by vegetation, at the foot of small limestone cliff.
Its waters are characterised by particularly intense and spectacular colours.
The first dives, which go back to the second half of the 1960s, and those during the following decades which pushed ever deeper, started a series of explorations which only gave an idea of the great submerged potential of the resurgence.
In 1992, the Swiss cave diver Jean Jacques Bolanz reached a depth of -131 metres, passing through areas which go down vertically, not very wide, until a chamber was reached - later baptised Sala Martini (-85m) - beyond which the cave flattens out and the slope becomes less accentuated. Bolanz's exploration stopped at a new underwater vertical: in various points, very visible rudiste fossils emerged from its walls.
Unfortunately, three years later, a fatal accident during an immersion by another team of cave divers led to the authorities barring access to the resurgence for safety reasons.
This ordinance blocked all attempts to continue the explorations for many years.
Only in 2008, doing a particularly favourable dry season, could Gigi Casati from Lecce, restart the immersions in Gorgazzo. Casati is a pupil of Jean Jacques Bolanz and was one of his companions during the previous mapping and exploration work carried out in the resurgence.

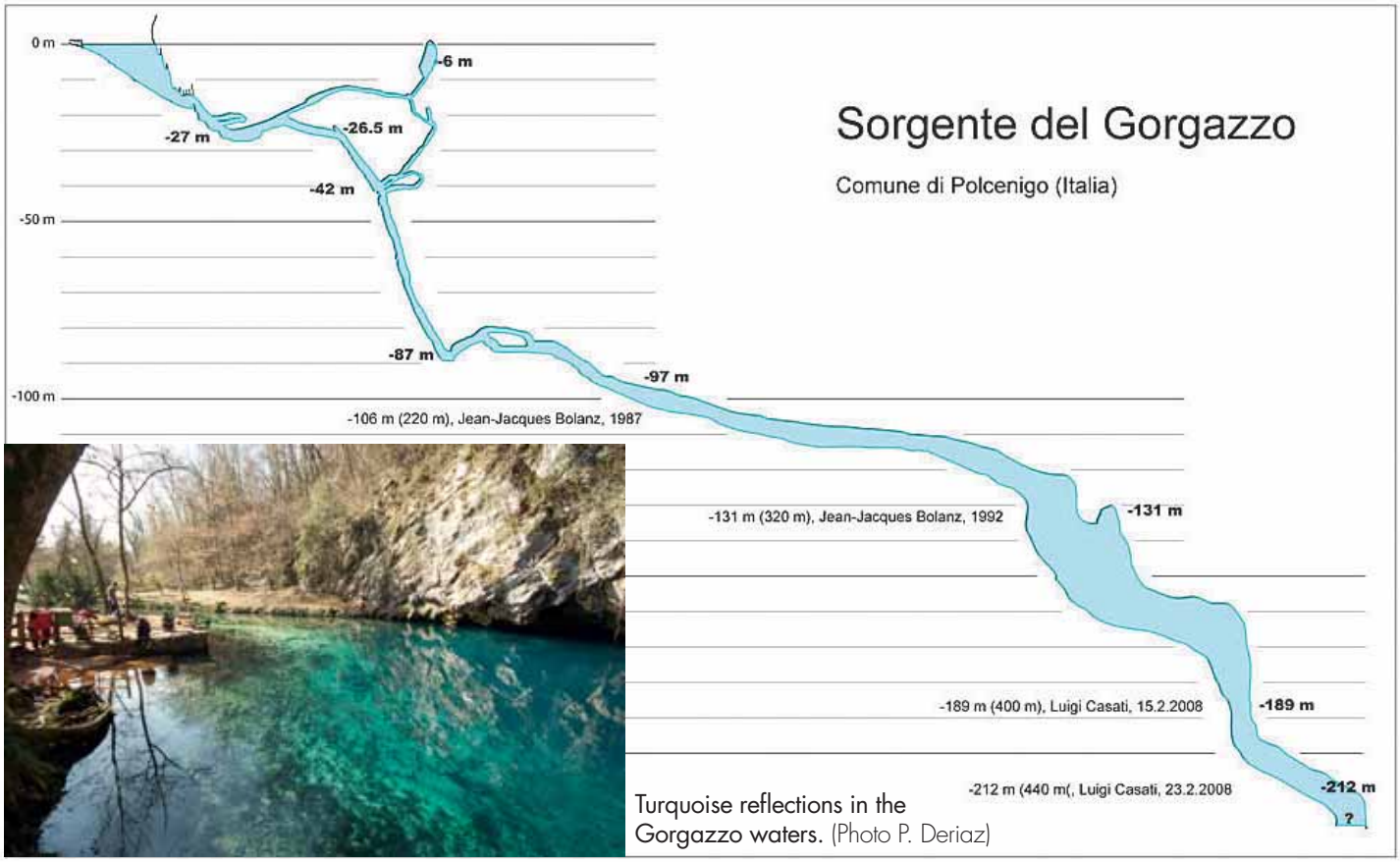
Above: the initial parts of Gorgazzo spring. (Photo R. Rinaldi)

FRIULI VENEZIA GIULIA

Speleologia in Rete
Immerse yourself in Gorgazzo
http://tinyurl.com/68-gorgazzo

A number of visits, despite being marked by bad luck and unfavourable environmental conditions, allowed Casati to reach the exploration limit of Bolanz again and to re-guideline the way.
Successively, three immersions in February of that year, within a few days of each other, allowed Casati to restart the exploration where it had been interrupted 16 years previously, significantly increasing the known depth which was brought first to -157 m, then to -190 m and finally to the current exploration limit of -212 m.
Some secondary branches were also explored, which brought the length of the cave to over 600 m, almost all of them surveyed.
The areas discovered by Casati in the deepest parts of the cave, unlike those explored by previous cave divers, are very large and go down with a marked vertical tendency. At the depth of -200 m, a 15x10m sub horizontal gallery with polished walls brought Casati to the start of slide having a 50° incline and to a new unexplored shaft, at over 400 linear metres from the entrance pool.
The exploration limit reached in 2008 at the Gorgazzo resurgence required a huge amount of materials, the backing and coordinated support of many cave divers, patient waits for the most favourable water conditions and, finally, a challenging immersion lasting 280 minutes. Gorgazzo is, currently, the deepest human exploration in an Italian resurgence. The immersion which reached the -212 limit had to be interrupted, because an analyser which controlled the oxygen's partial pressure in the internal closed circuit system had closed.
Since then, unfortunately, the authorities haven't issued any more permits for continuing the explorations. ■

Gorgazzo, rising from the deepest areas. (Photo R. Rinaldi)



Turquoise reflections in the Gorgazzo waters. (Photo P. Deriaz)

La Venta

A unique story in the world of speleology, not only in Italy, as told by one of the founding members

edited by the Editorial Staff

The La Venta Association is already well-known internationally, however we would now like to know some of the lesser-known facets of its history and organisation. With the help of Tullio Bernabei, one of the main founders of this "supergroup", we'll go hunting for behind-the-scenes information which, perhaps, could inspire positive models to imitate.

Dear Tullio, we have to start from the beginning, that is from the small nucleus which led to the flowering of the current situation. It had its epicentre in Rome, in the Circolo Speleologico Romano, a fellowship which was the first in Italy to embark on expeditions already in the 1950s, to then undertake the extraordinary explorations in Chiapas in the early 1980s. What was the stimulus which led you to go beyond that experience and what were your criteria for choosing your first travel companions?

As often happens in speleology, I can say that the beginning was caused by a fight. In 1988 I left the Circolo Speleologico Romano because I didn't like the way things worked and how the group was being run. Naturally the experiences in Mexico in the 80s with the CSR were decisive for my "development", and it was precisely the desire to do those things better and more effectively which led me to search for new solutions and new companions. In March 1989, along with my cousin Marco Topani who had left the CSR along with me, I participated in an expedition to Palawan in the Philippines. There we got to know Tono De Vivo and we got along well, managing to put together some first ideas. In August of that same year we organised the first expedition in Central Asia, involving many friends from all over Italy, I could say the best and most open of that time. I think that Samarcanda '89 was a great factory of ideas, actions, techniques and ways of thinking. Among others there were Gaetano Boldrini and Italo Giulivo, with whom I would found La Venta in 1991, as well as Giovanni Badino and Ugo Vacca who joined shortly afterwards.

A *sima* of Selva El Ocote (Chiapas, Mexico). (Archive La Venta)

From the very beginning you called yourselves an "association of geographic explorations", an expression which brings to mind experiences not limited to speleology. But to what degree can one really imagine exploration, physically speaking, of the water and land globe today? In other words, everything is now searchable through artificial instruments (satellites, helicopters, bathyscaphs, binoculars, probes, etc), while it is generally agreed that only speleology requires a first person physical commitment. Therefore, in which sense should this "geographic exploration" be understood?

If we take a look at the modern definition that many today give speleologists, which is "geographers of the dark", I could say with a touch of presumption that we got the name right… However, I think that we were very influenced by the places we were experiencing in those years: in Central Asia we found Hellenistic period walls and hundreds of dinosaur footprints, in Mexico unknown pre-Columbian traces. All this was much more than speleology alone: it was looking with different and more alert eyes, I'd like to say more curious ones, at the world around us. Imagine that even today in the Selva El Ocote in Chiapas, Mexico, our explorers do it for real, even more on the surface than underground. Despite the technologies, I think that a physical presence is still necessary and decisive in many areas, sometimes even in known ones.

For several years after its foundation La Venta was officially made up of a limited nucleus of friends united by a common passion, to which occasional, specially invited outside figures would participate. Then you finally opened up, why? And, expanding, what are now the "admission criteria" you use to guarantee your identity and shared values?

As I said, the first nucleus was made up of five friends (myself, Marco, Tono, Gaetano and Italo), then almost immediately Giovanni and Ugo joined. Then a long stable period followed, with specially invited outsiders, as you mentioned. The opening up happened between 1997 and 1998, because a long and complex speleo-archaeological expedition in the

Rio la Venta Canyon, which lasted two months, on one hand brought to light the capacities and skills of some participating friends, on the other our organisational limits for operations of that kind as a 7 person group. That experience was so demanding for us that it seemed right to open the doors of the Association. It was still a delicate and much discussed operation. Back then the admission criteria were a kind of recognition of the work carried out Mexico and having at least three important skills: speleological, organisational and knowing how to get along together.
Today the criteria are less strict and we number over 50 between Italians and non-Italians: many members haven't experienced expeditions together. But the need remains for an objective capability in the field of speleology, or a similar one, along with the desire give a hand practically and in Italy, not only during expeditions. The candidates, who need to be introduced by a member, are asked to write a letter in which they explain why they want to become part of La Venta. Shared values are created quickly during expeditions and more slowly during the social activities in Italy, but they are created and are felt. Naturally not all members end up being ideal, but I can say that we haven't made any big mistakes.

Quatro Cienegas desert: rigging a descend route (Coahuila, Mexico).
(Archive La Venta)

Being involved in geographic and speleological research, loosely defined, requires having a group with adequate scientific backgrounds or specific technical knowledge. But the youngest team is the one which can guarantee results in the most challenging field situations, but is normally more attracted by the exploration aspect itself. Do you manage to make these two approaches live together easily, even though in the speleological field they have historically been very different from each other?
We are trying. The "young" generation of the 1990s has passed and now we have fewer young members. Effectively, as far as pure speleological engagement is concerned, the results aren't as good. However, this is compensated by the explorative maturity reached by many "Laventians" and helps the living together process of the two approaches, the technical and scientific. We still have to find a way to add more new forces, which isn't easy.

Preparation for the descent into Te Toke Taung cave (Shan, Myanmar).
(Photo P. Petrignani, Archive La Venta)

La Venta is made up of individuals coming not only from Italy anymore but also from many other countries, have you ever thought of collaborating with other organisations having similarities with yours? For example the French Centre Terre or the American AMCS or the US Deep Caving Team, which just in these weeks is trying for the "jackpot" in the Sistema Cheve?
Very little. There haven't been any particular chances or needs, and again with a bit of presumption, international groups involved in many and different areas such as we are, from my point of view don't exist. Additionally, I sincerely believe that they fear us, mistakenly. The few times we have neared "occupied territories" offering collaboration, they have politely slammed the door in our face.

How is the choice made to start a research campaign? What are the presuppositions which you find positive for an initial investment? Basically, how the decisions made on who, what and where?

Usually it starts with the interest of a member who finds a particular place: through study, through contacts or going there at his/her own cost for a first look. As a general rule, if caves aren't involved, it doesn't interest us. Then the Association decides to invest a bit of money for a second look and the more interested members take off with the understanding that they will then dedicate themselves to that project not take off for vacation. The initial principal criterion is usually the absence of previous speleological research: we like opening roads, not following them. With few exceptions.

From projects carried out exclusively in exotic lands, you have now started being active in Italy, like for example on Monte Kronio in Sicily. What are the motivations behind these new Italian projects?
An exception to my previous statement is exactly the Kronio Project in Sicily, where we joined up with the Commissione Grotte Boegan of Trieste, the Stufe di San Calogero's historic explorers. For now this is the only important project we are backing in Italy, it's not beginning of a domestic phase, but only the fruit of interest, curiosity, esteem and personal friendships. It's an adventure of extraordinary interest at the human, technical and scientific levels. We are counting on making an important contribution from both the technical-scientific and documentary aspects.

We heard about the initiative to found a La Venta group in Mexico, together with your local collaborators. Are there any Native People among them or are they all Latinos?
Actually, it's not a speleological group but a centre for karst studies, therefore having slightly different aims and outlooks. La Venta is involved, both as a name and as a place, because this new Association in practice has the honour and the burden of inheriting the fruits of 20 years of our researches, and use them to start systematic, daily and shared actions in the area. I'm not only talking about explorations and studies, but also about training, education, conservation and helping sustainable tourism. A couple of our friends are close to the new association, but are not yet members for contingent reasons. One is Manuel Perez, who lives in the middle of the karst area and is already a skilled speleologist, the other is Lucas Ruiz, who belongs to the native Tzotzil population, a true force of nature born in the Selva El Ocote and already a La Venta member..

Cueva of Rio La Venta (Chiapas, Mexico). (Photo R. De Luca, Archive La Venta)

Inside the Upsala glacier shelter, Patagonia. Tullio Bernabei (center), Tono De Vivo (left). (Photo P. Petrignani)

Could you tell us in a few words, over the past twenty years, which expectations have been fulfilled and which are still the critical points?
That's a mouthful… I can say that we've transformed many speleological dreams into reality. We reached goals which were unimaginable even to us and we opened new roads. Speleological exploration has become geographic, in the sense of paying attention to everything surrounding the underground world and which is somehow tied to it. We took the production of documentation to a professional level and changed some speleological attitudes, Italian and otherwise, but also changed the attitudes of many local people who had nothing to do with speleology. Being a bit rhetorical, I'd say we made many people dream, as well as ourselves. But I can't tell you what La Venta is today, if not an ongoing experiment begun over 20 years ago. It's a situation in change, a continuous process of adaptation. We could survive ourselves and as an association go on for decades, or quickly implode and leave only memories, I really don't know. The critical points are on one hand, the lack of time and resources to dedicate to La Venta given the increasing complexity of our lives, on the other necessity of being ever more professional while remaining volunteers. Not easy. Maybe this is the most difficult exploration of them all…

What should people who are interested in knowing more about the association and your achievements do?
In the meantime, visit our site www.laventa.it and sign up for our free newsletter. Then read our magazine, KUR, which can also be downloaded from the site and maybe also some of the many books we've published. If after studying us, someone has a proposal to make, just write us: good people are always needed, no matter what language they speak. ■

Italy. Notes on a *different kind* of speleological organisation

The increasing complexity of research encourages new aggregations, leaving behind divisions and vested interests

Massimo Goldoni

If we take a look at Italy's physical geography, we can understand a lot about its history. With the exception of the Po river valley, the peninsula is filled with uninterrupted mountain ranges. Then there's the sea, which divides the continental part from two large islands, which are regions themselves. Italy's history is one of diversity, of conflicts, of an unimaginable variety of traditions, customs and architectures. Speleology in Italy is a product of all that. Different climates, different rock morphologies and different ways of interpreting the meaning of exploration itself. For these reasons, the history of organized speleology in Italy has some particular characteristics, while still sharing many common elements with other countries. Until the 1980s, the activity of large cave groups prevailed, which either acted alone or in cooperation with others. In the second half of the 1970s, progression only using rope started spreading. This was the beginning of several conflicts. Progression on rope alone allows smaller, more agile and faster teams. But that went against established ways of thinking and existing hierarchies. For a certain period of time, many felt that they had to satisfy the needs of a few. A cave normally undertaken with heavy ladders and hemp ropes changed immediately if travelled using nylon ropes and contemporary techniques. This erased existing glories and undermined accumulated prestige. New caves and new bottoms were found, because obstructions were removed, pits were traversed horizontally or explorers climbed up instead of down. Territorial conflicts emerged, but also new affinities and new talents could appear. Before, one could be a supporting member of a strong team, but from a certain point on, the selection process became drastic, despite the fact that the average level of competence rose. The techniques of rope progression are an unavoidable skill which needed to be mastered. But it was also expected that everyone should have some basic knowledge of the underground world and karsts. The paramilitary aspect, which had characterized many expeditions until then, disappeared. Then in 1988 something unique occurred in the speleological world.

Participation… (Photo G. Badino)

Solidarity… (Photo G. Badino)

The cleaning operation of the Spluga della Preta in the Monti Lessini (Province of Verona) began. The cave was always known as the "Abyss" due to its sequence of initial pits, including the "p.131" which opens abruptly in a green pasture. The Abyss had seen and suffered from 60 years of explo-

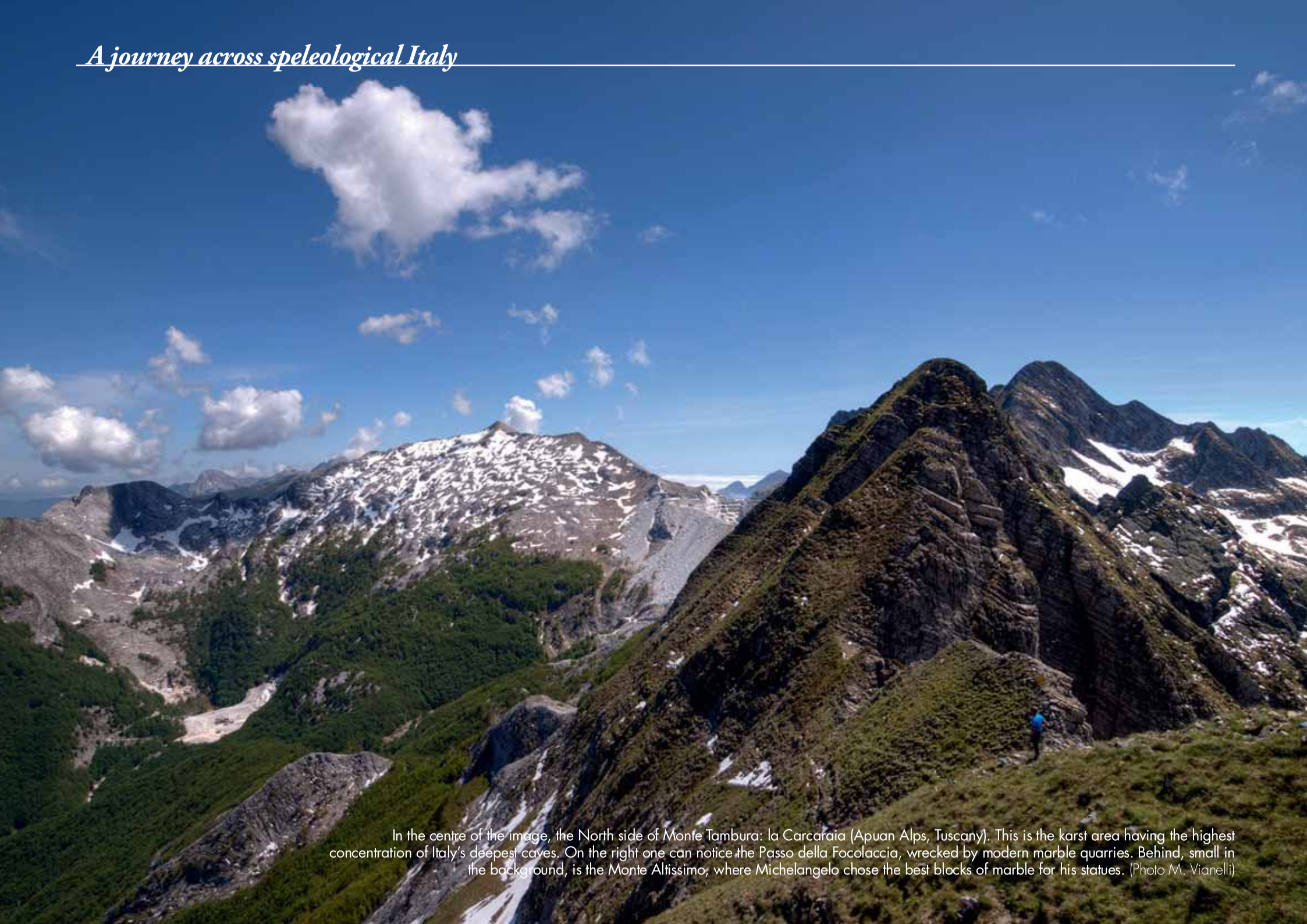
Collaborations… (Photo V. Crobu)

'80s on the road. (Photo M. Sivelli)

rations. It was full of those expeditions' rubbish. The "Operation Corno D'Aquilio" also included further study, mapping and colourings, but the most impressive result was the 3500 kg of garbage carried out of the cave.
Hundreds of speleologists, from many regions and many countries, free from vested interests, all aiming for a common goal, beyond the ideas of the various cave groups. Everyone had a space; those working deep down, those helping on the surface, those placing fluorescein and those sorting the rubbish carried outside. It was a pragmatic revolution, which swept away all the imaginary castles of roles and small power bases. It wasn't a painless process. The Italian Speleological Society (SSI) understood, through its President Forti, that it was time to open up to a new world. Within the Italian Alpine Club (CAI) a period began which would end in the mid-1990s with fairly traumatic proceedings. A new speleology was born, which was capable of joining together to pursue objectives, which could specialize itself to overcome limitations, which could mix and cross-contaminate. Groups and Federations still ruled the territory, but individual explorers became ubiquitous migrants. The Spelaion 2012 meeting in Borgo Celano (Puglia) was a moment of contemplation on the state of the art of speleological research in Italy. It was a chance for people currently involved in complex cave explorations to compare various ways of working together, different research techniques and the acquisition and transfer of information and data. Recent years have been characterized by exceptional results.
Conjunctions, new entrances, new pieces in the puzzle of complex karst systems and siphons left behind. The protagonists are widely varied in origin, ways of working together and research methods. There are projects focused on an area, complex formations created by explorations, Federations which function as a group and impromptu formations which exploit the moment. This is variety and richness. Looking beyond vested interests, symbols and pennants, the Italian Speleological Society has asked for and proposed the creation of a picture of what is happening in Italian speleology today. The Society, together with the Italian Alpine Club, has opened the debate on crucial topics, such as the proper relationship with the landscape (including the social landscape), the adherence to existing regulations and the safeguarding of speleological practice, the capacity of administering data, images and information. The necessity of education and spreading information. We're at both a landing and a starting point because, as was said in one of our better slogans a decade ago, "It's again time for new travellers"... ■

Spluga della Preta... human garbage. (Photo S. Serventi)

... Libiamo, ne' gli allegri calici... (Photo G. Badino)



In the centre of the image, the North side of Monte Tambura: la Carcaraia (Apuan Alps, Tuscany). This is the karst area having the highest concentration of Italy's deepest caves. On the right one can notice the Passo della Focolaccia, wrecked by modern marble quarries. Behind, small in the background, is the Monte Altissimo, where Michelangelo chose the best blocks of marble for his statues. (Photo M. Vianelli)

Longest and deepest caves in Italy - Longest (updated to june 2013)

For the updated list, visit
http://tinyurl.com/68-le-piu

N°	Nome	Regione	Comune (Provincia)	Sviluppo
1	Complesso della Valle del Nosè	LOMBARDIA	Sormano/Zelbio (CO)	> 61000 m
2	Complesso del Monte Corchia	TOSCANA	Stazzema (LU)	> 57000 m
3	Complesso di Piaggia Bella	PIEMONTE	Briga Alta (CN)	43000 m
4	Complesso Carsico della Codula Ilune	SARDEGNA	Urzulei-Baunei (OG)	> 42000 m
5	Complesso del Col delle Erbe	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	~ 40000 m
6	Sistema Buso della Rana/Pisatela	VENETO	Monte di Malo (VI)	37000 m
7	Grotta della Bigonda	TRENTINO ALTO ADIGE	Ospedaletto (TN)	36200 m
8	Complesso della Carcaraia	TOSCANA	Minucciano (LU)	> 35000 m
9	Sistema dei Piani Eterni	VENETO	Cesiomaggiore (BL)	34000 m
10	Complesso Fiume-Vento	MARCHE	Genga (AN)	30000 m
11	Abisso Bueno Fonteno	LOMBARDIA	Fonteno (BG)	> 22000 m
12	Complesso del Grignone	LOMBARDIA	Esino/Mandello Lario (LC)	> 21000 m
13	Complesso Omber en Banda al Bus del Zel-791	LOMBARDIA	Serle (BS)	> 20000 m
14	Complesso del Foran del Muss	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	~ 20000 m
15	Complesso Mutera - Fantozzi	PIEMONTE	Ormea (CN)	18403 m
16	Grotta del Bue Marino	SARDEGNA	Dorgali (NU)	17400 m
17	Complesso Ispinigoli-S.Giovanni Su Anzu-Nurachi	SARDEGNA	Dorgali (NU)	17000 m
18	Complesso Cappa-18-Denver-Straldi	PIEMONTE	Briga Alta (CN)	16000 m
19	Grotta di Monte Cucco	UMBRIA	Costacciaro (PG)	16000 m
20	Grotta di Su Bentu-Sa Oche	SARDEGNA	Oliena(NU)	15740 m
21	Complesso Labassa - Ombelico del Margua	PIEMONTE	Briga Alta (CN)	14000 m
22	Sa Rutta 'e s'Edera	SARDEGNA	Urzulei(OG)	12391 m
23	Grotta Maddalena	LOMBARDIA	Morterone (LC)	> 11000 m
24	Is Angurtidorgius	SARDEGNA	Villaputzu(CA)	10890 m
25	Grotte di Oliero	VENETO	Valstagna VI)	~ 10000 m
26	Complesso Faraone-Fanaccia	TOSCANA	Minucciano (LU)	~ 10000 m
27	Sistema Spipola-Acquafredda	EMILIA ROMAGNA	Croara San Lazzaro (BO)	9800 m
28	Buca del Selcifero	TOSCANA	Vagli di Sotto (LU)	9430 m
29	Grotta Bessone	PIEMONTE	Frabosa Soprana (CN)	9021m
30	Complesso Via col Vento-Schiaparelli-Cima Paradiso	LOMBARDIA	Luvinate(VA)	> 9000 m
31	Sistema Paolo Fonda-Laricetto-Sisma	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	> 8500 m
32	Grotta Su Mannau	SARDEGNA	Fluminimaggiore (CI)	8200 m
33	Grotta Nuova di Villanova	FRIULI VENEZIA GIULIA	Lusevera (UD)	> 8000 m
34	Abisso Pozzo della Neve	MOLISE	Campochiaro (CB)	> 8000 m
35	Abisso Milazzo	TOSCANA	Seravezza (LU)	> 8000 m
36	Buco Cattivo	MARCHE	Genga (AN)	8000 m
37	Abisso Aladino	TRENTINO ALTO ADIGE	Daone (TN)	8000 m
38	Abisso Led Zeppelin	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	7700 m
39	Abisso Olivifer	TOSCANA	Massa (MS)	7600 m
40	Nuovi Orizzonti	LOMBARDIA	Luvinate (VA)	> 7500 m
41	Complesso di Monte Pelato	TOSCANA	Seravezza (LU)	> 7000 m
42	Busa di Castelsotterra	VENETO	Volpago del Montello (TV)	7000 m
43	Complesso dell'alpe Turati	LOMBARDIA	Erba (CO)	7000 m
44	Complesso Fossa del Noglar-La Val-Mainarda-Battei	FRIULI VENEZIA GIULIA	Clauzetto (PN)	6924 m
45	Buca Go Fredo	TOSCANA	Vagli di Sotto (LU)	6900 m
46	Complesso C1-Regioso	PIEMONTE	Ormea (CN)	6500 m
47	Complesso Parsifal-Cocomeri	PIEMONTE	Briga Alta (CN)	6500 m
48	Spluga della Preta	VENETO	Sant'Anna d'Alfaedo (VR)	6500 m
49	Grotta Claudio Skilan	FRIULI VENEZIA GIULIA	Trieste (TS)	6350 m
50	Grotta delle Vene	PIEMONTE	Ormea (CN)	6285 m
51	Grotta Egidio Feruglio	FRIULI VENEZIA GIULIA	Lusevera (UD)	6064 m
52	Grotta Lovettecannas	SARDEGNA	Baunei (OG)	5719 m
53	Complesso del Monte Cavallo di Pontebba	FRIULI VENEZIA GIULIA	Pontebba (UD)	5700 m
54	Grotta Marelli	LOMBARDIA	Luvinate (VA)	5700 m
55	Abisso Bacardi	PIEMONTE	Frabosa Soprana (CN)	5500 m

Longest and deepest caves in Italy - Deepest (updated to june 2013)

For the updated list, visit
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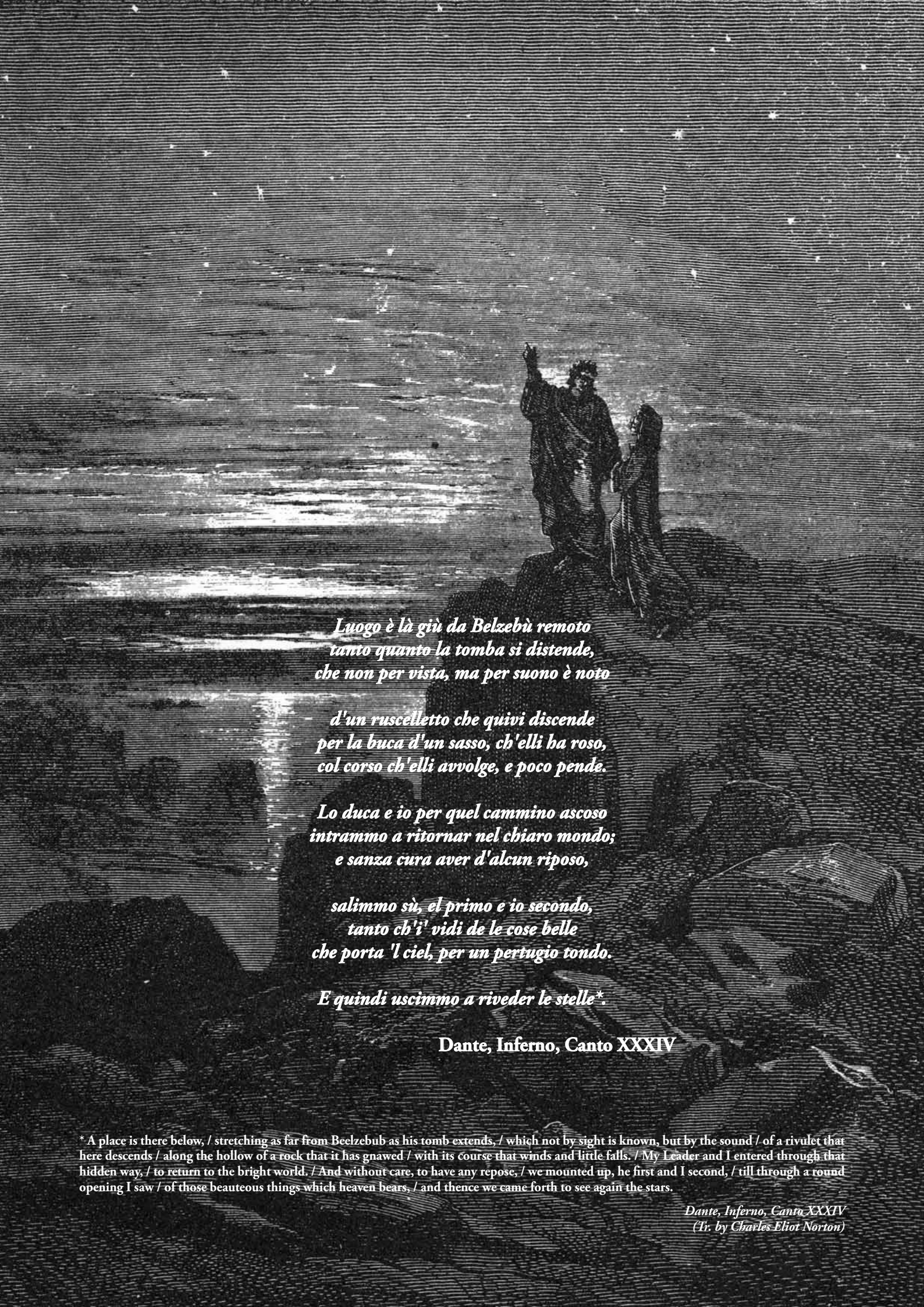
N°	Nome	REGIONE	Comune (Provincia)	Dislivello
1	Abisso Paolo Roversi	TOSCANA	Minucciano (LU)	–1300+50 m
2	Abisso Olivifer	TOSCANA	Massa (MS)	–1215 m
3	Complesso del Grignone	LOMBARDIA	Esino/Mandello Lario (LC)	–1190 m
4	Complesso del Monte Corchia	TOSCANA	Stazzema (LU)	–1187 m
5	Abisso Perestroika	TOSCANA	Minucciano (LU)	–1160 m
6	Complesso della Carcaraia	TOSCANA	Minucciano (LU)	–1125 m
7	Complesso del Foran del Muss	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–1118 m
8	Abisso Mani Pulite	TOSCANA	Minucciano (LU)	–1060 m
9	Buca del Selcifero	TOSCANA	Vagli di Sotto (LU)	–1058 m
10	Abisso Pozzo della Neve	MOLISE	Campochiaro (CB)	–1048 m
11	Buca del Muschio	TOSCANA	Minucciano (LU)	–1042 m (-)
12	Abisso Led Zeppelin	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–1031 m
13	Buca Go Fredo	TOSCANA	Vagli di Sotto (LU)	–1015 m
14	Abisso di Malga Fossetta	VENETO	Asiago (VI)	–1011 m
15	Complesso Pianone-Pinelli-Paleri	TOSCANA	Massa (MS)	–1008 m
16	Abisso dei Piani Eterni	VENETO	Cesiomaggiore (BL)	–971 m
17	Grotta di Monte Cucco	UMBRIA	Costacciaro (PG)	–935 m
18	Abisso dello Gnomo	TOSCANA	Vagli di Sotto (LU)	–925 m
19	Complesso di Piaggia Bella	PIEMONTE	Briga Alta (CN)	–925 m
20	Abisso Cul di Bove	MOLISE	Campochiaro (CB)	–913 m
21	Complesso del Col delle Erbe	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–880 m
22	Abisso dei Dragni Volanti	TOSCANA	Vagli di Sotto (LU)	–880 m
23	Spluga della Preta	VENETO	Sant'Anna d'Alfaedo (VR)	–877 m
24	Abisso del Corno di Campobianco	VENETO	Asiago (VI)	–846 m
25	Ouso di Passo Pratiglio	LAZIO	Supino (FR)	–840 m
26	Abisso Oriano Coltelli	TOSCANA	Vagli di Sotto (LU)	–825 m
27	Abisso del Col della Rizza	FRIULI VENEZIA GIULIA	Caneva (PN)	–795 m
28	Abisso "Queen Mama"	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–790 m
29	Capitano Paff	LOMBARDIA	Esino Lario (LC)	–785 m
30	Complesso Cappa-18-Denver-Straldi	PIEMONTE	Briga Alta (CN)	–780 m
31	Complesso Faraone-Fanaccia	TOSCANA	Minucciano (LU)	–780 m
32	Sistema del Col Lopic	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–770 m
33	Sistema Paolo Fonda-Laricetto-Sisma	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–770 m
34	Abisso delle Spade	LOMBARDIA	Esino Lario (LC)	–768 m
35	Complesso S20-S31-FDZ2	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–760 m
36	Abisso dei Fulmini	TOSCANA	Seravezza (LU)	–760 m
37	Abisso Obelix	VENETO	Lusiana (VI)	–750 m
38	Abisso Amore Quanto Latte	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–740 m
39	Abisso Capitan Findus	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–735 m
40	Abisso a SE della Quota 1972 (ET5)	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–726 m
41	Abisso II del Poviz (Gronda Pipote)	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–720 m
42	Complesso Via col Vento-Schiaparelli-Cima Paradiso	LOMBARDIA	Luvinate (VA)	–720 m
43	Ouso I della Rava Bianca	LAZIO	Carpineto Romano (Roma)	–715 m
44	Abisso Firn	FRIULI VENEZIA GIULIA	Chiusaforte (UD)	–713 m
45	Complesso del Monte Pelato	TOSCANA	Seravezza (LU)	–708 m
46	Abisso Franco Milazzo	TOSCANA	Seravezza (LU)	–700 m
47	Complesso dell'Arnetola	TOSCANA	Vagli di Sotto (LU)	–690 m
48	Abisso Francesco Simi	TOSCANA	Vagli di Sotto (LU)	–690 m
49	Complesso del Monte Cavallo di Pontebba	FRIULI VENEZIA GIULIA	Pontebba (UD)	–690 m
50	Abisso Pozzi	TOSCANA	Vagli di Sotto (LU)	–689 m
51	Abisso A11	PIEMONTE	Briga Alta (CN)	–680 m
52	Abisso Sandro Mandini	TOSCANA	Vagli di Sotto (LU)	–678 m
53	Abisso del Bifurto	CALABRIA	Cerchiara di Calabria (CS)	–671 m
54	Abisso dello Smilodonte	TOSCANA	Fivizzano (MS)	–655 m
55	Abisso Eunice	TOSCANA	Vagli di Sotto (LU)	–651 m



Luogo è là giù da Belzebù remoto
tanto quanto la tomba si distende,
che non per vista, ma per suono è noto

d'un ruscelletto che quivi discende
per la buca d'un sasso, ch'elli ha roso,
col corso ch'elli avvolge, e poco pende.

Lo duca e io per quel cammino ascoso
intrammo a ritornar nel chiaro mondo;
e sanza cura aver d'alcun riposo,

salimmo sù, el primo e io secondo,
tanto ch'i' vidi de le cose belle
che porta 'l ciel, per un pertugio tondo.

E quindi uscimmo a riveder le stelle.*

Dante, Inferno, Canto XXXIV

*** A place is there below, / stretching as far from Beelzebub as his tomb extends, / which not by sight is known, but by the sound / of a rivulet that here descends / along the hollow of a rock that it has gnawed / with its course that winds and little falls. / My Leader and I entered through that hidden way, / to return to the bright world. / And without care, to have any repose, / we mounted up, he first and I second, / till through a round opening I saw / of those beauteous things which heaven bears, / and thence we came forth to see again the stars.**

Dante, Inferno, Canto XXXIV
(Tr. by Charles Eliot Norton)

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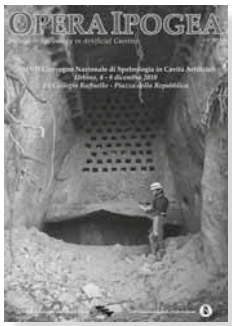

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